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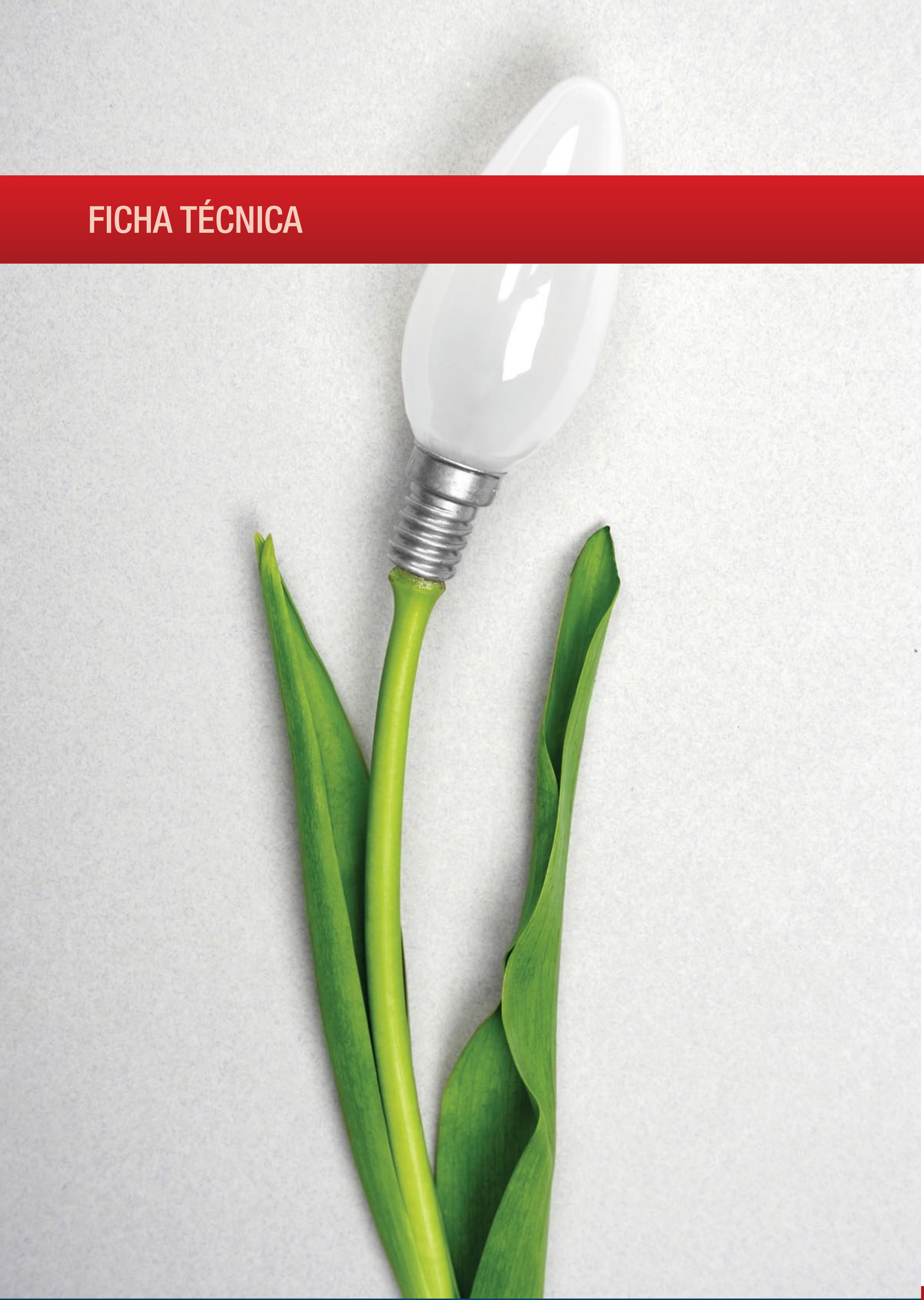

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APRESENTAÇÃO

Com esta publicação consolidam-se os relatórios produzidos no âmbito do Projeto de Apoio aos Diálogos Setoriais Brasil-União Europeia. Estes diálogos tiveram como objetivo a troca de experiências e o levantamento de informações que pudessem apoiar o governo brasileiro na formulação e implementação de políticas públicas relacionadas à eficiência energética e à sustentabilidade da energia eólica, no âmbito da política ambiental.

Estes relatórios são resultado de duas Ações distintas. Uma delas voltou-se especificamente às políticas de eficiência energética e sobre mudança do clima e a outra teve como foco a sustentabilidade da geração de energia eólica. Estas ações fizeram parte da sexta convocatória do projeto, sendo desenvolvidas entre dezembro de 2012 e maio de 2013.

Para o desenvolvimento de cada uma das ações foram selecionados consultores brasileiros e europeus. Para a Ação de Eficiência Energética e Mudança do Clima, foram selecionados os consultores Hamilton Pollis (Brasil) e Javier Gonzalez Vidal (Espanha) que desenvolveram estudo abordando melhores práticas na estrutura governamental de energia e meio ambiente; políticas de eficiência energética e sua integração às políticas relacionadas à mudança global do clima; o elemento ambiental na formulação da política energética e a efetividade da regulação existente considerando o estímulo à eficiência energética.

Para a Ação de Fomento à Geração Sustentável de Energia Eólica, os consultores Leontina Pinto (Brasil) e Juan Martinez (Espanha) desenvolveram estudo sobre as políticas públicas voltadas ao fomento sustentável da geração de energia eólica no Brasil e na União Europeia, respectivamente. Foram abordadas as experiências, políticas e boas práticas da União Europeia e Brasil relacionadas à sustentabilidade da expansão da geração de energia eólica, incluindo instrumentos de ordenamento territorial, avaliação de impactos ambientais e contribuição para redução de emissões de gases de efeito estufa.

Em ambas ações, todo o processo de trabalho foi realizado com o acompanhamento técnico da equipe do Departamento de Mudanças Climáticas do Ministério do Meio Ambiente, sendo realizadas revisões que resultaram em quatro relatórios finais. Com o objetivo de facilitar a comunicação entre peritos brasileiros e estrangeiros, os relatórios foram escritos na língua inglesa.

Registra-se o agradecimento à dedicação dos consultores e da equipe técnica que fizeram parte desta iniciativa, cujo resultado é um produto que estimulará a reflexão sobre as interfaces e potenciais de trabalho entre a área energética e a ambiental, com reflexos relevantes sobra as ações de combate à mudança do clima.

Departamento de Mudanças Climáticas
Secretaria de Mudanças Climáticas e Qualidade Ambiental
Ministério do Meio Ambiente do Brasil

INTRODUÇÃO

Atualmente existe um movimento global de estímulo ao uso de fontes renováveis de energia e da melhoria da eficiência energética como parte de uma estratégia para reduzir as emissões de gases de efeito estufa. Como consequência disso, muitos países, incluindo o Brasil e os estados membro da União Europeia, têm desenvolvido políticas públicas e regulações para promover a sustentabilidade ambiental do setor energético. No Brasil, a matriz energética é uma das menos intensivas em carbono do mundo, com a participação de cerca de 45% de fontes renováveis, em especial biomassa e hidroeletricidade. Entretanto, o aumento da demanda por energia inerente ao processo de desenvolvimento nacional requererá um esforço focado na integração da produção energética com as questões ambientais e sobre mudança do clima.

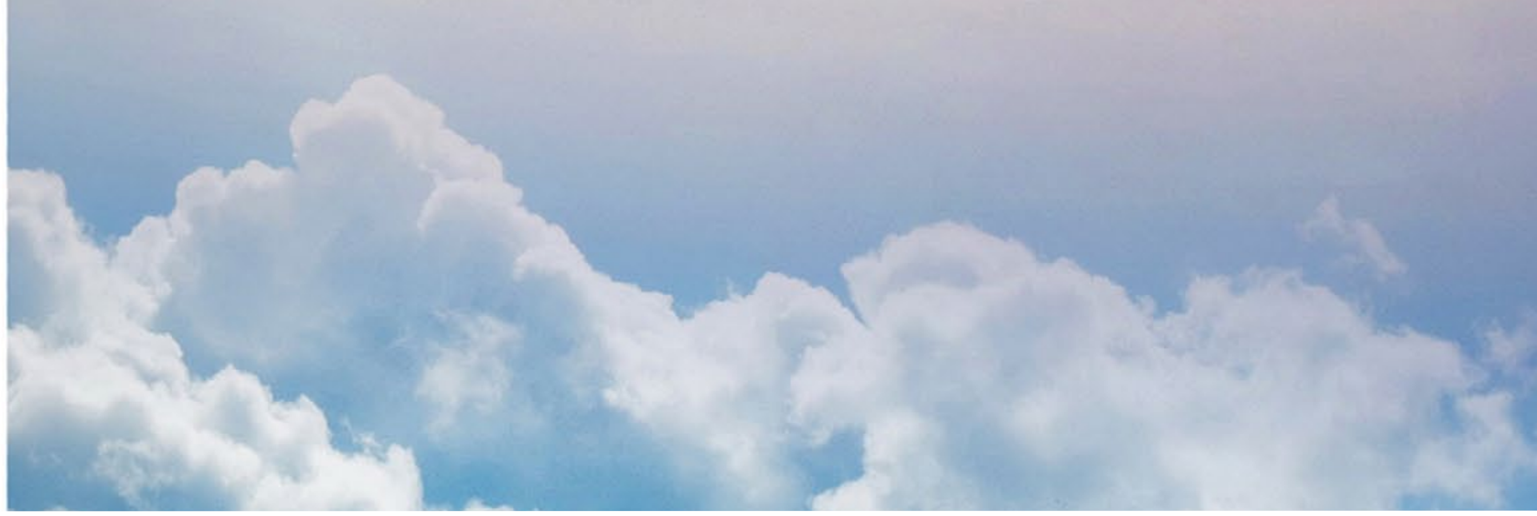
Em 2001, o Brasil viveu uma crise no setor elétrico, resultando, entre outras medidas, na promulgação, pleo governo brasileiro, da Lei no. 10.295, que define a Política Nacional de Uso Racional e Conservação de Energia. Essa lei se tornou conhecida como a Lei de Eficiência Energética e estabeleceu que o poder executivo definiria níveis máximos de consumo energético e níveis mínimos de eficiência energética para equipamentos manufaturados ou vendidos no Brasil e para edificações residenciais e comerciais. Em dezembro de 2001, o Decreto no 4.059 que regulamentou a Lei de Eficiência Energética, definiu os procedimentos para estabelecer os indicadores e níveis de eficiência energética.

Embora a motivação para essa lei tenha sido a crise provocada por um longo período de estiagem que diminuiu a capacidade de produção de energia, a Lei no 10.295 abriu o caminho para a promoção de ações de eficiência energética, o que vem promovendo ganhos ambientais.

Com a publicação da lei que estabeleceu a Política Nacional sobre Mudança do Clima, em 2009, o Brasil assumiu o compromisso nacional voluntário de reduzir suas emissões de gases de efeito estufa (GEE) entre 36,1% e 38,9%, em relação às emissões projetadas para o ano de 2020. Com vistas à implementação desse compromisso, foram definidas ações prioritárias em decreto presidencial no qual o incentivo à eficiência energética e às fontes renováveis estão incluídos

O Plano Decenal de Energia (PDE) foi concebido para ser o plano de mitigação e adaptação às mudanças climáticas do setor energético. Esse plano é revisado todos os anos e em sua última versão, o PDE 2021, identifica-se o planejamento do governo brasileiro relacionado à promoção da eficiência energética e das fontes renováveis de energia, como descrito abaixo, de 2011 à 2021:

O perfil de emissões de Gases de Efeito Estufa (GEE) no Brasil até 2005 tinha como principal emissor o setor de mudança do uso da terra e florestas que inclui, entre outros, as emissões decorrentes da supressão de vegetação na Amazônia. Entretanto, através das políticas



de combate ao desmatamento, foi possível uma robusta, constante e consistente redução de emissões desse setor, entre 2004 e 2012.

Com base nas estimativas anuais de gases de efeito estufa, tornadas públicas pelo Ministério de Ciência,Tecnologia e Inovação em 2013, com a referida redução do desmatamento na Amazônia, o setor energético assumiu a segunda posição, em termos relativos, na participação das emissões de gases de efeito estufa no Brasil, ficando somente atrás somente do setor agropecuário.

Portanto, o setor energético deverá receber especial atenção no que diz respeito ao controle de emissões de GEE, sem perder de vista que a comunidade internacional reconhece por meio da Convenção-Quadro das Nações Unidas sobre Mudança do Clima que as prioridades dos países em desenvolvimento sejam a promoção do desenvolvimento sustentável e da erradicação da pobreza. Apesar dos avanços em relação ao desvio de emissões no setor energético em relação ao cenário tendencial para 2020, incluindo ações visando à promoção da eficiência energética (EE) no Brasil nos últimos anos, existem ainda muitas barreiras relevantes para o desenvolvimento deste mercado, principalmente relacionadas ao financiamento e capacitação.

Considerando essas questões, a União Europeia- UE tem alguns exemplos e práticas em que as políticas de energia e de mudança do clima são interligadas. Em dezembro de 2008, a UE definiu unilateralmente as seguintes metas para o ano de 2020:

- reduzir a emissão de GEE em 20% em comparação com 1990;
- aumentar a participação das energias renováveis em 20%; e
- aumentar a eficiência energética em 20%.

Em junho de 2011, a Comissão Europeia (CE) propôs uma nova Diretiva de Eficiência Energética para reforçar os esforços dos Estados Membros na utilização mais eficiente da energia em todos os estágios da cadeia de energia, desde a transformação de energia até a sua distribuição ao consumidor final. A CE propôs medidas que merecem ser conhecidas: a obrigação legal de estabelecer esquemas de economia de energia por todos os Estados Membros, o setor publico liderando como exemplo, grandes economias de energia pelos consumidores através de melhores serviços de energia, e melhoria da eficiência energética na indústria.

Todas essas experiências acerca das medidas políticas para promoção da redução de emissões por meio do setor energético são relevantes para verificar como os departamentos de política do clima e de energia interagem na União Europeia, bem como para comparação das políticas desenvolvidas no setor energético na Europa e no Brasil, respeitadas as respectivas características e questões de soberania.

Nesse contexto, o Ministério do Meio Ambiente do Brasil em cooperação com a União Europeia, por meio do projeto “Apoio aos Diálogos Setoriais”, propôs o desenvolvimento de estudo comparativo das experiências europeias e brasileiras em temas considerados de extrema relevância para o contexto atual de mitigação de emissões de GEE, que são a eficiência energética e a sustentabilidade da geração de energia eólica.

Dessa forma, esta publicação apresenta dois capítulos dedicados à Eficiência Energética e Mudança do Clima, referentes à experiência europeia e brasileira respectivamente e mais dois capítulos que abordam a sustentabilidade da geração eólica de energia, também referentes à experiência europeia e brasileira. O resultado das discussões apresentadas nos capítulos traz conteúdo técnico para subsidiar os tomadores de decisão no governo, no que diz respeito a elementos que poderão servir para a orientação de políticas energéticas.

CAPÍTULO 1

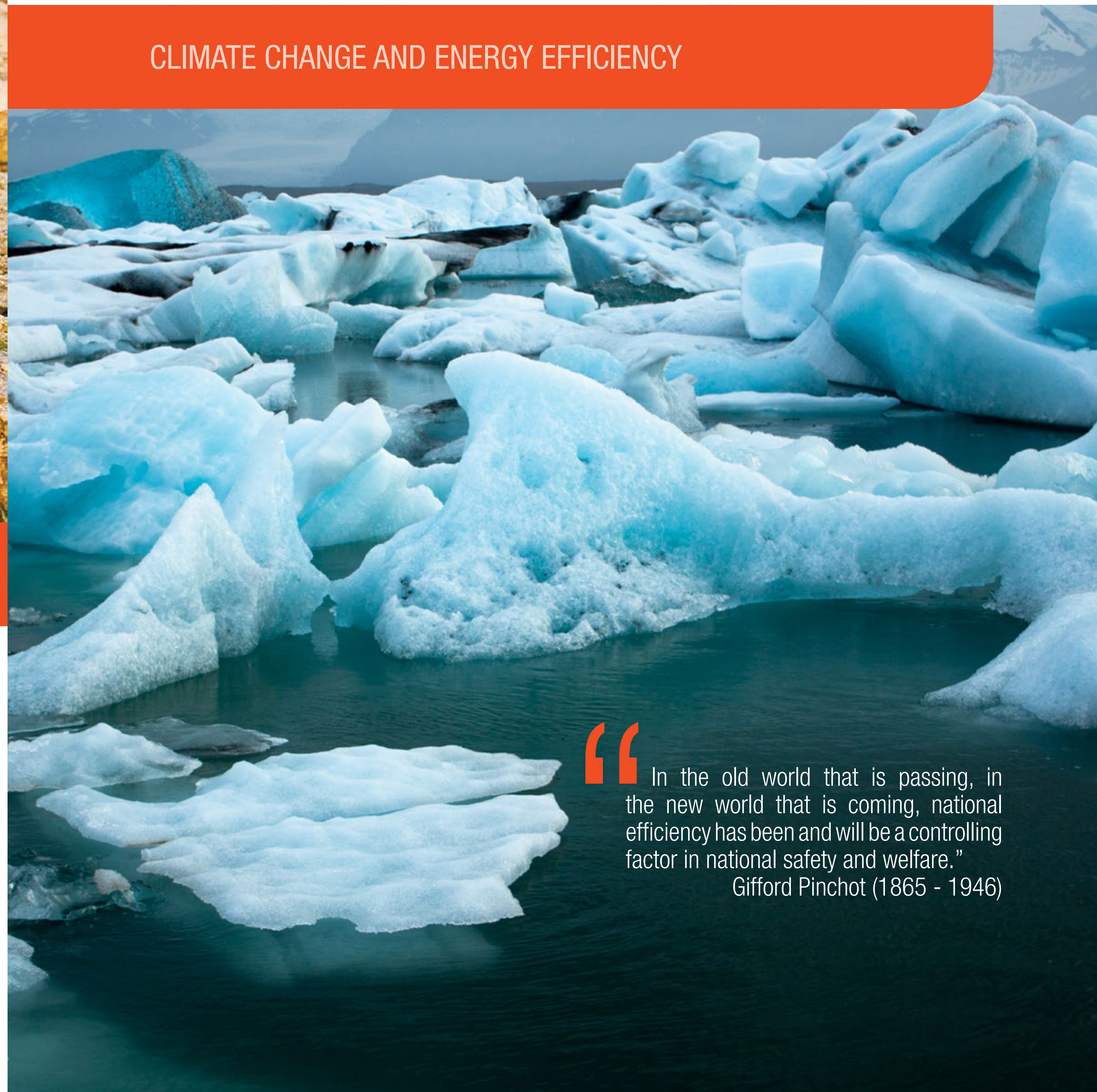
EFICIÊNCIA ENERGÉTICA E MUDANÇA CLIMÁTICA EXPERIÊNCIA EUROPEIA - Francisco Javier Gonzalez Vidal

"How could I look my grandchildren in the eye and say I knew what was happening to the world and did nothing."

David Attenborough

This project has been developed under the contract of the European Commission with reference EuropeAid/130075/C/SER/BR to support the sectoral dialogues EU – Brazil. This report aims at the exchange of experiences and the collection of elements to support the Brazilian government in the formulation and implementation of policies related to energy efficiency also covering the scope of environmental policy. The report reproduces to a large extent several fragments of some references cited in the bibliography, which correspond to work developed for the European Commission by external consultants and that are available on the website Europe.eu

CLIMATE CHANGE AND ENERGY EFFICIENCY



"In the old world that is passing, in the new world that is coming, national efficiency has been and will be a controlling factor in national safety and welfare."

Gifford Pinchot (1865 - 1946)

SUMMARY

This project has been developed under the contract of the European Commission with reference EuropeAid/130075/C/SER/BR to support the sectoral dialogues EU – Brazil.

This report aims at the exchange of experiences and the collection of elements to support the Brazilian government in the formulation and implementation of policies related to energy efficiency also covering the scope of environmental policy.

The report reproduces to a large extent several fragments of some references cited in the bibliography, which correspond to work developed for the European Commission by external consultants and that are available on the website Europe.eu.

The report is divided in four chapters. The first chapter introduces the approach in the European Union (EU) to climate change and energy efficiency. It starts with a brief introduction to the EU legislative procedure and a description of some of the most relevant actors in these topics, its competences and its relations. It follows with some examples of the government structures applied in several Member States that show substantial different approaches. It also provides a general overview of the EU legislation on energy efficiency and climate change, with a special focus on the EU Climate and Energy Package and the Energy Efficiency Directive. Eventually, a brief description of the financing scenario and programmes in place is provided.

The second chapter performs an analysis of energy consumption and greenhouse gas emissions in the EU, focusing on an end-user analysis published by the European Environmental Agency to identify the most relevant sectors: building, transport and industry. For each of these sectors, an assessment of the potential, the policy options and some examples of best practices have been reproduced from reports published by the European Commission in its website, with special recognition to the work series "Next phase of the European Climate Change Programme: Analysis of Member States actions to implement the Effort Sharing Decision and options for further community-wide measures", elaborated by the AEA Group, Ecofys and the Fraunhofer Institute for Systems and Innovation Research. This second chapter includes also a final section on cross-cutting issues, where the situation and potential of the Energy Services Companies and the Green Public Procurement is discussed.

Based on the fact that a monitoring system is key in order to assess the effectiveness of the policies and measures implemented both at the EU and national levels, the third chapter describes the ODYSSEE- MURE project. Coordinated by ADEME, it is one of the main energy efficiency monitoring tools that is based on a set of databases containing both indicators and measures. Eventually, this chapter also gives an overview of the energy efficiency trends in the EU, reproducing parts of the brochures published in the project website elaborated by Enerdata.

The forth chapter provides some conclusions and recommendations derived from the information included in the report, and could serve as a final synthesis.

The fifth chapter includes the references of the reports and documents that have been consulted for the elaboration of this report.

Last but not least, I would like to share my appreciation and gratitude towards the colleagues of the Ministry of Environment of Brazil in charge of the project (Alexandra Albuquerque Maciel and Ana Lucia Dolabella) and Mr. Hamilton Pollis, who helped me throughout the course of this work and provided me with great advice and a lot of useful information.

1. AN INTRODUCTION TO THE EUROPEAN APPROACH TO ENERGY EFFICIENCY AND CLIMATE CHANGE

1.1. The EU and the legislative procedure.

The European Union, abbreviated as EU, is an economic and political union of 27 European countries. The EU was established on 1 November 1993 by the Treaty on European Union (Maastricht Treaty). On 31 December 1994, the EU had 12 Member States: Belgium, Denmark, Germany, Ireland, Greece, Spain, France, Italy, Luxembourg, the Netherlands, Portugal and the United Kingdom. From January 1995, the EU added three Member States: Austria, Finland and Sweden. For informational and statistical purposes this is referred to as the EU-15.

In May 2004, 10 more countries joined the EU: the Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia and Slovakia. On 1 January 2007, Bulgaria and Romania became members of the EU. For informational and statistical purposes the total of the 27 countries is referred to as the EU-27.

The EU today has a surface area of 4.326.183 km², 503.678.862 inhabitants (1 January 2012 estimate) and 23 official languages.

The EU is a regional economic integration organization, to which its member States have transferred part of their sovereign powers for policy making, including in the field of climate change, to the European Council and the European Parliament.

The diversity of national circumstances (economic, social, environmental) in both the EU-15 and the EU-27 and the complex EU-wide policy making process make it necessary to apply flexible approaches in framing climate change policy at the EU level.

In the EU's unique institutional set-up:

• the EU's broad priorities are set by the European Council, which brings together national and EU-level leaders

• directly elected MEPs (Members of the European Parliament) represent European citizens in the European Parliament

• the interests of the EU as a whole are promoted by the European Commission, whose members are appointed by national governments

• governments defend their own countries' national interests in the Council of the European Union.

The European Council sets the EU's overall political direction – but has no powers to pass laws. Led by its President – currently Herman Van Rompuy – and comprising national heads of state or government and the President of the Commission, it meets for a few days at a time at least every 6 months.

There are 3 main institutions involved in EU legislation:

• the European Parliament, which represents the EU's citizens and is directly elected by them;

• the Council of the European Union, which represents the governments of the individual member countries. The Presidency of the Council is shared by the member states on a rotating basis.

• the European Commission, which represents the interests of the Union as a whole.

Together, these three institutions produce through the "Ordinary Legislative Procedure" the policies and laws that apply throughout the EU. In principle, the Commission proposes new laws, and the Parliament and Council adopt them. The Commission and the member countries then implement them, and the Commission ensures that the laws are properly applied and implemented.

The European Commission (EC) is the executive body of the EU. It ensures the application of the Treaties and of measures adopted by the institutions pursuant to them. It also oversees the application of Union law under the control of the Court of Justice of the EU. The EC, the Council and the European Parliament are the institutions that develop the EU policies and laws through ordinary legislative procedure, which starts with the proposal by the EC and ends with the adoption of a common decision by the Council and the Parliament. The complex decision-making procedure involves a Directorate General (DG) responsible for certain matters making a proposal, other relevant DGs commenting on it through inter-service consultations and the College (comprising all Commissioners) adopting the final proposal. The proposals are prepared by the EC following the participatory principle.

1.2. EU Competent authorities and their competences.

European Commission

The European Commission is one of the main institutions of the European Union. It represents and upholds the interests of the EU as a whole. It drafts proposals for new European laws. It manages the day-to-day business of implementing EU policies and spending EU funds.

The 27 Commissioners, one from each EU country, provide the Commission's political leadership during their 5-year term. Each Commissioner is assigned responsibility for specific policy areas by the President. The current President of the European Commission is José Manuel Barroso who began his second term of office in February 2010. The President is nominated by the European Council. The Council also appoints the other Commissioners in agreement with the nominated President.

The appointment of all Commissioners, including the President, is subject to the approval of the European Parliament. In office, they remain accountable to Parliament, which has sole power to dismiss the Commission.

The day-to-day running of the Commission is taken care of by the Commission's staff – administrators, lawyers, economists, translators, interpreters, secretarial staff, etc. organized in departments known as Directorates-General (DGs).

The Commission represents and upholds the interests of the EU as a whole. It oversees and implements EU policies by:

• proposing new laws to Parliament and the Council

• managing the EU's budget and allocating funding

• enforcing EU law (together with the Court of Justice)

• representing the EU internationally, for example, by negotiating agreements between the EU and other countries.

1. Proposing new laws

The Commission has the 'right of initiative' – it can propose new laws to protect the interests of the EU and its citizens. It does this only on issues that cannot be dealt with effectively at national, regional or local level (subsidiarity principle).

When the Commission proposes a law, it tries to satisfy the widest possible range of interests. To get the technical details right, it consults experts through various committees and groups. It also holds public consultations.

The Commission's departments produce a draft of the proposed new law. If at least 14 of the 27 Commissioners agree with it, the draft is then sent to the Council and Parliament. After debating and amending the draft, they decide whether to adopt it as a law.

2. Managing the EU's budget and allocating funding

With the Council and Parliament, the Commission sets broad long-term spending priorities for the EU in the EU 'financial framework'. It also draws up an annual budget for approval by Parliament and the Council, and supervises how EU funds are spent – by agencies and national and regional authorities, for instance. The Commission's management of the budget is scrutinized by the Court of Auditors.

The Commission manages funding for EU policies (e.g. agriculture and rural development) and programmes such as 'Erasmus' (student exchanges).

3. Enforcing European law

As 'guardian of the Treaties', the Commission checks that each member country is applying EU law properly. If it thinks a national government is failing to apply EU law, the Commission first sends an official letter asking it to correct the problem. As a last resort, the Commission refers the issue to the Court of Justice. The Court can impose penalties, and its decisions are binding on EU countries and institutions.

4. Representing the EU internationally

The Commission speaks on behalf of all EU countries in international bodies like the World Trade Organization. It also negotiates international agreements for the EU such as the Cotonou Agreement (on aid and trade between the EU and developing countries in Africa, the Caribbean and the Pacific).

The Commission is based in Brussels and Luxembourg and has offices (representations) in every EU country and delegations in capital cities around the world.

The Commission is divided into several departments and services. The departments are known as Directorates-General (DGs). Each DG is classified according to the policy it deals with. The Commission services deal with more general administrative issues or have a specific mandate, for example fighting fraud or creating statistics. Both are listed below:

Departments (DGs)

- Agriculture and Rural Development (AGRI)
- Budget (BUDG)
- Climate Action (CLIMA)
- Communication (COMM)
- Communications Networks, Content and Technology (CNECT)
- Competition (COMP)
- Economic and Financial Affairs (ECFIN)
- Education and Culture (EAC)
- Employment, Social Affairs and Inclusion (EMPL)
- Energy (ENER)
- Enlargement (ELARG)
- Enterprise and Industry (ENTR)
- Environment (ENV)
- EuropeAid Development & Cooperation (DEVCO)
- Eurostat (ESTAT)
- Health and Consumers (SANCO)
- Home Affairs (HOME)
- Humanitarian Aid (ECHO)
- Human Resources and Security (HR)
- Informatics (DIGIT)
- Internal Market and Services (MARKT)
- Interpretation (SCIC)
- Joint Research Centre (JRC)
- Justice (JUST)
- Maritime Affairs and Fisheries (MARE)
- Mobility and Transport (MOVE)
- Regional Policy (REGIO)
- Research and Innovation (RTD)
- Secretariat-General (SG)
- Service for Foreign Policy Instruments (FPI)
- Taxation and Customs Union (TAXUD)
- Trade (TRADE)
- Translation (DGT)

Services

- Bureau of European Policy Advisers (BEPA)
- Central Library
- European Anti-Fraud Office (OLAF)
- European Commission Data Protection Officer
- Historical archives
- Infrastructures and Logistics - Brussels (OIB)
- Infrastructures and Logistics - Luxembourg (OIL)
- Internal Audit Service (IAS)
- Legal Service (SJ)
- Office For Administration And Payment Of Individual Entitlements (PMO)
- Publications Office (OP)

For the purpose of this report, the departments with competences related to energy efficiency, climate change and environment are described below.

D.G. Energy

The Directorate-General for Energy is responsible for developing and implementing a European energy policy. Through the development and implementation of innovative policies, the Directorate-General aims at:

- Contributing to setting up an energy market providing citizens and business with affordable energy, competitive prices and technologically advanced energy services.

- Promoting sustainable energy production, transport and consumption in line with the EU 2020 targets and with a view to the 2050 decarbonization objective.

- Enhancing the conditions for secure energy supply in a spirit of solidarity between Member States.

In developing a European energy policy, the Directorate-General aims to support the Europe 2020 programme which, for energy, is captured in the Energy 2020 strategy (COM(2010) 639 final of 10 November 2010).

The Directorate-General carries out its tasks in many different ways. For example, it develops strategic analysis and policies for the energy sector; promotes the completion of the internal energy market encompassing electricity, gas, oil and oil products, solid fuels and nuclear energy; supports the reinforcement of energy infrastructure, ensures that indigenous energy sources are exploited in safe and competitive conditions; ensures that markets can deliver agreed objectives, notably in efficiency and renewable energies; promotes and conducts an EU external energy policy; facilitates energy technology innovation; develops the most advanced legal framework for nuclear energy, covering safety, security and non-proliferation safeguards; monitors the implementation of existing EU law and makes new legislative proposals; encourages the exchange of best practices and provides information to stakeholders.

All this work is aided by expert input from the Executive Agency for Competitiveness and Innovation (EACI), the Euratom Supply Agency (ESA) and the Agency for the Cooperation of Energy Regulators (ACER, operational from March 2011).

Energy and environmental policies are inextricably linked. All energy production and consumption has environmental impacts. Whilst it is often tempting to overlook the environment during difficult economic times, the challenges of producing and using energy resources sustainably and protecting our natural environment equally represent an opportunity to pursue sustainable economic growth.

In many regards energy and environmental objectives go hand in hand, such as:

- energy efficiency and reducing energy use: saving energy can help avoid impacts associated with extractive industries and with energy generation, transformation, distribution and consumption in general. It can help reducing GHG emissions, air pollution, impacts to surface and ground waters, habitat fragmentation and biodiversity disturbance through infrastructure and land use, etc. The EU has put forward several measures to improve efficiency at all stages of the energy chain and it is aiming for a 20% cut in Europe's annual primary energy consumption by 2020 (mainly the Energy Efficiency Plan and Directive, that will be further discussed in this document and have to be implemented by the Member States and their respective competent authorities).

- measures to increase the share of sustainable renewable energy sources in the energy mix can lower overall environmental and climatic pressures compared to other forms of energy. Such measures can also contribute to improved resource efficiency where they result in a more efficient utilization of non-recyclable waste streams.

- measures aiming at using resources in a more efficient way also contribute to reducing energy demand: this is in particular the case when products are re-used, materials recycled, when all production and consumption chains are organized in a more efficient way.

However, under some circumstances, energy-environment interactions can entail a number of risks or trade-offs, whether related to climate, air, land, biodiversity, waste or water. EU environmental legislation and the Commission's Resource Efficiency agenda are there to ensure that EU policies make the most of all the potential for reducing risks and impacts of resource and energy consumption. This will bring direct and indirect health and environmental improvements, reduce imports and allow the EU to better compete internationally in a world of constrained resources.

In this context the Environment Directorate-General is working on gathering further knowledge on environmental impacts and risks of energy resources and assessing relevant policies, notably via external studies and modelling, as well as providing guidance on the application of existing EU environmental legislation to specific energy resources. It is also collaborating with other services on interlinkages between environment, energy, research and innovation, climate change and taxation policies.

D.G. Environment

The Environment Directorate-General of the European Commission ('DG Environment') was set up as a team of five people in a branch of DG Industry in 1973 to protect, preserve and improve Europe's environment for present and future generations. It now has just over 500 staff, reflecting evolving environmental awareness among European citizens, and an understanding that nature and environment do not recognize man-made borders and need regionally coordinated solutions.

It proposes to the European Commission policies and legislation that protect natural habitats, defend clean air and water, ensure proper waste disposal, improve knowledge of the toxicity of chemical substances, and help European businesses move towards a sustainable economy.

The DG also makes sure that Member States apply EU environmental law correctly. This means helping Member States comply with the legislation, collect and analyze the information of the monitoring mechanisms, and investigating complaints made by EU citizens and non-governmental organizations.

The European Commission has the power to take legal action if it seems that EU environment law has been infringed or non-compliance is identified. The Commission first sends an official letter asking it to correct the problem. As a last resort, the Commission refers the issue to the Court of Justice. The Court can impose penalties, and its decisions are binding on EU countries and institutions. It is a common and public procedure.

DG Environment also represents the European Union in environmental matters at international meetings, including for instance the United Nations Convention on Biodiversity or the United Nations Framework Convention on Climate Change (UNFCCC).

In international forums, the DG tries to agree international policies to stop the ongoing loss of biodiversity, reduce waste and air and water pollution, and strengthen the ecosystem services that make life on Earth possible.

The basic framework for EU environmental policy for 2002-2012 was the Sixth Community Environment Action Programme (6th EAP). The 6th EAP mapped out the main areas of policy and outlined actions needed to achieve them. The four priority areas were natural resources and waste, environment and health, nature and biodiversity and climate change.

Climate change and biodiversity are profoundly interdependent – the more climate changes, the greater the impact on biodiversity; the more we lose biodiversity, the more difficult it will be to adapt to and limit climate change.

In 2010, faced with the growing urgency of the climate question, the Commission set up a new Directorate-General to concentrate efforts in this area. DG Climate Action now proposes policy and represents the EU in the international negotiations, while DG Environment concentrates on ensuring that relevant environmental aspects like soil, forests and biodiversity are factored into climate policy.

D.G. Clima

The Directorate-General for Climate Action ("DG CLIMA") was established in February 2010, climate change being previously included in the remit of DG Environment of the European Commission. Its main tasks are:

- Leads international negotiations on climate. The Directorate-General for Climate Action is at the forefront of international efforts to combat climate change. It leads the respective Commission task forces on the international negotiations in the areas of climate change and ozone depleting substances and coordinates bi-lateral and multi-lateral partnerships on climate change and energy with third countries.

- Helps the EU to deal with the consequences of climate change and to meet its targets for 2020. DG CLIMA develops and implements cost effective international and domestic climate change policies and strategies in order for the EU to meet its targets for 2020 and beyond, especially with regard to reducing its greenhouse gas emissions. Its policies also aim at protecting the ozone layer and at ensuring that the climate dimension is appropriately present in all Community policies and that adaptation measures will reduce the European Union's vulnerability to the impacts of climate change.

- Implements the EU Emissions Trading System (EU ETS).

- Monitors the implementation of Member States' emission reduction targets in the sectors outside the EU ETS through the Effort Sharing Decision (ESD).

- Promotes low carbon and adaptation technologies

Other relevant actors in the energy and climate change scenario are:

European Environment Agency

The European Environment Agency (EEA) is an agency of the European Union that started to work in 1994, whose task is to provide sound, independent information on the environment. It is a major information source for those involved in developing, adopting, implementing and evaluating environmental policy, and also the general public.

In line with the importance given to climate change by environmental institutions of the European Union, and in order to meet its target in this particular area, the Agency gives special treatment to this problem. This is reflected in the regular presence of climate change in the general reports of the Agency and the regular publication of specific thematic reports (only during 2012 the EEA published in its website 13 publications related to the topic of climate change).

One of its tasks is to elaborate the report for the annual submission of the greenhouse gas inventory of the European Union to the United Nations Framework Convention on Climate Change and the Kyoto Protocol.

Joint Research Centre

The Joint Research Centre is the scientific and technical arm of the European Commission. It is providing the scientific advice and technical know-how to support a wide range of EU policies. Its status as a Commission service, which guarantees independence from private or national interests, is crucial for pursuing its mission:

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security, including nuclear; all supported through a cross-cutting and multidisciplinary approach.

The JRC has seven scientific institutes, located at five different sites in Belgium, Germany, Italy, the Netherlands and Spain, with a wide range of laboratories and unique research facilities.

Executive Agency for Competitiveness and Innovation

The Executive Agency for Competitiveness and Innovation (EACI) was established by a Commission decision[41]. It is responsible for managing EU action in the fields of energy, entrepreneurship, innovation and sustainable freight transport under the Competitiveness and Innovation Framework Programme (CIP) and the second Marco Polo Programme (2007–2013) established by Regulation (EC) No 1692/2006 of the European Parliament and of the Council[42]. The EACI's mission consists of efficient management of these programmes and thereby contributes to achieving their objectives. As part of this mandate, the EACI has been entrusted with certain tasks related to management of the Intelligent Energy – Europe II Programme. Exercising the powers delegated to it and as programmed by the Commission, the Agency carries out all operations necessary for implementing the parts of the Programme entrusted to it, in particular those connected with the award of contracts (procurement) and grants. The EACI works on the basis of delegated powers, and in close cooperation with its parent Commission departments, i.e. — for Intelligent Energy - Europe — the Directorate-General for Energy and the Directorate General for Mobility and Transport.

The Covenant of Mayors

The Covenant of Mayors is the mainstream European movement involving local and regional authorities, voluntarily committing to increasing energy efficiency and use of renewable energy sources on their territories. By their commitment, Covenant signatories aim to meet and exceed the European Union 20% CO2 reduction objective by 2020.

After the adoption, in 2008, of the EU Climate and Energy Package, the European Commission launched the Covenant of Mayors to endorse and support the efforts deployed by local authorities in the implementation of sustainable energy policies. Indeed, local governments play a crucial role in mitigating the effects of climate change, all the more so when considering that 80% of energy consumption and CO2 emissions is associated with urban activity.

For its unique characteristics - being the only movement of its kind mobilizing local and regional actors around the fulfilment of EU objectives - the Covenant of Mayors has been portrayed by European institutions as an exceptional model of multi-level governance.

In order to translate their political commitment into concrete measures and projects, Covenant signatories notably undertake to prepare a Baseline Emission Inventory and submit, within the year following their signature, a Sustainable Energy Action Plan outlining the key actions they plan to undertake.

Beyond energy savings, the results of signatories' actions are manifold: creation of skilled and stable jobs, not subject to delocalization; healthier environment and quality of life; enhanced economic competitiveness and greater energy independence. These actions serve as examples for others to follow, notably through referring to the "Benchmarks of Excellence", a database of best practices submitted by Covenant signatories. The Catalogue of Sustainable Energy Action Plans is another such unique source of inspiration, as it shows at a glance the ambitious objectives set by other signatories and the key measures they have identified to reach them.

Agency for the Cooperation of Energy Regulators

The Agency for the Cooperation of Energy Regulators (ACER) is the European Union body created by the Third Energy Package to further progress on the completion of the internal energy market both for electricity and for natural gas. ACER was officially launched in March 2011 and is seated in Ljubljana, Slovenia.

As an independent European structure which fosters cooperation among European energy regulators, ACER ensures that market integration and harmonization of regulatory frameworks are done in respect of EU's energy policy objectives:

- A more competitive, integrated market which offers consumers more choice;

- An efficient energy infrastructure guaranteeing the free movement of energy across borders and the transportation of new energy sources, thus enhancing security of supply for EU businesses and consumers;

- A monitored and transparent energy market guaranteeing consumers fair, cost-reflective prices and deterrence of abusive practices.

The overall mission of ACER as stated in its founding regulation is to complement and coordinate the work of national energy regulators at EU level and work towards the completion of the single EU energy market for electricity and natural gas.

ACER plays a central role in the development of EU-wide network and market rules with a view to enhance competition. It coordinates regional and cross-regional initiatives which favor market integration. It monitors the work of European networks of transmission system operators (ENTSOs) and notably their EU-wide network development plans. Finally, it monitors the functioning of gas and electricity markets in general, and of wholesale energy trading in particular.

ACER is thus a central institution in the creation of a Single Energy Market to the benefit of all EU consumers.

41. Commission Decision 2004/20/EC of 23 December 2003, as amended by Commission Decision 2007/372/EC of 31 May 2007 (OJ L 140, 1.6.2007, p. 52).

42. OJ L 328, 24.11.2006, p. 1.

1.3. Member States competent authorities and their

To deal with a phenomenon as diverse and complex as climate change, it is essential a sustained effort and a comprehensive approach aimed at identifying strategies, policies and tools to develop effective action against climate change.

Only from a positive and open approach effective responses to global warming can be devised. The collaboration of the various stakeholders, governments, businesses, social organizations and citizens is essential to succeed in the search for solutions, not only from the point of view of mitigation to the causes, but also for adaptation to the effects of climate change.

For some EU countries, the energy efficiency is considered as a mitigation measure for climate change and thus all energy efficiency, environmental protection and climate change are monitored by one, unique Ministry. One such example is Greece:

GREECE

For Greece, the energy autonomy and independence is getting distinguished from using sustainable energy and saving energy, those later being mainly measures for climate change mitigation. As the goal now is the creation of a sustainable model of economy based on cleaner environment and proper management of natural resources and land planning, the "Ministry of Environment" has become the "Ministry of Environment, Energy & Climate Change" which is now responsible "for the protection of the natural environment and resources, the improvement of quality of life, the mitigation and adjustment to the implications of climate change and the enhancement of mechanisms and institutions for environmental governance. To do that, the Ministry of Environment, Energy and Climate Change (in Greek: YPEKA) has developed a strategic plan based on 4 pillars amplified into strategic objectives. Pillar Nr 1 concerns "Combating Climate Change by moving towards a competitive economy of low carbon consumption", and its Strategic Objectives include : a) the improvement of energy efficiency, b) the increase of the share of the country's energy use from renewable sources and natural gas, whilst ensuring the reliability of energy supplies, c) the consumers safety for the provision of reliable energy products and services, d) the promotion of green products, sustainable production and consumption patterns.

For some governmental structures, energy efficiency is considered as a cross-cutting issue which is governed by more than one Ministry, and through specially designated Institutes or Departments that have taken over some of the functions of Ministries. Such countries are United Kingdom and Spain.

UNITED KINGDOM

UK has also created a separate and autonomous Department for Climate Change into the Ministry called DECC: The Department of Energy and Climate Change (DECC) is a British government department created on 3 October 2008 by Prime Minister Gordon Brown to take over some of the functions of the Department for Business, Enterprise and Regulatory Reform (energy) and Department for Environment, Food and Rural Affairs (climate change). It is led by the Secretary of State for Energy and Climate Change, currently the Rt Hon Edward Davey.

SPAIN

In Spain, for example, the Ministry which is mainly responsible for questions related to energy efficiency policy is the Ministry of Environment, Rural and Marine Affairs. Still, the Ministry of Industry, Tourism and Trade as well and through Energy Diversification and Saving Institute (IDAE) has promoted a programme to encourage enterprises to do energy saving and efficiency technologies investment projects, as well as innovative and outstanding projects in industry, building, services, energy transformation or transport areas.

Some governmental structures consider that renewable energy and energy efficiency are strongly linked to economy, and thus two Ministries (the Ministry of Environment and the Ministry of Economy) lead issues related to energy efficiency. One such country is Poland.

POLAND

For Poland, protection and sustainable management of natural resources (including improving resource efficiency and lowering material and energy intensity of the economy) is recognized as an essential condition for a stable performance of the national economy. This for several reasons: First, because natural environment and natural heritage contribute significantly to the economic growth in Poland. Second, because Polish economy remains among the most-energy – and material-intensive in the EU. Third, because it is expected that market forces and economic considerations will increase eco-innovation and energy and material savings. Fourth, because increasing income and better living conditions cause changes in consumption patterns which may lead to stronger pressure on the environment and its resources in the future.

For the above reasons, in Poland, the Ministry of Environment and the Ministry of Economy are carrying our work to respond to energy efficiency targets.

Other Governmental Structures concern the building-up of a unique and autonomous Agency destined to develop (together with one Ministry) the national policy for the efficient use of energy. An example of this structure is Romania.

ROMANIA

The Romanian Agency for Energy Conservation is responsible for the implementation of the Law No.199/2000 on efficient use of energy. In order to achieve its role ARCE has the following attribution and responsibilities:

- to develop, jointly with the Ministry of Economy and Finance, the national policy for the efficient use of energy, and to propose it for the Government approval, as part of the state energy policy;

- to implement and monitor the national policy and the programmes for the efficient use of energy;

- to co-operate with the national and international institutions and organizations in the field of efficient use of energy and reducing the negative impact on the environment;

- to participate at the development of norms and technical regulations on increasing energy efficiency of the equipments for energy production, transport, distribution and consumption, for buildings and for any other activities;

- to certify the conformity of the equipments, based on tests and measurements to be carried out according to the regulations in force;

- to co-ordinate the energy efficiency programmes funded by international institutions or organizations based on government agreements;

- to evaluate from technical point of view and to advise investment energy efficiency projects that applied for finances from the Special Fund for the Energy System Development and from other internal and external sources, at the Government disposal;

- to develop the synthesis of the energy efficiency programmes on the national level;

- to cooperate with the authorized institutions in order to develop the energy balance sheets and energy databases necessary for the evaluation of energy demand / offer; to develop short, medium and long term scenarios for the evolution of this rate, including the calculation of the energy efficiency indicators at national level;

- to provide free expertise to local authorities, administrators of public buildings, administrators of households and the commercial agents for the design and development of energy efficiency projects;

- to develop and co-ordinate the training programmes, as well as the certification of the staff with tasks in the field of energy management;

- to advise, together with other ministries, the

own energy efficiency programmes of the consumers, developed according with the provisions of the Law 199/2000;

• to cooperate with National Authority for Consumer Protection for the market survey in order to respect technical regulation regarding energy efficiency;

• to promote the renewable energy sources: biomass, wind energy, geothermal, micro-hydro, solar energy and others.

Other governmental structures consider renewable energy and energy efficiency as a new business sector, and more particularly sustainable business (and entrepreneurship):

NETHERLANDS

For Netherlands, for example, it is referred (http://www.government.nl/ministries/ez) that the Ministry of Economic Affairs promotes Netherlands as a country of enterprise with a strong international competitive position and an eye for sustainability. It is committed to creating an excellent entrepreneurial business climate, by creating the right conditions and giving entrepreneurs room to innovate and grow, by paying attention to nature and the living environment, by encouraging cooperation between research institutes and businesses. This is the approach to enhance the leading positions in agriculture, industry, services and energy, and invest in a powerful, sustainable country.

CYPRUS

The same goes for Cyprus, where energy sustainability is important for all economic activities in the island. Thus, there is an Energy Service in the Ministry of Commerce, Industry and Tourism which has the overall responsibility of Energy in Cyprus and specifically for:

• Monitoring and coordinating the supply and availability of sufficient energy capacity for domestic needs.

• Monitoring and participating in the formation of the European Policy for energy issues.

• Suggesting ways for the implementation of the European Acquis, assists in the preparation of Laws, Regulations, Rules etc and implements programmes for their promotion.

• Preparing and implementing programmes for energy conservation, the promotion of renewable energy sources (RES) and the developing of technologies for the utilization of RES

• Assisting the Government in the formation of the national energy policy for Cyprus in coordination with all other bodies involved

Other governmental structures consider that the objectives of energy efficiency, energy supply and environmental accountability should be managed from one Ministry which links together Economy and Technology.

GERMANY

In Germany, economic efficiency, security of supply and environmental compatibility are the central aims of German energy policy. In Germany, the Federal Ministry of Economy and Technology has the lead responsibility for the formulation and implementation of energy policy (http://www.bmwi.de/English/Navigation/energy-policy,did=79110.html).

And other governmental structures consider that the objectives of energy efficiency, energy supply and environmental accountability should be managed from just one Ministry which is purely dealing with Energy issues:

BULGARIA

In Bulgaria, there are strategies or action plans that apply to specific sectors, such as a) the environmental sector and b) the energy sector. The strategy for the energy sector in particular, includes the following action plans / programmes:

• Energy Strategy on Bulgaria until 2020

• National Long Term Programme for Encouraging the Use of Biomass 2008-2020

• National Action Plan on Energy Efficiency 2008-2010

• National Action Plan for Renewable Energy (2010)

All strategies and action plans which concern energy are designed by the Ministry of Energy and Energy Resources (founded in June 2006).

The following paragraphs will describe with more detail the Spanish example.

Spain - Agencies and institutions involved in the fight against climate change at the national level:

Spanish Climate Change Office: Established within the Ministry of Environment by Royal Decree in 2001. Its functions are set out in Article 3.1 of Royal Decree 401/2012, which also established the Unit for Coordination of Actions against Climate Change and the Unit for Emissions Trading and Flexible Mechanisms, and include:

• Formulate the national policy on climate change

• Promote and conduct public information and awareness raising

• Represent the ministry in international organizations and follow up of international conventions

• Promote the integration of climate change adaptation in the sectoral policy planning. Integrating climate change adaptation into Spanish state legislation has progressed in recent years, particularly since the adoption of the Climate Change National Adaptation Plan. Specific regulations can be identified that have joined efforts to integrate climate change adaptation, such as the laws on public health, biodiversity, risk of flooding, desertification and water planning.

• Coordinate developed plans and programs relating to the measures and strategies to mitigate and adapt to climate change.

• Promote the development and implementation of technologies that make it possible to reduce emissions of greenhouse gases, such as integration of the transfer of such technologies in development and cooperation policies.

• Apply the rules of emission trading.

The National Climate Council was created in 1992 under the Ministry of Environment due to the need to promote research on climate change, the analysis of the social and economic implications and the growing social awareness. Its task is the processing, monitoring and evaluation of the Spanish strategy to combat climate change, making proposals and recommendations for defining policies and measures to combat climate change and its derived impacts, adaptation strategies and strategies for limiting emissions of greenhouse gases. It is formed by the representatives of the various departments of the Central Government involved in the matter, together with representatives of the Regional Governments, the Spanish Federation of Municipalities and Provinces, the investigation sector and of the most representative social and non-governmental organizations.

The Climate Change Policy Coordination Committee (CCPCC) is created by Act 1/2005 as an organ of coordination and collaboration between the Central Government and the Regional Governments (the competent authorities for environmental issues) for implementing the system of emission trading designed at the European level and compliance with international and Community obligations.

Interministerial Commission for Climate Change: Created by Royal Decree 1886/2011, will carry out the functions of monitoring and proposing various policies related to climate change. Formed with representatives of the following departments: Ministry of Agriculture, Food and Environment (Chair), Foreign Affairs and Cooperation, Finance and Public Administration, Home Affairs, Development, Education, Culture and Sport, Industry, Energy and Tourism, Agriculture, Food and Environment, Economics and Competitiveness, and Health, Social Services and Equality.

The Institute for Energy Diversification and Saving (IDAE) was born as an Energy Study Centre, but eventually became a Public Business Body with financial autonomy. It has the following competences: Improve energy efficiency and enhance the establishment of renewable energies, revitalize the market through the presentation of technical and financial services for replicable innovative projects, give expression to the energy efficiency and development of renewable energies of the Ministry of Industry and Energy through actions.

As an example, the Spanish Strategy on Climate Change and Clean Energy was discussed in the Climate Change Policy Coordination Committee and eventually approved by the National Climate Council and the Interministerial Commission for Climate Change.

1.4. EU Legislation on energy efficiency and climate change. Mutual interactions and incentives.

European Climate Change Programme

The European Union (EU) has long been committed to international efforts to tackle climate change and felt the duty to set an example through robust policy-making at home.

The European Commission has taken many climate-related initiatives since 1991, when it issued the first Community strategy to limit carbon dioxide (CO2) emissions and improve energy efficiency. These include: a directive to promote electricity from renewable energy, voluntary commitments by car makers to reduce CO2 emissions by 25% and proposals on the taxation of energy products.

However, it was clear that action by both Member States and the European Community needed to be reinforced if the EU was to succeed in cutting its greenhouse gas emissions to 8% below 1990 levels by 2008-2012, as required by the Kyoto protocol.

The EU Council of Environment Ministers acknowledged the importance of taking further steps at Community level by asking the Commission to put forward a list of priority actions and policy measures.

The Commission responded in June 2000 by launching the European Climate Change Programme (ECCP). The goal of the ECCP was to identify and develop all the necessary elements of an EU strategy to implement the Kyoto Protocol.

The development of the first ECCP (2000-2004) involved all the relevant groups of stakeholders working together, including representatives from the Commission's different departments (DGs), the Member States, industry and environmental groups.

The second European Climate Change Programme (ECCP II) was launched in October 2005 at a major stakeholder conference in Brussels, and explored further cost-effective options for reducing greenhouse gas emissions in synergy with the EU's Lisbon strategy' for increasing economic growth and job creation. New working groups were established, covering carbon capture and geological storage, CO2 emissions from light-duty vehicles, emissions from aviation, and adaptation to the effects of climate change.

The first task of the second phase of the ECCP was to facilitate and support the actual implementation of the priorities identified in the first phase. The ECCP Steering Committee followed up on progress made. Some of the measures included, for example:

• The proposal for an EU framework for emissions trading

• A Communication and proposal for a Directive on the promotion of biofuels

• A proposal for a Directive to promote combined heat and power (CHP)

• A Communication regarding vehicle taxation

• Several working groups

The ECCP II consisted of several working groups:

• ECCP I review (with 5 subgroups: transport, energy supply, energy demand, non-CO2 gases, agriculture)

• Aviation

• CO2 and cars

• Carbon capture and storage

• Adaptation

• Reducing greenhouse gas emissions from ships

Additional measures were also investigated (Flexible Mechanisms, Agriculture, Sinks-Sub group on Agricultural Soils, Forest-Related Sinks).

Together with the climate change problem, the EU also faces serious energy challenges related to sustainability and energy security. At European level, the comprehensive package of policy measures to reduce greenhouse gas emissions initiated through the ECCP, was enhanced in each of the EU Member States that put in place its own domestic actions that were based on the ECCP measures such as:

• increased use of renewable energy (wind, solar, biomass) and combined heat and power installations;

• improved energy efficiency in buildings, industry, household appliances;

• reduction of CO2 emissions from new passenger cars;

• abatement measures in the manufacturing industry;

• measures to reduce emissions from landfills.

EU climate and energy package

All these measures are better understood under the common framework of the EU climate and energy package. It was adopted in 2009 to implement the 20-20-20 targets endorsed by EU leaders in 2007 - by 2020 there should be a 20 % reduction of GHG emissions compared with 1990, a 20 % share of renewable energies in EU energy consumption, and energy efficiency improvement by 20 %. This comprehensive and clearly targeted energy and climate policy aimed at providing a secure and predictable investment scenario for EU industry, and the core of the package comprised four pieces of complementary legislation.

1. Revision and strengthening of the EU Emissions Trading System (ETS): a single EU-wide cap on emission allowances from 2013 onwards, with a linear annual reduction until 2020 (21% reduction compared to 2005 levels) and beyond; the progressive replacement of free allocation of allowances by auctioning; and an expansion of the system to new sectors and gases. Further structural measures are currently under discussion.

2. An "Effort Sharing Decision" for emissions from sectors not covered by the EU ETS, e.g. transport, housing, agriculture and waste. Each Member State will have to achieve a binding national emissions limitation target for 2020. Overall, these national targets will cut the EU's emissions from the non-ETS sectors by 10 % by 2020 compared with 2005 levels.

3. Binding national targets for renewable energy: this will help reduce EU's dependence on imported energy as well as bring down GHG emissions.

4. A legal framework to promote the development and safe use of carbon capture and storage (CCS).

A very clear division in two areas has been adopted: the sectors covered under the EU ETS on one hand, and the non EU ETS sectors under the so called Effort Sharing Decision (ESD).

EU emissions trading system (EU ETS)

The EU emissions trading system (EU ETS) is a cornerstone of the European Union's policy to combat climate change and it is a key tool for reducing industrial greenhouse gas emissions cost-effectively becoming more energy efficient. It is the first - and still by far the biggest - international system for trading greenhouse gas emission allowances, and covers more than 11,000 power stations and industrial plants in 31 countries, as well as airlines, representing around 45% of the EU's greenhouse gas emissions.

The EU ETS works on the 'cap and trade' principle. A 'cap', or limit, is set on the total amount of certain greenhouse gases that can be emitted by the factories, power plants and other installations in the system. The cap is reduced over time so that total emissions fall. In 2020, emissions from sectors covered by the EU ETS will be 21% lower than in 2005.

Within the cap, companies receive or buy emission allowances which they can trade with one another as needed. They can also buy limited amounts of international credits from emission-saving projects around the world. The limit on the total number of allowances available ensures that they have a value.

After each year a company must surrender enough allowances to cover all its emissions, otherwise heavy fines are imposed. If a company reduces its emissions, it can keep the spare allowances to cover its future needs or else sell them to another company that is short of allowances. The flexibility that trading brings ensures that emissions are cut where it costs least to do so.

By putting a price on carbon and thereby giving a financial value to each tonne of emissions saved, the EU ETS has placed climate change on the agenda of company boards and their financial departments across Europe. A sufficiently high carbon price also promotes investment in clean, low-carbon technologies.

In allowing companies to buy international credits, the EU ETS also acts as a major driver of investment in clean technologies and low-carbon solutions, particularly in developing countries.

Launched in 2005, the EU ETS is now in its third phase, running from 2013 to 2020. A major revision approved in 2009 in order to strengthen the system means the third phase is significantly different from phases one and two and is based on rules which are far more harmonized than before. The main changes are:

• an EU-wide cap on allowances, as opposed to 27 individual Member State caps, decreasing by 1.74% annually, up to and beyond 2020, providing much greater regulatory predictability and stability

• auctioning as the default system of allocation in phase 3 (2013-2020). In 2013 more than 40% of general allowances will be sold through auctioning, and this proportion will rise progressively in the following years. Under the relevant EU legislation at least half of auctioning revenues, and all of the revenues from auctioning allowances to the aviation sector, should be used to combat climate change in Europe or other countries. Member states are obliged to inform the Commission of how they use the revenues. Germany, for instance, is spending a large part of its auctioning revenues on climate change projects in developing countries and emerging economies.

• harmonized rules for free allocation, based on performance benchmarks established prior to phase 3

• stricter rules on the type of international credits that are allowed for use in the EU ETS

• replacement of 27 national electronic registries by a single Union registry

While emissions trading has the potential to cover many economic sectors and greenhouse gases, the focus of the EU ETS is on emissions which can be measured, reported and verified with a high level of accuracy. The system covers the following greenhouse gases and sectors:

• Carbon dioxide (CO2) from:
  • Power and heat generation
  • Energy-intensive industry sectors including oil refineries, steel works and production of iron, aluminium, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals
  • Commercial aviation

• Nitrous oxide (N2O) from production of nitric, adipic, glyoxal and glyoxlic acids

• Perfluorocarbons (PFCs) from aluminium production

Participation in the EU ETS is mandatory for companies operating in these sectors, but in some sectors only plants above a certain size are included. Governments can exclude certain small installations from the system if fiscal or other measures are in place that will cut their emissions by an equivalent amount.

To address the competitiveness of industries covered by the EU ETS, production from sectors and sub-sectors deemed to be exposed to a significant risk of 'carbon leakage' will receive a higher share of free allowances in the third trading period between 2013 and 2020. This is because they face competition from industries in third countries which are not subject to comparable greenhouse gas emissions restrictions.

Free allowances are in principle allocated on the basis of product-specific benchmarks for each relevant product. The benchmarks are multiplied by a historical production figure and some other factors that are needed to ensure the respect of the annually decreasing total cap on ETS allowances.

For the sectors and sub-sectors included in the 'carbon leakage' list, the free allocation is multiplied by a factor of 1 (100%) while for other sectors the allocation will be multiplied by a lower figure (80% in 2013, reducing every year to reach 30% in 2020). The "exposed" sectors are thus not exempted from the ETS. Furthermore, given that the benchmarks are based on the most efficient installations, only the most efficient installations in each sector receive for free an amount of allowances that may cover all their needs.

The example of the EU ETS has inspired other countries and regions to launch cap and trade schemes of their own such as Australia, South Korea and China. The EU aims to link up the ETS with compatible systems around the world to form the backbone of an expanded international carbon market. The European Commission has agreed in principle to link the ETS with Australia's system and is also negotiating with Switzerland.

The EU ETS legislation allows participants to use most categories of credits from the Kyoto Protocol's Clean Development Mechanism (CDM) and Joint Implementation (JI) mechanism towards fulfilling part of their EU ETS obligations.

Currently, the ETS faces a challenge in the form of a growing surplus of allowances, largely because of the economic crisis which has depressed emissions more than anticipated. In the short term this surplus risks undermining the orderly functioning of the carbon market; in the longer term it could affect the ability of the EU ETS to meet more demanding emission reduction targets cost-effectively. The Commission has therefore taken the initiative to postpone (or 'back-load') the auctioning of some allowances as an immediate measure, while also launching a debate on structural measures (e.g. increasing the EU reduction target to 30% in 2020) which could provide a sustainable solution to the surplus in the longer term.

Effort Sharing Decision (ESD)

As regards the Effort Sharing Decision (ESD - Decision 406/2009/EC of the European Parliament and of the Council, of 23 April 2009, on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020), it was agreed by the EU as part of the Climate and Energy package and sets national emission limits for greenhouse gas (GHG) emissions in the ESD sectors in the 27 EU Member States in 2020. The ESD covers emissions from all sources outside the EU's Emissions Trading Scheme (ETS), except for international maritime emissions and emissions and removals from land use, land-use change and forestry (LULUCF). In order of importance, the three largest sectors are:

- Energy use in road transport,
- Energy use in the built environment and
- Emissions from agriculture.

Other sources include emissions from less energy intensive businesses in the industry sector; methane emissions from waste; industrial process emissions (including F-gases) and fugitive emissions from the energy sectors (leakage of gas pipelines, coal mining).

The Decision defines linear legally binding emissions trajectories in Member States for the period 2013-2020 with annual monitoring and compliance checks. It also provides flexibility for Member States in reaching their targets by allowing transfers of annual emissions allocations between years, between Member States and the use of external credits through the Clean Development Mechanism. From a national perspective, the ESD can be regarded as a (flexible) emissions ceiling, which can be achieved via multiple sectors, comprising both national and Community wide instruments.

Under the ESD, all Member States have individual 2020 emissions targets, which, based on the original estimates, average out at -10% for the EU as a whole compared to 2005. In Member States where GDP/capita exceeds the EU average, a deeper emissions reduction than the EU average is required, up to -20% below 2005. Countries with a low GDP per capita will be allowed to increase their emissions in ESD sectors by up to 20% above 2005 levels. This approach reflects projections that their relatively higher economic growth in the next decade will be accompanied by increased emissions in, for instance, the transportation sector. Nevertheless, these targets still represent a limit on their total emissions and will require a reduction effort also in these Member States.

In contrast to sectors in the EU ETS, which are regulated at EU level, it is the responsibility of Member States to define and implement national policies and measures to limit emissions from the sectors covered by the Effort Sharing Decision. Examples of potential policies and measures include a shift from transport based on fossil fuels, promotion of public transport, ambitious energy performance standards for buildings, more efficient heating systems, renewable energy for heating, more efficient farming practices, and conversion of animal waste to biogas. Some best practices of these policies will be discussed in the following chapter.

Nevertheless, a number of measures taken at EU level focused on energy efficiency by DG Energy will help Member States to reduce emissions. For example:

- CO_2 emission standards for new cars and vans will cut emissions from road transport;

- Emission reductions from buildings will be aided by measures to improve the energy performance of buildings, eco-design requirements for energy–related products, and energy labelling systems to inform consumers;

- Restrictions on fluorinated industrial gases (F-gases) and implementation of other EU environmental policies, e.g. on soil protection and waste, will also contribute to reaching the national targets.

The annual reports that Member States are required to make under the Effort Sharing Decision will cover not only their emissions but also the policies and measures they are undertaking and projections of their future progress. Together with the various flexibilities at their disposal, this should enable Member States to take timely action to ensure that they comply with their annual emission allocations. If a Member State's report for a given year shows it is not in line with its annual limits, however, it will have to take corrective action.

Any shortfall in emission reductions will have to be achieved in the next year, multiplied by a factor of 1.08 as a penalty. On top of this, Member States will have to submit a corrective action plan to the Commission detailing, among other things, how and when they intend to get back on track towards meeting their 2020 targets. The Commission and the EU Climate Change Committee (comprising the Member States) can comment and give recommendations on the plans.

he Commission can also launch an infringement procedure against the Member State concerned. The combination of the mechanism for corrective action and the potential use of the infringement procedure strengthens the credibility of the EU's mitigation measures under the Effort Sharing Decision. It also gives greater certainty to Member States which achieve greater emission reductions than required and would like to sell their surplus emission allocations to another Member State.

Renewable energy (RES)

Regarding the piece of the package dealing with renewable energy, Directive 2009/28/EC on the promotion of the use of energy from renewable sources, it establishes a common framework for the use of energy from renewable sources in order to limit greenhouse gas emissions and to promote cleaner transport. To this end, national action plans are defined, as are procedures for the use of biofuels.

The Member States are to establish national renewable energy action plans which set the share of energy from renewable sources consumed in transport, as well as in the production of electricity and heating, for 2020. These action plans must take into account the effects of other energy efficiency measures on final energy consumption (the higher the reduction in energy consumption, the less energy from renewable sources will be required to meet the target). These plans will also establish procedures for the reform of planning and pricing schemes and access to electricity networks, promoting energy from renewable sources.

Each Member State must be able to guarantee the origin of electricity, heating and cooling produced from renewable energy sources. The information contained in these guarantees of origin is normalized and should be recognized in all Member States. It may also be used to provide consumers with information on the composition of the different electricity sources.

Member States should also build the necessary infrastructures for energy from renewable sources in the energy transport sector. To this end, they should ensure that operators guarantee the transport and distribution of electricity from renewable sources, and provide for priority access for this type of energy.

The Directive takes into account energy from biofuels and bioliquids. From 1 January 2017, their share in emissions savings should be increased to 50 %. Biofuels and bioliquids are produced using raw materials coming from outside or within the Community. Biofuels and bioliquids should not be produced using raw materials from land with high biodiversity value or with high carbon stock. To benefit from financial support, they must be qualified as "sustainable" in accordance with the defined criteria.

According to the directive, the share of energy from renewable sources in the transport sector must amount to at least 10 % of final energy consumption in the sector by 2020. However, on 17 October 2012, the Commission published a proposal to limit global land conversion for biofuel production, and raise the climate benefits of biofuels used in the EU. The use of food-based biofuels to meet the 10% renewable energy target of the Renewable Energy Directive will be limited to 5%.

According to their forecast documents, ten Member States expect to exceed their national targets for renewable energy, and five expect to need to use the Directive's cooperation mechanisms and reach their target by developing some renewable energy in another Member State or a third country. Whilst Member States expect to use the cooperation mechanisms for only a small amount of energy (around 2-3 mtoe), the forecast total production of renewable energy would exceed the 20% target and reach 20.3%.

Carbon capture and geological storage (CCS)

The final piece of the climate and energy package deals with carbon capture and geological storage (CCS). CCS is a technique for trapping carbon dioxide as it is emitted from large point sources, compressing it, and transporting it to a suitable storage site where it is injected into the ground. The technology of carbon capture and storage has significant potential as a mitigation technique for climate change, both within Europe and internationally, particularly in those countries with large reserves of fossil fuels and a fast-increasing energy demand. In the EU the CO2 emissions avoided through CCS in 2030 could account for some 15% of the reductions required.

CO2 can be sequestered directly in geological formations including oil and gas reservoirs, unmineable coal seams, and deep saline reservoirs. The security of sequestration depends on the site characteristics and management: the 2005 IPCC Special Report on CCS concluded that the fraction retained in appropriately selected and managed geological reservoirs is very likely to exceed 99% over 100 years and is likely to exceed 99% over 1000 years.

Before carbon dioxide gas from power plants and other point sources can be stored, it must be captured as a relatively pure gas. This is not a new technology as CO2 is routinely separated and captured as a by-product from industrial processes. Captured CO2 needs to be stored (in compressed form) and transported to the place of sequestration. An important downside is the cost of capture and storage. Capture in particular is an expensive component. Flue gas from coal- or gas-fired power plants contains relatively low concentrations of CO2 (10-12% for coal, and around 3-6% for gas), and the energy needed to capture at such low concentrations imposes a significant efficiency penalty and thus additional cost.

Directive 2009/31/EC on the geological storage of carbon dioxide lays down extensive requirements for the site selection, which is a crucial stage for ensuring the integrity of a project. A site can only be selected for use if a prior analysis shows that, under the proposed conditions of use, there is no significant risk of leakage or damage to human health or the environment. The operation of the site must be closely monitored and corrective measures taken in the case that leakage does occur. In addition, the Directive contains provisions on closure and post-closure obligations, and sets out criteria for the transfer of responsibility from the operator to the Member State.

With regard to liability for any leakage, inclusion in the Emissions Trading System ensures that allowances would have to be surrendered for any emissions resulting from leakage. Liability for local damage to the environment is dealt with by using the existing Directive on Environmental Liability. Liability for damage to health and property is left for regulation at Member State level.

Energy Efficiency Plan and Energy Efficiency Directive

The climate and energy package creates pressure to improve energy efficiency but does not address it directly; the EU's energy efficiency action plan does. Taking into account that current estimates show the EU is not on track to achieve its target of reducing its estimated energy consumption for 2020 by 20%, additional measures on energy efficiency were proposed for implementation throughout the economy to bring the EU back on track to achieve its objective by 2020. As a result, the Commission adopted an Energy Efficiency Plan[41] . Its aim is to give a high profile to energy efficiency, provide a clear commitment and set key areas for priority action.

Hence, the Energy Efficiency Plan 2011 forms part of the European Union's 20 % target (aimed at reducing primary energy consumption) and the 2020 Energy strategy. It aims at:

• promoting an economy that respects the planet's resources;

• implementing a low carbon system;

• improving the EU's energy independence;

• strengthening security of energy supply.

In order to meet these objectives, the plan proposes to act at different levels.

- Fostering low energy consumption in the construction sector.

The Plan emphasizes the necessity to implement the means for reducing final energy consumption in buildings, as this sector is responsible for almost 40 % of the final energy consumption in Europe. However, it highlights several obstacles such as "split incentives" which hinder improvements in the energy performance of buildings.

In order to effectively promote low energy consumption in the construction sector, the training of architects, engineers and technicians should be adapted, for example under the "Agenda for new skills and jobs".

As part of the Europe 2020 Strategy 'An Agenda for new skills and jobs' is the Commission's contribution to reaching the EU employment rate target for women and men of 75 % for the 20-64 years age group by 2020. The strategy also highlights the EU's targets to reduce the early school leaving rate to under 10% and increase the number of young people in higher education or equivalent vocational education to at least 40%.

To make Europe's labour markets function better and to deliver the right mix of skills, the Commission proposes concrete actions that will help:

• To step up labour market reform to improve flexibility and security of labour markets ('flexicurity');

• To give people and businesses the right incentives to invest in training to continuously upgrade people's skills in line with labour market needs;

• To ensure decent working conditions while improving the quality of employment legislation;

• To ensure the right labour market conditions are in place for job creation such as less administrative burdens or lowering the taxes on labour and mobility.

The Agenda for new skills and jobs complements the Commission's 'Youth on the Move' initiative, which aims to help young people to gain the knowledge, skills and experience they need to make their first job a reality.

As one such example, the Commission launched the 'BUILD UP Skills: Sustainable Building Workforce Initiative' to support Member States in assessing training needs for the construction sector, developing strategies

41. COM(2011) 109 Final

to meet them, and fostering effective training schemes. This may lead to recommendations for the certification, qualification or training of craftsmen. The Commission will also work with the Member States to adapt their professional and university training curricula to reflect the new qualification needs (in line with the European Qualification Framework). The Commission's Flagship Initiative "An Agenda for New Skills and Jobs" calls for skills supply to be matched with labour market needs. Transition to energy-efficient technologies requires new skills, environment-conscious vocational education and training in construction and in many other sectors.

The Plan also states that Energy Service Companies (ESCOs) may give financial assistance to public authorities to modernize buildings and thus reduce their energy consumption, accepting financial risk by covering – or helping to finance - upfront investment costs and refinancing this through the savings achieved.

- Developing competitive European industry.

The Commission wishes to encourage new production capacity and infrastructures to replace old equipment. These new infrastructures must comply with the requirements of the EU ETS and the Directive on industrial emissions.

It is also crucial to introduce a scheme for the effective recovery of heat losses from electricity and industrial production, and to valorize cogeneration.

The Commission also proposes to create instruments which allow financial value to be attributed to energy savings and link profits of utilities (suppliers and distributors) to energy efficiency and not to the volume of energy delivered.

Lastly, the Plan provides for increased energy efficiency in industry, particularly in European small and medium-sized enterprises (SMEs), delivering to them information (for example about legislative requirements, criteria for subsidies to upgrade machinery, availability of training on energy management and of energy experts) and develop appropriate incentives (such as tax rebates, financing for energy efficiency investments, or funding for energy audits). But energy efficiency will also be an important issue for large companies, for which regular energy audits shall be mandatory.

- Adapting national and European financing.

In order to promote energy efficiency, the European Commission proposes to intensify energy taxation and carbon taxes by means of the following instruments:

- the cohesion policy;
- the Intelligent Energy Europe programme (2007-2013);
- intermediated funding;
- the European Energy Programme for Recovery;
- the Framework Programme for research, technological development and demonstration activities (2007-2013).

- Making savings for the consumer

Initially, the Commission proposes to reinforce the approach of the "Ecodesign" Directive and to define strict standards for heating boilers, water heaters and computers for example.

Furthermore, consumers' understanding of the Ecolabel should be improved in order to facilitate the choice of energy-efficient products. Consumers should also have information about their own energy consumption in real time by means of "intelligent" individual meters, as recommended in the Directive establishing the internal market in electricity.

- Improving transport efficiency

The transport sector represents 32 % of final energy consumption. The Commission intends to define a strategy to improve the efficiency of this sector, for example by introducing traffic management in all modes of transport.

- Widening the scope of the national framework

Member States have implemented national plans to meet the target of reducing EU primary energy consumption by 20 %. However, the Commission suggests widening the scope of these plans to cover all stages of the energy chain and better exploit potential energy savings.

Many of these measures will be implemented through the provisions of the recently agreed Energy Efficiency Directive[42]. The most relevant issues of this directive are:

- Public bodies will need to buy energy-efficient buildings, products and services, and refurbish 3% of their buildings each year to drastically reduce their energy consumption.

- Energy utilities will have to encourage end users to cut their energy consumption through efficiency improvements such as the replacement of old boilers or insulation of their homes.

- Industry will be expected to become more aware of energy-saving possibilities, with large companies required to undertake energy audits every 3 years.

- Consumers will be better able to manage their energy consumption thanks to better information provided on their meters and bills.

- Energy transformation will be monitored for efficiency, with the EU proposing measures to improve performance if necessary, and promoting cogeneration of heat and electricity.

- National energy regulatory authorities will have to take energy efficiency into account when deciding how and at what costs energy is distributed to end users.

- Certification schemes will be introduced for providers of energy services to ensure a high level of technical competence.

The expected benefits are the following:

- Consumers will benefit from having better information available to control their energy consumption and influence their energy bills.

- The environment will benefit from reduced greenhouse gas emissions.
- Public bodies will reduce their spending for energy consumption by using more efficient buildings, products and services.

- The EU economy will benefit from a more secure energy supply and economic growth through the creation of new jobs, particularly in building renovation.

The Energy Efficiency Directive establishes a common framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union's 2020 20% headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date. It lays down rules designed to remove barriers in the energy market and overcome market failures that impede efficiency in the supply and use of energy, and provides for the establishment of indicative national energy efficiency targets for 2020. The Directive brings forward legally binding measures to step up Member States' efforts to use energy more efficiently at all stages of the energy chain – from the transformation of energy and its distribution to its final consumption. Measures include the legal obligation to establish energy efficiency obligations schemes or policy measures in all Member States. These will drive energy efficiency improvements in households, industries and transport sectors. Other measures include an exemplary role to be played by the public sector and a right for consumers to know how much energy they consume.

Under this common and general framework for energy efficiency, sectoral legislation is also in place to face sector specific problems. Some of the most relevant topics are:

- Buildings: On 19 May 2010, the EU adopted the Energy Performance of Buildings Directive 2010/31/EU (EPBD) which is the main legislative instrument to reduce the energy consumption of buildings. Under this Directive, Member States must establish and apply minimum energy performance requirements for new and existing buildings, ensure the certification of building energy performance and require the regular inspection of boilers and air conditioning systems in buildings. Moreover, the Directive requires Member States to ensure that by 2021 all new buildings are so-called 'nearly zero-energy buildings'. It also provides for the leading role of the public sector.

42. Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on Energy Efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC

• Cogeneration: On 11 February 2004, the Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market was adopted. The purpose is to facilitate the installation and operation of electrical cogeneration plants (a technology allowing the production in one process of heat and electricity) in order to save energy and combat climate change. This directive has been repealed by the energy efficiency directive insofar as it no longer makes it possible to tap energy saving potential to the full. The latter focuses on the high efficiency cogeneration.

• End-use efficiency and energy services: On 5 April 2006, the EU adopted the Directive 2006/32/EC on energy end-use efficiency and energy services. It included an indicative energy savings target for the Member States, obligations on national public authorities as regards energy savings and energy efficient procurement, and measures to promote energy efficiency and energy services. Member States had to adopt and achieve an indicative energy saving target of 9 % by 2016 in the framework of a national energy efficiency action plan (NEEAP). This directive has been repealed by the energy efficiency directive insofar as it no longer makes it possible to tap energy saving potential to the full. However, Article 4 of Directive 2006/32/EC should continue to apply in order to enable Member States to reach the objective of achieving 9 % of energy savings by 2016.

• Products: The energy demand of households accounts for 25% of the final energy needs in the EU. Higher standards of living and comfort, multiple purchases of electric appliances and the growing need for air-conditioning are the main reasons for this trend. Energy consumption by consumer electronics and Internet is also steadily growing. Apart from the user's behavior, the response is to act in two complementary ways: Energy Labelling of household appliances to raise the awareness of consumers, and Minimum Efficiency Requirements imposed to products on the design phase.

The production, distribution, use and end-of-life management of energy-related products (ErPs) is associated with important impacts on the environment, such as the consequences of energy and other materials/resources consumption, waste generation and release of hazardous substances. It is estimated that over 80% of all product-related environmental impacts are determined during the design phase of a product.

On 19 May 2010, the EU adopted the Directive 2010/30/EU on energy labels. Energy labels help consumers choosing products which save energy and thus money. They also provide incentives for the industry to develop and invest in energy efficient product design.

On 21 October 2009, the EU adopted the Directive 2009/125/EC, establishing a framework for the setting of ecodesign requirements for energy-related products. Ecodesign aims at reducing the environmental impact of products, including the energy consumption throughout their entire life cycle. It therefore makes no direct provision for mandatory requirements for specific products. This is done for given energy-related products via implementing measures. These eco-design implementing measures are developed following consultations with interested parties. At the outset, a preparatory study will consider whether and which ecodesign requirements should be set for a particular product, recommending ways to improve its environmental performance.

The directive prevents disparate national legislations on the environmental performance of these products from becoming obstacles to the intra-EU trade. This should benefit both businesses and consumers, by enhancing product quality and environmental protection and by facilitating free movement of goods across the EU.

Energy related products (the use of which has an impact on energy consumption) account for a large proportion of the energy consumption in the EU and include:

• Energy-using products (EUPs), which use, generate, transfer or measure energy (electricity, gas, fossil fuel), such as boilers, computers, televisions, transformers, industrial fans, industrial furnaces etc.

• Other energy related products (ERPs) which do not use energy but have an impact on energy and can therefore contribute to saving energy, such as windows, insulation material, shower heads, taps etc.

Specific provisions for lamps (phase-out of incandescent light bulbs and other energy inefficient lamps), office equipment (European Energy Star Programme) and tyres (from November 2012, the label provides information on fuel efficiency, wet grip and external rolling noise through clear pictograms) are especially remarkable.

The Directive is under the responsibility of DG Enterprise and Industry and DG Energy.

Energy taxation

It is also interesting to mention the EU energy taxation proposal, which will replace the previous Directive 2003/96/EC. On 27 October 2003, the EU adopted the Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity. Its objective was to widen the scope of the EU's minimum rate system for energy products, previously limited to mineral oils, to all energy products including coal, natural gas and electricity. This intended to reduce distortions of competition that existed between Member States as a result of divergent rates of tax on energy products, reduce distortions of competition between mineral oils and the other energy products, increase incentives to use energy more efficiently (to reduce dependency on imported energy and to cut carbon dioxide emissions), and allow Member States to offer companies tax incentives in return for specific undertakings to reduce emissions.

After a decade, current taxes on energy products often don't provide a strong enough incentive for people to consume less or opt for cleaner forms of energy. In fact, sometimes taxes make it cheaper to use dirtier fuels and more polluting forms of energy. In addition, the EU ETS already helps to limit CO2 emissions in some industries that should not face a double burden from the CO2 taxes.

On 13 April 2011, the European Commission presented its proposal to overhaul the outdated rules on the taxation of energy products in the European Union. The new rules aim to restructure the way energy products are taxed to remove current imbalances and take into account both their CO2 emissions and energy content. Existing energy taxes would be split into two components that, taken together, would determine the overall rate at which a product is taxed. The Commission wants to promote energy efficiency and consumption of more environmentally friendly products and to avoid distortions of competition in the Single Market. The main changes will be the following:

• Taxes on motor fuels, heating fuels and electricity will be based on the energy content of the product and the amount of CO2 it emits. More polluting products will be taxed more heavily, and the use of "cleaner" energy will be promoted.

• The EU will set a minimum rate for taxes based on energy and CO2 content. To ensure fair treatment, the minimum rate will be the same for competing products (e.g. for all heating fuels or all motor fuels). Moreover, actual tax rates – set by national governments – will have to be the same for competing products.

• CO2-related taxes will only apply to industrial plants not covered by the EU emissions trading scheme – so that all economic sectors share the burden of reducing CO2 emissions fairly, either via the Energy Taxation Directive or the emissions trading scheme.

On the long term, the European Commission is looking at cost-efficient ways to make the European economy even more climate-friendly and less energy-consuming. By 2050, the European Union could cut most of its greenhouse gas emissions and clean technologies are assumed to be the future for Europe's economy.

Roadmap for moving to a competitive low-carbon economy in 2050

With its Roadmap for moving to a competitive low-carbon economy in 2050, the European Commission has looked beyond these short-term objectives and set out a cost-effective pathway for achieving much deeper emission cuts by the middle of the century. All major economies will need to make deep emission reductions if global warming is to be held below 2°C compared to the temperature in pre-industrial times.

The Roadmap is one of the long-term policy plans put forward under the Resource Efficient Europe flagship initiative intended to put the EU on course to using resources in a sustainable way.

The Roadmap suggests that, by 2050, the EU should cut its emissions to 80% below 1990 levels through domestic reductions alone. It sets out milestones which form a cost-effective pathway to this goal - reductions of the order of 40% by 2030 and 60% by 2040. It also shows how the main sectors responsible for Europe's emissions - power generation, industry, transport, buildings and construction, as well as agriculture - can make the transition to a low-carbon economy most cost-effectively.

A low-carbon society will live and work in low-energy, low-emission buildings with intelligent heating and cooling systems. Electric and hybrid cars will be driven in cleaner cities with less air pollution and better public transport.

Many of these technologies exist today but need to be developed further. Besides cutting the vast majority of its emissions, Europe could also reduce its use of key resources like oil and gas, raw materials, land and water.

The transition to a low-carbon society would boost Europe's economy thanks to increased innovation and investment in clean technologies and low- or zero-carbon energy. A low-carbon economy would have a much greater need for renewable sources of energy, energy-efficient building materials, hybrid and electric cars, 'smart grid' equipment, low-carbon power generation and carbon capture and storage technologies.

To make the transition the EU would need to invest an additional €270 billion or 1.5% of its GDP annually, on average, over the next four decades. The extra investment would take Europe back to the investment levels seen before the economic crisis, and would spur growth within a wide range of manufacturing sectors and environmental services. Up to 1.5 million additional jobs could be created by 2020 if governments used revenues from CO2 taxes and from auctioning of emission allowances to reduce labour costs.

Energy efficiency will be a key driver of the transition. By moving to a low-carbon society, the EU could be using around 30% less energy in 2050 than in 2005. Households and businesses would enjoy more secure and efficient energy services.

More locally produced energy would be used, mostly from renewable sources. As a result, the EU would be less dependent on expensive imports of oil and gas and less vulnerable to increases in oil prices. On average, the EU could save € 175-320 billion annually in fuel costs over the next 40 years.

In addition, greater use of clean technologies and electric cars will drastically reduce air pollution in European cities. Fewer people would suffer from asthma and other respiratory diseases; considerably less money would need to be spent on health care and on equipment to control air pollution. By 2050, the EU could save up to €88 billion a year in these areas.

The Roadmap for moving to a low-carbon economy shows how the effort of reducing greenhouse gas emissions should be divided cost-effectively between different economic sectors. All sectors will have to contribute according to their technological and economic potential.

GHG reductions compared to 1990	2005	2030	2050
Total	-7%	-40 to -44%	-79 to -82%
Power (CO2)	-7%	-54 to -68%	-93 to -99%
Industry (CO2)	-20%	-34 to-40%	-83 to -87%
Transport (incl. CO2 aviation, excl. maritime)	+30%	+20 to -9%	-54 to -67%
Residential and services (CO2)	-12%	37 to -53%	-88 to -91%
Agriculture (Non- CO2)	-20%	36 to -37%	-42 to -49%
Other Non (CO2 emissions)	-30%	-72 to -73%	-70 to -78%

These percentages have been based on a large number of different decarbonization scenarios.

The power sector has the biggest potential for cutting emissions. It can almost totally eliminate CO2 emissions by 2050. Electricity could partially replace fossil fuels in transport and heating. Electricity will come from renewable sources like wind, solar, water and biomass or other sources that are low in carbon emissions like nuclear power plants or fossil fuel power stations equipped with carbon capture and storage technology. The share of these clean technologies in power generation could increase rapidly, from 45% today, to around 60% in 2020 and almost 100% in 2050. For this to happen the cap on emissions from the power sector under the EU Emission Trading System will need to be strengthened and considerable investment put into smart grids.

While emissions from transport are still increasing today, they could be reduced to more than 60% below 1990 levels by 2050. For passenger cars, we would first see further improvements in the fuel efficiency of cars with traditional petrol and diesel engines. After 2025, a shift to plug-in hybrid cars and electric cars will allow CO2 emissions from cars to be cut very steeply. Planes will be powered largely by biofuels and also heavy duty vehicles (lorries) will not fully shift towards electro mobility. Biofuels used should be sustainable to avoid increased pressure on biodiversity and an increase of greenhouse gas emissions through changes in land use.

Emissions from houses and office buildings can be almost completely cut, by around 90% in 2050. The energy performance of buildings will be improved drastically; 'passive' housing technology will become mainstream for new buildings and old buildings will be retrofitted. Heating, cooling and cooking will be largely powered by electricity and renewable energy, instead of fossil fuels. Investments can be recovered over time through reduced energy bills.

Energy intensive industries will also make a large contribution by cutting emissions by more than 80% by 2050. Technologies used will get cleaner and more energy-efficient. In addition, a large-scale introduction of carbon capture and storage technologies, which allow CO2 to be stored underground instead of pumped into the atmosphere, would be needed. This would require big investments of €10 billion annually by 2040-2050.

As global food demand grows, the share of agriculture in the EU's total amount of emissions will raise to about a third by 2050. But reductions are possible and it is vital to achieve these emission cuts in the agricultural sector as well; otherwise other sectors will need to make a bigger reduction effort. Agriculture will need to cut emissions from fertiliser, manure and livestock and can contribute to the storage of CO2 in soils and forests. But also changes towards a more healthy diet with more vegetables and less meat can reduce emissions.

1.5. Financing

Financial support is available through various EU programmes and instruments aimed at assisting Member States in supporting EU policy implementation and initiating associated investments. A description of some of them is provided below.

European Energy Efficiency Fund (EEE F)

The Fund was launched on 1st July 2011 with a global volume of EUR 265 million, providing tailor-made debt and equity instruments to local, regional and (if justified) national public authorities or public or private entities acting on their behalf. EEE F aims at financing bankable projects in energy efficiency (70%), renewable energy (20%) and clean urban transport (10%) through innovative instruments and in particular promoting the application of the Energy Performance Contracting (EPC). A technical assistance grant support (EUR 20 million) is available for project development services (technical, financial) linked to the investments financed by the Fund.

The European Energy Efficiency Fund (EEEF) completed its first energy efficiency project on 12 March 2012 with the Jewish Museum Berlin and Johnson Controls. The project will result in annual energy savings of € 294,327 and a 55% cut of CO2.

The Jewish Museum Berlin Foundation (JMB) and Johnson Controls Systems & Service GmbH (JC), signed an Energy Performance Contract (EPC) of EUR 3.1 million of energy efficiency measures on the two buildings of the museum. Based on a detailed analysis of energy consumption of both buildings performed by Johnson Controls, energy efficiency measures will include optimization of heating, ventilation & air conditioning, energy efficient lighting and optimization of the energy management system.

The EEEF provides upfront financing to Johnson Controls, the Energy Service Company (ESCO) in charge of guarantying the energy savings. To do so, the EEE F purchases 70% of the Johnson Controls' energy savings revenues against the Jewish Museum for the building retrofitting services performed by Johnson Controls. The retrofit leads to a reduction of CO2 emissions by 1,812 t per annum - equal to approximately 55 % savings compared to the baseline year 2010. Johnson Controls Systems & Service GmbH guaranteed energy savings of net EUR 294,327 per annum (43.2%) and is responsible for maintenance and building operation services for the period of 10 years.

Another example is the funding by the EEE F of the building retrofit of the University of Applied Sciences Munich in similar conditions.

European Regional Development Fund

The ERDF aims to strengthen economic and social cohesion in the European Union by correcting imbalances between its regions. In short, the ERDF finances:

- direct aid to investments in companies (in particular SMEs) to create sustainable jobs;
- infrastructures linked notably to research and innovation, telecommunications, environment, energy and transport;
- financial instruments (capital risk funds, local development funds, etc.) to support regional and local development and to foster cooperation between towns and regions;
- technical assistance measures.

Cohesion Fund

The Cohesion Fund is aimed at Member States whose Gross National Income (GNI) per inhabitant is less than 90% of the Community average. It serves to reduce their economic and social shortfall, as well as to stabilize their economy. It supports actions in the framework of the Convergence objective. It is now subject to the same rules of programming, management and monitoring as the Europe Structural Funds and the ERDF.

The Cohesion Fund finances activities under the following categories:

- Trans-European transport networks, notably priority projects of European interest as identified by the Union;
- environment; here, Cohesion Fund can also support projects related to energy or transport, as long as they clearly present a benefit to the environment: energy efficiency, use of renewable energy, developing rail transport, supporting intermodality, strengthening public transport, etc.

For the 2007-2013 period the Cohesion Fund concerns Bulgaria, Cyprus, the Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia and Slovenia. Spain is eligible to a phase-out fund only as its GNI per inhabitant is less than the average of the EU-15.

Under the current financing period (2007-2013), EU Cohesion policy funding has increasingly focused on investments in energy efficiency and renewables, in line with the Europe 2020 Strategy for smart, sustainable and inclusive growth and the 20% energy efficiency target. The planned funding allocations in the 2007-2013 Cohesion Policy programmes for sustainable energy investments amounts to about EUR 9.4 billion, of which approximately EUR 5.1 billion is targeted at improving energy efficiency.

Under the Joint European Support for Sustainable Investment in City Areas (JESSICA) initiative, Member States are offered the possibility to invest some of their Structural Funds allocations in financial engineering instruments (revolving funds) supporting urban development. These financial instruments (so-called Urban Development Funds) invest in public-private partnerships and other projects included in integrated plans for sustainable urban development.

Competitiveness and Innovation Framework Programme (CIP)

With small and medium-sized enterprises (SMEs) as its main target, the Competitiveness and Innovation Framework Programme (CIP) supports innovation activities (including eco-innovation), provides better access to finance and delivers business support services in the regions. It encourages a better take-up and use of information and communication technologies (ICT) and helps to develop the information society, but it also promotes the increased use of renewable energies and energy efficiency.

In the future, the new Programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME) will run from 2014 to 2020, with a planned budget of €2.5bn (current prices).

Currently, the CIP runs from 2007 to 2013 with an overall budget of € 3621 million and is divided into three operational programmes. Each programme has its specific objectives, aimed at contributing to the competitiveness of enterprises and their innovative capacity in their own areas, such as ICT or sustainable energy:

- The Entrepreneurship and Innovation Programme (EIP)
- The Information Communication Technologies Policy Support Programme (ICT-PSP)
- The Intelligent Energy Europe Programme (IEE)

Intelligent Energy – Europe

The Intelligent Energy – Europe Programme II (IEE II) focuses on removal of non-technological barriers to energy efficiency and renewable energy market uptake. Under the 2007-2013 programming period, EUR 730 million is available. The IEE helps creating favourable market conditions, shaping policy development and implementation, preparing the ground for investments, building capacity and skills, informing stakeholders and fostering commitment. This also includes projects on financing energy efficiency in public buildings.

The programme is implemented by the EACI (European Agency for Competitiveness and Innovation), whose objective is to contribute to secure, sustainable and competitively priced energy for Europe, by providing for action[41]:

– to foster energy efficiency and the rational use of energy resources;

– to promote new and renewable energy sources and support energy diversification;

– to promote energy efficiency and the use of new and renewable energy sources in transport.

IEE II builds on the experience of the first Intelligent Energy — Europe (IEE) Programme. It is the main EU instrument for tackling non-technological barriers to the efficient use of energy and to the use of new and renewable energy sources. With about € 730 million of

41. Decision No 1639/2006/EC of the European Parliament and of the Council of 24 October 2006 establishing a Competitiveness and Innovation Framework Programme (2007 to 2013), OJ L 310, 9.11.2006, p.15, Article 37.

funds available between 2007 and 2013, the Intelligent Energy Europe Programme (IEE) helps deliver on the ambitious climate change and energy targets that the EU has set for itself.

The programme supports concrete projects, initiatives and best practices via annual calls for proposals. Examples of projects funded under this programme include:

- Training on new construction techniques that can lead to 50 percent or more energy savings compared with traditional buildings;
- Improving the effectiveness of support schemes for electricity generation from renewable energy sources across Europe;
- Helping Europe's cities to develop more energy-efficient and cleaner transport.

IEE II forms part of the overarching Competitiveness and Innovation Framework Programme (CIP)[42] with a view to achieving the EU energy policy objectives and to implementing the Lisbon Agenda.

IEE II aims to give effect to energy-specific legislation. The objectives and priorities set out in this Work Programme tie in with evolving EU policy communications and legislation, including:

– EUROPE 2020 — A strategy for smart, sustainable and inclusive growth[43]
– Energy 2020 — A strategy for competitive, sustainable and secure energy[44]
– Energy Roadmap 2050[45]
– Energy Efficiency Plan 2011[46]
– Directive on energy efficiency[47]
– Directive on the energy performance of buildings[48]
– Directive on the energy performance of buildings (recast)[49]
– Directive on cogeneration of heat and power[50]
– Directive on energy end-use efficiency and energy services[51]
– Ecodesign Directive on energy-related products[52]
– Directive on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products[53]
– Regulation on labelling of tyres with respect to fuel efficiency and other essential parameters[54]
– Energy Star Agreement[55]
– Biomass Action Plan[56]
– Renewable energy road map — Renewable energies in the 21st century: building a more sustainable future[57]
– Directive on the promotion of the use of energy from renewable sources[58]
– Offshore Wind Energy: Action needed to deliver on the energy policy objectives for 2020 and beyond[59]
– White Paper 'Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system'[60]
– Action Plan on Urban Mobility[61]
– Directive on the promotion of clean and energy-efficient road transport vehicles[62]
– Revised Fuel Quality Directive[63]
– Investing in the Development of Low Carbon Technologies (SET Plan)[64]
– Resource Efficiency Flagship Initiative[65]
– Roadmap for a Resource Efficiency Europe[66]
– EU's Renewed Sustainable Development Strategy[67]
– Regulation No 1233/2010 of 15 December 2010 amending Regulation (EC) No 663/2009 establishing a programme to aid economic recovery by granting Community financial assistance to projects in the field of energy
– Regulation (EC) No397/2009 amending Regulation (EC) No1080/2006 on the European Regional Development Fund as regards the eligibility of energy efficiency and renewable energy investments in housing[68]
– Council Regulation (EC) No 74/2009 of 19 January 2009 amending Regulation (EC) No 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and Council Decision 2009/61/EC of 19 January 2009 amending Decision 2006/144/EC on the Community strategic guidelines for rural development (programming period 2007 to 2013)
– Communication – Renewable energy: a major player in the European energy market[69]

But the IEE II opens up opportunities for synergy with actions under other EU and CIP - Competitiveness and Innovation Framework Programmes. The possibility of having access to the instruments, networks and facilities for small and medium-sized enterprises (SMEs) provided for the whole CIP is one example.

ELENA Facility

Launched in 2009 under IEE II, this initiative provides technical assistance grants (of up to 90% of eligible costs) to local and regional authorities for development and launch of sustainable energy investments over their territories. The EU support is conditional to investments induced with a minimum leverage of 1:20. It consists of 4 operational windows with the European Investment Bank (EIB), KfW (Kreditanstalt für Wiederaufbau), CEB (Council of Europe Development Bank) and EBRD. So far, some EUR 31 million assigned to 17 projects should trigger investments nearing EUR 1.6 billion, within the 3-year duration of ELENA contracts. About a third of these investments addresses the buildings sector and EPC and a third is allocated to urban transport projects. ELENA Facility enables the financing of investments both by private and public sources and facilitates connection with financial instruments.

Mobilising Local Energy Investments (MLEI)

MLEI is also a Project development assistance addressing projects between EUR 6 million and EUR 50 million, run through annual call for proposals managed by the Executive Agency for Competitiveness and Innovation (EACI).

FP7 Funding

FP7 is the short name for the Seventh Framework Programme for Research and Technological Development. This is the EU's main instrument for funding research in Europe and it runs from 2007-2013. FP7 is also designed to respond to Europe's employment needs, competitiveness and quality of life.

Under the current EU Research & Development Framework Programme (FP7 2007- 2013), about EUR 2.3 billion is dedicated to energy-related research. Most of this budget is used to support research, technological development and demonstration projects through the annual Calls for Proposals.

European Energy Programme for Recovery

A €4bn programme was set up in 2009 to co-finance projects, designed to make energy supplies more reliable and help reduce greenhouse emissions, while simultaneously boosting Europe's economic recovery.

42. Articles 37 to 45 of Decision No 1639/2006/EC of the European Parliament and of the Council of 24 October 2006 establishing a Competitiveness and Innovation Framework Programme (2007 to 2013).
43. Communication from the Commission — EUROPE 2020 — A strategy for smart, sustainable and inclusive growth, COM(2010) 2020.
44. Communication from the Commission — Energy 2020 — A strategy for competitive, sustainable and secure energy, COM(2010) 639.
45. Communication from the Commission – Energy Roadmap 2050, SEC(2011)1565 Final
46. COM(2011) 109 Final
47. Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on Energy Efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC
48. irective 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.
49. Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings.
50. Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC and Commission Decision of 19 November 2008 establishing detailed guidelines for the implementation and application of Annex II to Directive 2004/8/EC of the European Parliament and of the Council.
51. Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC.
52. Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (recast).
53. Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products.
54. Regulation No 1222/2009 of the European Parliament and of the Council of 25 November 2009 on labelling of tyres with respect to fuel efficiency and other essential parameters, OJ L 342/46.
55. Council Decision 2006/1005/EC of 18 December 2006 concerning conclusion of the Agreement between the Government of the United States of America and the European Community on the coordination of energy-efficiency labelling programmes for office equipment, OJ L 381, 28.12.2006.
56. Communication from the Commission — Biomass Action Plan (SEC(2005) 1573).
57. Communication from the Commission — Renewable energy road map — Renewable energies in the 21st century: building a more sustainable future, COM (2006) 848.
58. Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.
59. Communication from the Commission — Offshore Wind Energy: Action needed to deliver on the energy policy objectives for 2020 and beyond, COM(2008) 768.
60. COM(2011) 144 Final.
61. Communication from the Commission — Action Plan on Urban Mobility, COM(2009) 490.
62. Directive 2009/33/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of clean and energy-efficient road transport vehicles.
63. Directive 2009/30/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC.
64. Communication from the Commission — Investing in the Development of Low Carbon Technologies (SET Plan), COM(2009)519.
65. COM (2011) 21 final
66. COM (2011) 571 final
67. Review of the EU Sustainable Development Strategy, COM (2009) 400 final
68. Regulation (EC) no 397/2009 of the European Parliament and the Council OJ L 126/3, 21 May2009.
69. COM (2012) 0271 final

The projects cover 3 broad fields: 44 gas and electricity infrastructure projects, 9 offshore wind projects and 6 carbon capture and storage projects.

SET-Plan

The European Strategic Energy Technology Plan establishes an energy technology policy for Europe. It's a strategic plan to accelerate the development and deployment of cost-effective low carbon technologies. The plan comprises measures relating to planning, implementation, resources and international cooperation in the field of energy technology.

Among other initiatives, the plan includes the Smart Cities Initiative that aims to improve energy efficiency and to step up the deployment of renewable energy in large cities going even further than the levels foreseen in the EU energy and climate change policy. This initiative will support cities and regions that take pioneering measures to progress towards a radical reduction of greenhouse gas emissions through the sustainable use and production of energy. It will bring the cities involved to the forefront of the development of the low-carbon economy.

NER300

"NER300" is a financing instrument managed jointly by the European Commission, European Investment Bank and Member States, so-called because Article 10(a) 8 of the revised Emissions Trading Directive 2009/29/EC contains the provision to set aside 300 million allowances (rights to emit one tons of carbon dioxide) in the New Entrants' Reserve of the European Emissions Trading Scheme for subsidizing installations of innovative renewable energy technology and carbon capture and storage (CCS). The allowances will be sold on the carbon market and the money raised - which could be 2.4 bn EUR if each allowance is sold for 8 EUR - will be made available to projects as they operate.

Energy Performance Contracting Campaign (EPCC)

In the new Multiannual Financial Framework for 2014 to 2020, the Commission has proposed to increase the funding available for energy efficiency measures and renewable energy. In addition, the recently agreed Energy Efficiency Directive obliges Member States to renovate public buildings, to introduce energy efficiency obligations and to establish financing facilities for energy efficiency measures. The binding measures contained within the Directive will require considerable investment by Member States at an early stage.

In response to this changing financial and regulatory landscape, DG Energy in cooperation with the European Investment Bank's Public Private Partnership Expertise Centre (EPEC), ManagEnergy Initiative and the Covenant of Mayors is launching an EU-Energy Performance Contracting Campaign to support Member States and market actors with rolling out of functioning energy services market.

The aim of the campaign is to enable country-specific discussion and capacity building of the core stakeholders, which should enable better understanding of a business model based on investments financed by savings, address issues such as accounting of public deficit and debt, increase the confidence of the core stakeholders towards reliability and effectiveness of the EPC model, and help Member States with establishing an enabling legal and financial framework for the market with energy services.

The campaign consists of targeted capacity buildings seminars which will be organized across the EU. Furthermore, training materials, guidance documents and best practice examples will be made available and shared. The campaign is progressively being rolled out at the national level (in co-operation with EPEC), regional level (through the ManagEnergy Initiative) and local level (via the Covenant of Mayors).

Horizon 2020

Horizon 2020, the European Union's new funding programme for research and innovation for the period 2014-2020 reflects the ambition to deliver ideas, growth and jobs for the future. It represents a clear break from the past as it brings together all existing Union research and innovation funding, including the Framework Programme for Research, the innovation related activities of the Competitiveness and Innovation Framework Programme and the European Institute of Innovation and Technology (EIT), into one single framework programme.

For the implementation of Horizon 2020, the European Commission is responsible for drawing up work programmes. In doing so, the Commission wishes to take account of advice and inputs provided by several advisory sources, including Advisory Groups of high level experts. The first Horizon 2020 calls are expected to be published by the end of 2013. The Commission services plan to set up a number of Advisory Groups covering the Societal Challenges and other specific objectives of Horizon 2020. Some of the areas proposed are 'Secure, clean and efficient energy' 'Smart, green and integrated transport' and 'Climate action, resource efficiency and raw materials'.

This new approach intends to clarify the complex scenario of funding currently in place where many different mechanisms coexist and could hamper their proper understanding and use.

As a synthesis, the European Energy Efficiency Fund (EEE F) was established as a Financial Engineering Instrument to provide tailored financing to sustainable energy projects, create confidence and valuation around energy efficiency investments and enhance the market by leveraging and attracting investors. In particular, the fund supports the development of energy performance contracting. IEE II provides useful capacity building and awareness for project developers that will then have access to EEE F financing. A good example is the ELENA facility (European Local Energy Assistance) that helps recipients to prepare and scale-up their projects to reach a critical size and access financing from the Fund or another source. ELENA is funded by the IEE programme and contributes to cover the technical assistance costs related to eligible investment projects or programmes.

The CIP is designed to complement the 7th Framework Programme for research and technological development activities (FP7), including technology platforms for such areas as biofuels, photovoltaics, wind energy, electricity grids, the forest sector, heating and cooling, transport and sustainable chemistry. Whereas the energy component of FP7 focuses on research, development and demonstration, for IEE II, the field of activity includes best available energy technologies and techniques, and non-technological action. Thus, IEE II contributes to bridging the gap between the successful demonstration of innovative low carbon technologies under FP7 and their effective, broad market uptake.

The European Institute of Innovation and Technology (EIT) aims at boosting Europe's innovation capacity via the integration of excellent research, business and education. EIT's main operational arms, the Knowledge and Innovation Communities (KICs), are actively working in the promotion of innovation in the field of sustainable energy. EIT KICs act as a catalyst, adding value to the existing research base by accelerating the take-up and the exploitation of technologies and research outcomes. They put a strong emphasis on talent and entrepreneurship skills, equipping students, researchers and entrepreneurs with the knowledge and attitudes to turn ideas into new business opportunities. Apart from KIC InnoEnergy which addresses renewable energy, energy efficiency, smart grids and electric storage, EIT ICT Labs work on the role of ICT in Smart Energy Management, and Climate-KIC takes as thematic priorities resilient low carbon cities and low carbon production systems. Under Cohesion Policy, at least EUR 9 billion of structural and cohesion policy funds has been earmarked for investments in energy efficiency (EE) and renewable energies (RES) in 2007-2013. Following the 2009 amendment of the European Regional Development Fund (ERDF) regulation, expenditure on energy efficiency improvements and on the use of renewable energy in existing housing in all MS is now eligible, up to a ceiling of 4% of the total national ERDF allocation. Expenditure could therefore be boosted, serving the purpose of contributing to the EPBD implementation and the national targets for renewable energy and energy savings. Synergies with actions financed under Cohesion Policy should be explored and promoted; proposers are encouraged to establish links with local managing authorities for the Cohesion Policy funds to find out more about complementary projects and schemes in their Member State/region.

For 'dissemination and promotion' projects, the IEE II Programme and FP7 again complement each other: New technologies are emerging on the market following developments in the field of research and innovation. The IEE II Programme will focus on promoting energy products and systems which are ready for rapid market growth and on tackling non-technological market barriers, whereas FP7 with the Strategic Energy Technology Plan (SET-Plan) will support research, development, demonstration and dissemination of new knowledge about innovative energy technologies and the results of technological research and demonstration projects. To maximise the impact of IEE II projects, proposers are encouraged to link their proposals with complementary FP7 initiatives where appropriate.

2. SECTORAL ANALYSIS AND POLICY OPTIONS.

This chapter begins with an analysis of the greenhouse gas emissions and energy consumption in the EU. Of course, the energy sector is the most relevant for the emissions. But, based on an European Environmental Agency report, an effort will be made to help improve the understanding of the past GHG emission trends in the energy sector from the demand or end-user side, redistributing emissions from energy industries to the final user (by sector). This will lead to the conclusion that the main sectors to focus on should be the building sector (commercial and residential), transport and industry. Policies applied in these sectors in the EU will then be described and some best practices in Member States discussed. Special attention should be paid at the two main differentiated areas of regulation as regards greenhouse gas emissions, the EU Emissions Trading Scheme and the Effort Sharing Decision, that covers the emissions from all the activities not included in the EU ETS.

As in almost any other topic, when designing policies to be implemented with a final and clear objective there are some conditions that must be met in the process:

- Motivate all the involved actors providing information of the problems derived from the current situation and the advantages of changing.
- Enable the actors, now aware of the problems and willing to solve them, to take action. This can be done by removing info lacks, making alternative solutions available, providing infrastructure, etc.
- Engage the actors and provide example as an administration (Green Public Procurement, building renovation, etc.)
- Encourage to change behavior using different alternatives (taxes, incentives, awards, fines, social pressure).

It is very important to stress that the success of the process strongly depends on the quality of the knowledge (historic and expected data and behaviors, potential to improve and existent barriers, instruments to overcome both economic and non economic barriers) and the commitment of the decision makers (the team selection must include socioeconomic experts, stakeholders, etc.).

A good policy design process should deliver the optimal mix of the different kind of strategies. These fall into three broad categories, implying different levels of involvement by public authorities: information, promotion and regulation.

Informational strategies, aimed to change behavior and make informed decisions, include:

- Awareness campaigns
- Information on prevention techniques
- Training programmes for competent authorities
- Ecolabelling.

Promotional strategies, incentivizing behavioral change and providing financial and logistical support for beneficial initiatives, include:

- Support for voluntary agreements
- Promotion of environmental management systems
- Clean consumption incentives
- Promotion of research and development.

Regulatory strategies, enforcing limits on energy transformation, transportation and use and greenhouse gas emissions, expanding environmental obligations and imposing environmental criteria on public contracts, include:

- Planning measures
- Taxes and incentives
- Extended Producer Responsibility policies
- Green Public Procurement policies
- Ecodesign requirements.

These strategies are complementary and can be integrated into other relevant existing policy areas better than just compose a stand-alone national programme. In addition, economic instruments - if well designed and accompanied by complementary measures – can contribute very effectively to the ultimate objective and should be taken into consideration.

People, and the need for behavior change, are the key to energy efficiency and greenhouse gas emissions reduction. However, an insight into consumer and business behavior will enhance the efficacy of selected measures. An integrated mix of measures is ultimately required to substantially address the problem and change the way resources are managed.

2.1. EU analysis of energy consumption and greenhouse gas emissions

According the EU GHG Inventory elaborated by the European Environmental Agency, the total GHG emissions in the EU-15 decreased by 10.6 per cent between 1990 and 2010, whereas total GHG emissions including net emissions or removals from land use, land-use change and forestry (LULUCF) decreased by 11.3 per cent. This decrease in total GHG emissions was mainly attributed to CO2 emissions (constituting 82.9 per cent of total GHG emissions in 2010), which decreased by 6.4 per cent over this period. Over the same period, emissions of methane (CH4) decreased by 30.6 per cent, while emissions of nitrous oxide (N2O) decreased by 32.9 per cent.

The share of emissions of perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF6) (fluorinated gases (F-gases)) in total GHG emissions in the EU-15 increased from 1.3 per cent in 1990 to 2.2 per cent in 2010. It is noteworthy that HFCs were the only group of F-gases for which emissions increased between 1990 and 2010 (an increase of 162.3 per cent). This increase was driven by the phasing out of ozonedepleting substances such as chlorofluorocarbons and hydrochlorofluorocarbons under the Montreal Protocol and their replacement to a large extent with HFCs, mainly in refrigeration, air conditioning and foam production and as aerosol propellants. France, Italy, Germany and Spain reported the highest increases in absolute terms. Emissions of PFCs and SF6 decreased by 81.4 per cent and 43.5 per cent, respectively, over 1990–2010.

The other increasing trend is observed in GHG emissions from transport, which increased by 15.6 per cent during the same period mainly due to increased demand in road transportation.

The increase in GHG emissions due to growing population and transport was more than offset by the decrease in GHG emissions due to the decline in energy intensity, the restructuring of economic activity and related primary energy use, the change in trade patterns and the implementation of relevant Policies and Measures (PaMs).

Trends of total GHG emissions in the EU-15 were mostly underpinned by GHG emission trends in the energy sector, followed by the trends in the agriculture, industrial processes and waste sectors. In the energy sector, GHG emission trends were mainly driven by the dynamics of activities in road transportation, public electricity and heat production, manufacture of solid fuels, and households and services. In the agriculture sector, the GHG emission trends were mainly influenced by emissions from agricultural soils and enteric fermentation, driven mainly by a decline in the use of fertilizers and manure as well as in the number of livestock. In the industrial processes sector, GHG emission trends were driven by the production and consumption of halocarbons, production of nitric and adipic acids, and production of iron and steel. In the waste sector, GHG emission trends were driven by the quantities and management of solid waste disposal on land.

Between 1990 and 2010, GHG emissions from the energy sector decreased by 12.6 per cent in the EU-27 and by 7.2 per cent in the EU-15. The main drivers of emission reductions were the decline in emissions from manufacturing industries and construction (which declined by 29.3 per cent in the EU-15 and by 36.9 per cent in the EU-27) and more recently the decline in emissions from electricity generation. These reductions were somewhat offset by notable increases in emissions from transport. The framework for addressing emissions from the energy sector is the EU Energy and Climate Package with its targets for energy production and consumption, which is implemented through a mix of PaMs at the EU and Member State levels.

The GHG emissions from energy have decreased despite growing demand for electricity in the EU, driven in the early 1990s by the closure of inefficient coal-fired power plants and more recently by a fuel shift from coal and oil to natural gas and biomass. CO2 emissions from manufacturing industries and construction also declined since 1990, driven primarily by a decline in activity and by energy efficiency improvements.

Emissions from transport represent a growing share of total EU emissions (reaching 21.2 per cent in 2010) and addressing these emissions will be an important focus of future efforts. Between 1990 and 2010, transport emissions, excluding international bunkers, increased by 19.9 per cent (15.6 per cent for the EU-15) demonstrating a somewhat lower growth rate since 2000 compared with the previous decade. The increase in emissions from transport was driven primarily by increased economic growth and corresponding transport demand. The share of road transport grew over other modes, despite improvements in fuel efficiency of passenger and freight vehicles. Policies in place to reverse these trends include the introduction of requirements for light-duty vehicle CO2 reductions and complementary measures, as well as the EURO V and EURO VI standards.

Between 1990 and 2010, GHG emissions from non-energy sectors decreased by 22.2 per cent, nearly double the rate of reduction from the energy sector. Emission reductions over this period ranged from 13.8 per cent from agriculture to 36.7 per cent reductions from waste.

Between 1990 and 2010, GHG emissions from the industrial processes sector decreased in the EU-27 by 26.3 per cent and in the EU-15 by 25.1 per cent. In the 1990s, reductions were mainly driven by low economic activity and cement production in the member States, as well as GHG abatement measures in adipic acid production. In 2000–2010, emission reductions were driven by reduced production as well as PaMs implemented in cement, and iron and steel plants. However, these reductions have been somewhat offset by the 47.3 per cent increase in F-gases in the EU-15, driven by a tripling in HFC emissions, which reached a historical high in 2010 due to the rapid implementation in the EU of the phase out of ozone-depleting substances ahead of the schedule under the Montreal Protocol and increased use of appliances such as air-conditioning equipment.

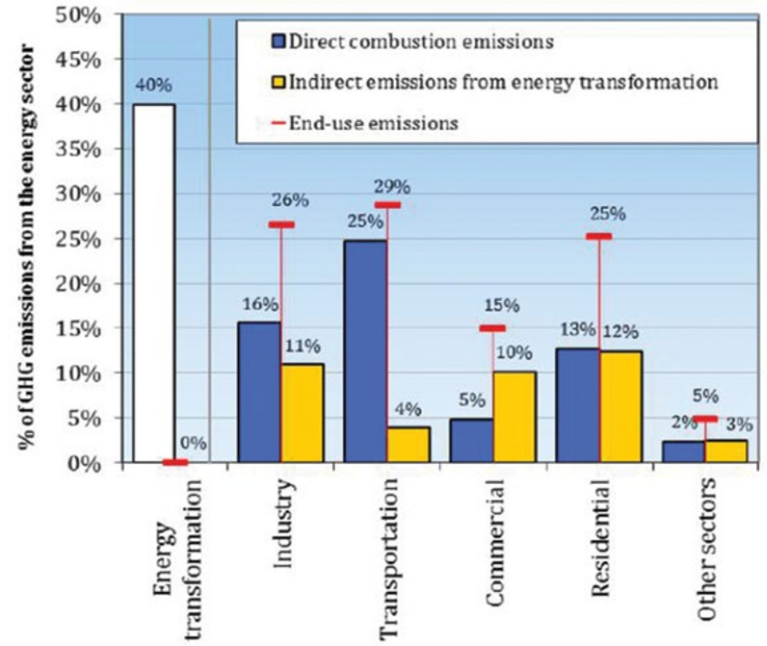
In 2010, agriculture accounted for 9.8 per cent of total GHG emissions in both the EU-27 and the EU-15. GHG emissions from agriculture decreased by 13.8 per cent in the EU-15 and by 22.3 per cent in the EU-27 during 1990–2010. These decreasing trends are driven mainly by the decline in the use of fertilizers and manure, and in numbers of livestock. In 2010, in the EU-15, CH4 accounted for 44.3 per cent of agricultural emissions while N2O accounted for 55.7 per cent. The land area under agricultural use across the EU-27 States has decreased by approximately 10 per cent from 1990 to 2005; however, it increased after 2007 due to the return into production of the land set aside under the Common Agricultural Policy (CAP).

The Land Use, Land Use Change and Forestry (LULUCF) sector was a net sink of 312 Tg CO2 eq in the EU-27 and of 178 Tg CO2 eq in the EU-15 in 2010. In 1990–2010, the net GHG removals increased by 8.9 per cent and 6.9 per cent for the EU-27 and the EU-15, respectively. The increasing trend was mainly driven by the member States' forest policies and the EU agricultural and environmental policies, which have resulted in less intensive agricultural practices and in an increase in forest and woodland conservation areas.

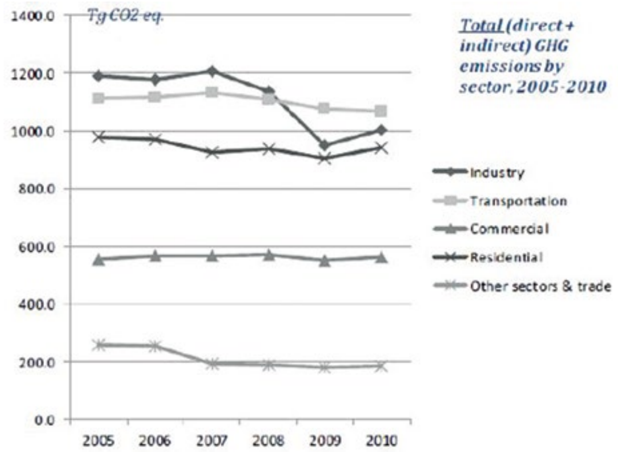
Between 1990 and 2010, GHG emissions from the waste sector decreased by 30.4 per cent in the EU-27 and by 36.7 per cent in the EU-15, mainly driven by the reduction in solid waste disposal and of biodegradable waste going to landfills, and the increase in landfill gas recovery due to the implementation of the EU landfill directive. While landfill waste management was the main driver of reductions, emissions from landfills continue to represent a large share of overall emissions from the sector (76.3 per cent in 2010) and will be a priority for future reductions. Recent assessments indicate that while municipal waste volumes have remained relatively stable over the past decade, despite population and economic growth, there has been more success in waste prevention and shifts away from landfilling of waste. The 2020 Roadmap on Resource Efficiency includes an aspirational objective of the virtual elimination of landfilling across member States by 2050.

2.2. An energy end-user analysis

According to the technical report 18/2012 by the European Environment Agency (EEA), households and industry in the EU each cause approximately a quarter of energy-related greenhouse gas emissions. The two sectors were largely responsible for the emissions increase in 2010. The report considers the 40 % of greenhouse emissions originating from energy industries such as heating plants, power stations and refineries. These emissions are then reallocated to the 'end-users' of the energy with the main objective of helping improve the understanding of the demand leading to greenhouse gas emissions.



End-use greenhouse gas emissions from energy use in EU27 in 2010



Trends in greenhouse gas emissions by end-use sector in EU-27, 2005-2010

Some interesting findings are the following:

- In the commercial and residential sectors, indirect emissions are higher than the direct combustion emissions attributed to these sectors. This is largely because of electricity supplied by thermal power stations and district heating (from centralized heating plants) in some areas.

- In transport, most emissions are emitted directly from the vehicle exhaust pipe, so there is a relatively small change when the indirect emissions are taken into account. Beside the emissions from petroleum refining, other indirect emissions in the transport sector come from power plants which generate electricity used by electric trains.

- 'Other sectors' include the indirect emissions from imports and exports of energy between countries, for example in the electricity trade. In some EU Member States there is a larger effect than in others, highlighting the relative importance of trade in energy for these countries. These effects can also vary significantly from year to year.

According to the importance of this information, it is justified to focus on the following sections in the policies implemented in the building, transport and industry sectors, followed by a section on cross-cutting issues and public awareness.

2.3. Building sector

This section is focused on policies targeting energy use in the building sector. There are a vast number of measures and options to reduce both the energy use and the environmental impacts from buildings. The measures fall into different categories, including financial measures, regulation, standardization, information, capacity building and new-market based instruments. Most of these options are cost effective – however, a large share of the improvement potential remains untapped. In the absence of further policy intervention it is unlikely that the full abatement potential will be realized. This is because certain barriers and market failures are in place.

The Directive on Energy Performance in Buildings (EPBD) is the main legislative instrument affecting energy use and efficiency in the building sector in the EU. The Directive tackles both new build and the existing housing stock. Originally approved in 2002, this Directive was being replaced by a recast Directive that was approved 19 May 2010. Small buildings were included in the scope of the directive and the potential of 'low or zero energy' was addressed. The EPBD recast focuses mainly on energy efficiency measures when new buildings are constructed or when existing buildings undergo major renovations.

2.3.1. Characteristics of the building sector

The building sector includes both the non-residential (services) and residential sectors. The European building sector accounts for 40 % of the total energy use and for 36 % of Europe's CO2 emissions. Together with an economic power of 9 % share of the total EU 27 GDP and 8 % of the total employment in Europe, the building sector represents a very important field of interest. Therefore it plays a major role in the European 20-20-20 energy policy.

In the EU legal framework, the Effort Sharing Decision only includes direct emissions e.g. natural gas combustion in heating systems. 'Indirect' emissions associated with electricity used within buildings, but emitted within the electricity generation sector, are assumed to be captured within the EU Emissions Trading System.

In the EU-27, the recent historical trend in buildings sector emissions has been a gradual decline that is partly masked by large annual fluctuations. From 1990 to 2008, emissions fell about 13 % from 720 to 635 Mt CO2 eq. The decline can be largely explained by rehabilitation activities on existing buildings (and partly demolition) which more than compensates for the additional emissions from new (and more efficient) buildings. The fluctuations from year to year can be explained by annual ambient temperature fluctuations that lead to variations in heating demand. In some Member States there was expansion of district heating (e.g. Sweden), therefore heating related emissions are reported in other sectors; also installation of heat pumps can have an effect.

Abatement potential

Developments in the building sector are, in general, quite slow. This is caused by long renovation cycles of approximately 30-40 years. This means that a building that has been newly built or has been recently renovated will not undergo major changes or improvements during this timeframe. As a result, this can lead to significant lock-in effects, if energy efficiency measures are not applied at all or are realized at too low an ambition level.

A key action to unlock the remaining cost effective abatement potentials of the building stock is deep renovation (i.e., a high retrofit rate combined with high ambition level of the measures applied). Rebound effects can reduce the abatement potential and therefore the abatement potential can in fact be lower.

Measures:

Improving building shell: wall insulation, roof insulation, ground floor, windows. Improved regulation & heat distribution: Condensing boilers, Efficient tap water, Passive Houses/zero energy houses, Biomass (Pellets etc.), Heat pumps, Solar water heater, Micro CHP, Ventilation system with heat recovery

The need for policy intervention

In the absence of further policy intervention it is unlikely that the full abatement potential will be realized. This is because certain barriers and market failures are in place. The following table represents a classification of the barriers that may obstruct the energy efficiency options throughout the building construction and operation, as well as the purchase and use of appliances, suggested by the Intergovernmental Panel on Climate Change in the 4th Assessment Report published in 2007.

Barrier categories	Definition	Examples
Financial costs/benefits	Ratio of investment cost to value of energy savings	Energy subsidies Higher up-front costs Lack of access to financing Lack of internalization of environmental, health and other external costs
Hidden costs/benefits	Cost or risks (real or perceived) that are not captured directly in financial flows	Costs and risks due to potential incompatibilities Performance risks Transaction costs Costs and risks due to potential incompatibilities Performance risks Transaction costs
Market failures	Market structures and constraints that prevent the consistent trade-off between specific energy-efficient investment and the energy saving benefits	Limitations of the typical building design process Landlord/tenant split and misplaced incentives Administrative and regulatory barriers (e.g. in the incorporation of distributed generation technologies)
Behavioral barriers	Lack of information provided on energy saving potentials	Tendency to ignore small opportunities for energy conservation Organizational failures (e.g. internal split incentives) Tradition, behavior, lack of awareness and lifestyle Corruption
Information barriers	Lack of information provided on energy saving potentials	Lacking awareness of consumers, building managers, construction companies, politicians
Political and structural barriers	Structural characteristics of political, economic, energy system which make efficiency investment difficult	Slow process of drafting local legislation Gaps between regions at different economic level Lack of detailed guidelines, tools and experts Lack of governance leadership/ interest Lack of equipment testing/ certification Inadequate energy service levels

The barriers presented can, on one hand, obstruct the implementation of energy efficiency measures in the building sector and, on the other hand, lead to investments in less cost-effective measures. Some of the barriers described above can be eliminated or reduced by intervention from the government. Therefore, various policy instruments which encourage energy efficiency in the building sector may be introduced. Such instruments may target households in fuel poverty, multi-residential buildings, renewable energies, etc.

2.3.2. Policy options

There are a vast number of measures and options to reduce both the energy use and the environmental impacts from buildings. Consequently a large number of different policy measures have historically been or are currently in place throughout the EU to promote greater energy efficiency in all segments of the building sector.

The MURE II database (see chapter 3) provides information on policies and measures taken or planned within EU Member States to improve energy efficiency and use of global renewable energy. Most policies and measures are of economic, regulatory and informative type. The financial measures can be differentiated by soft loans and by grants/subsidies. Only 13 % of the financing policies address soft loans, the remaining 87 % address grants and subsidies. Most of the regulatory instruments are related to the Energy Performance of Buildings Directive (EPBD - Directive 2010/31/EU) and its recast, other policies and measures can be considered as national policies that are not directly related to EU policies, most of these policies and measures focus on education and outreach and incentives and subsidies.

EU Policy Landscape

The main building block of the EU regulatory framework is the recast of Energy Performance of Buildings Directive (EPBD). It is the main legislative instrument affecting energy use and efficiency in the building sector in the EU. The Directive tackles both new build and the existing housing stock. Originally approved in 2002, this Directive was being replaced by a recast Directive that was approved 19 May 2010. Small buildings were included in the scope of the directive and the potential of 'low or zero energy' was addressed.

Overhauls have also been prepared for the eco-design and energy labeling directives within the framework of the EU policies on sustainable consumption and production (SCP). Together these measures may achieve an important part of the potentially available cost-effective energy-savings in buildings.

The EPBD recast focuses mainly on energy efficiency measures when new buildings are constructed or when existing buildings undergo major renovations. Consequently, this allows energy efficiency investments to be made at least cost, because they form part of the natural construction and renovation cycles. However major renovations of buildings are not made very often (about every 40 years on average) and there might be energy efficiency measures that are cost-effective also outside the major renovation cycles. In particular, the retrofitting of windows and roof insulation to reduce energy losses may allow energy cost savings that outweigh the investment costs, without the need to carry out these measures at the same time as a general major renovation of the building.

Currently, there is no European legislation that would address the retrofitting of building elements such as windows and roofs. Potentially, this was shown to be the most important area for additional policies in the EU to improve the environmental performance of buildings.

National Policies

A large number of different policy measures have historically been or are currently in place throughout the EU to promote greater energy efficiency in all segments of the building sector. These are often country or area specific and take into account local needs or circumstances. The following sections serve to introduce the measures which fall into different categories, including financial measures, regulation, standardization, information, capacity building and new-market based instruments.

Financial measures

Zero or low interest loans

These are loans with preferential zero or low interest rates, which are offered for specific energy efficiency investments. They are often offered by way of public–private partnerships, although they may also be provided directly by public bodies. Preferential loans are an important measure to support energy efficiency in buildings in Germany. According to EuroACE (European Alliance of Companies for Energy Efficiency in Buildings) in 2010 preferential loan support can be found in Austria, Czech Republic, Estonia, France, Hungary, Italy, Slovenia, Spain, UK (according to EuroACE in 2004 also: Finland, Lithuania, the Netherlands and the Slovak Republic).

Grants and subsidies

Grants usually finance part of the investment for a given energy efficiency project. Normally they support projects aimed at improvements to the building envelope, such as insulation, draught-proofing, windows and doors. Assistance is provided for efficient appliances and heating systems, as for instance, biomass, heat pumps, thermal regulation and combined heat and power (CHP), as well. Examples of programs offering support through grants are: the Green Investment Scheme in the Czech Republic, the Grants for Renovation and Prefabricated-Panel Residences in Hungary and Programs for the Thermal Rehabilitation of Multi-level Residential Buildings in Romania. The key advantage of grants and subsidies is that they immediately fill a financial gap.

Subsidies are similar to grants and involve the subsidization of part or all of the financial cost of energy efficiency improvements of buildings. Examples schemes include in the UK the Carbon Emissions Reduction Target, in Slovenia – Financial Stimulation for Energy Efficiency Renovation and Sustainable Buildings of New Buildings, in Poland – Infrastructure and Environmental Operation Program, etc.

Fiscal measures

Fiscal measures include, for example, reductions in VAT (Value Added Tax)[41] rates for energy-efficient installations. However, fiscal measures often lack clarity and are not well known by the public. Another disadvantage is that they are often tied to large administrative bodies and tend to be inflexible. According to OECD/IEA (2008) these measures did not appear to have had particularly large impacts in the cases where they were studied. That was the case in France, but also in the United States (US), where incentives were offered to create demand for energy-efficient goods, such as tax credits (a sum deducted from the total amount a taxpayer owes to the state) for the purchase of designated energy-efficient appliances. The lack of clarity and public awareness, together with the inflexibility of the administrative body are the main problems. The US government launched its tax incentives awareness programme based on this recognition .

Regulatory framework and standardization

Regulatory instruments cover a wide range of instruments by which a government will oblige actors to undertake specific measures and/or report on specific information. Examples include energy performance standards for appliances, equipment, and buildings, standardized methodologies for calculation, measurement and verification of the energy performance of buildings, energy certification of buildings, including the obligation to display the certification, eco-design requirements for building components, obligations on companies to reduce energy consumption, produce or purchase a certain amount of renewable energy, mandatory energy audits of industrial facilities and requirements to report on greenhouse gas emissions or energy use.

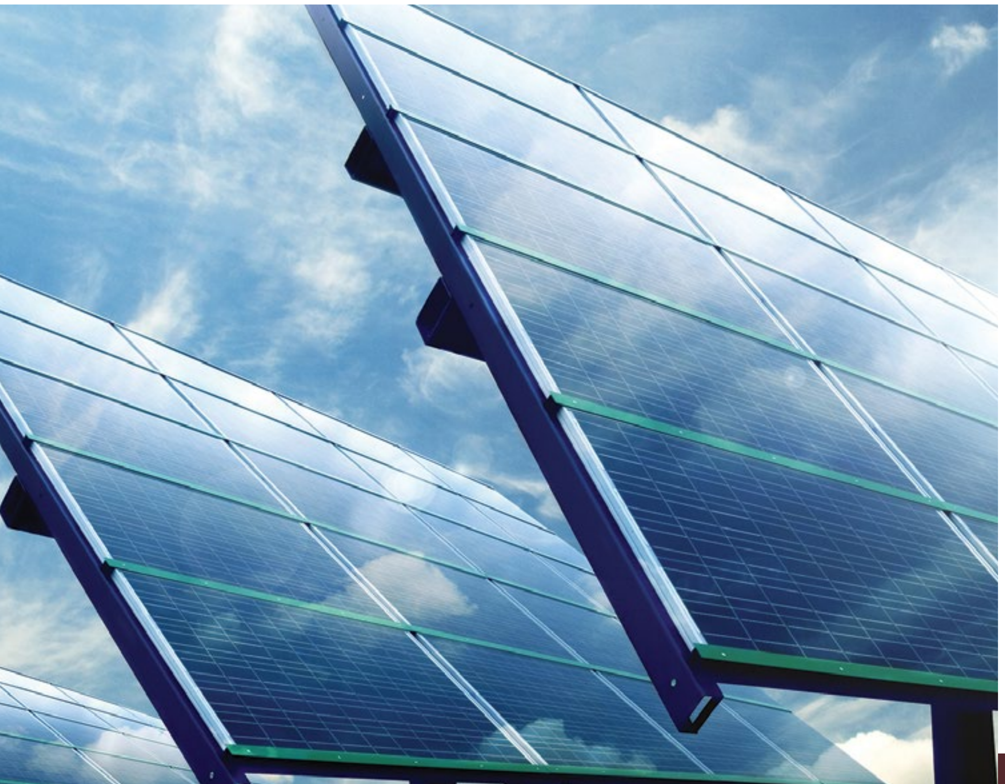
For the residential building sector, energy efficiency standards are a regularly used instrument. They prescribe minimum technical requirements for energy conversion systems and energy end-use systems. Two main approaches are prescriptive standards, which impose requirements on specific components of equipment, and performance standards, which impose requirements on the overall level of (specific) energy use. Most industrialized countries have standards for the energy efficiency of new buildings, both prescriptive (e.g., insulation values of walls and roofs) and performance standards. Energy efficiency standards can be very effective in reducing or limiting energy use, but they are rigid and prescriptive standards in particular do not allow much flexibility. Furthermore, legislative processes can take time, and an adequate system of monitoring is necessary to enforce compliance.

41. The Value Added Tax, or VAT, in the European Union is a general, broadly based consumption tax assessed on the value added to goods and services. It applies more or less to all goods and services that are bought and sold for use or consumption in the Community. Thus, goods which are sold for export or services which are sold to customers abroad are normally not subject to VAT. Conversely imports are taxed to keep the system fair for EU producers so that they can compete on equal terms on the European market with suppliers situated outside the Union.
Value added tax is:
• a general tax that applies, in principle, to all commercial activities involving the production and distribution of goods and the provision of services.
• a consumption tax because it is borne ultimately by the final consumer. It is not a charge on businesses.
• charged as a percentage of price, which means that the actual tax burden is visible at each stage in the production and distribution chain.
• collected fractionally, via a system of partial payments whereby taxable persons (i.e., VAT-registered businesses) deduct from the VAT they have collected the amount of tax they have paid to other taxable persons on purchases for their business activities. This mechanism ensures that the tax is neutral regardless of how many transactions are involved.
• paid to the revenue authorities by the seller of the goods, who is the "taxable person", but it is actually paid by the buyer to the seller as part of the price. It is thus an indirect tax.

Information, capacity building and market transformation

Information measures help to overcome the lack of suitable information that is seen as the main barrier to energy efficiency measures. All different players need reliable and understandable information: house owners, the construction industry and service providers, financiers and regulatory authorities. Information that needs to be exchanged includes e.g. technological options, saving potentials, support schemes, regulations. Supporting the establishment of energy service companies (so called ESCOs) is a specific measure that is regarded useful for helping overcome the barriers of bounded rationality and lack of information. Energy services provide this to energy end users, and may include the supply and installation of energy-efficient equipment, the supply of energy, as well as building refurbishment, maintenance and operation.

Environmental technology verification (ETV) programmes aim at increasing the acceptance of new technologies, by providing the customer with credible and understandable performance information. These programs help tackle market barriers related to uncertainty regarding the performance of energy efficiency technologies, bounded rationality and inadequate information.



Voluntary agreements

Voluntary agreements refer to measures that are undertaken voluntarily by government agencies or industry bodies, based on a formalized agreement. Agreements can refer to the actors' own energy use, or the energy use of the equipment they produce. There are incentives and benefits to undertaking the action, but generally few legal penalties in case of non-compliance. The scope of the action tends to be agreed upon in consultation with the relevant actors. These are often agreed to between a government and an industry body, with the latter agreeing to certain measures such as reporting information on energy use to the government, being subject to audits, and undertaking measures to reduce energy use.

The European Union has made voluntary agreements with car manufacturers and with selected household appliance manufacturers. This type of measure is less relevant to incentivize renovations of residential buildings.

Market based instruments

The economic rationale for using market-based instruments lies in their ability to correct market-failures in a cost-effective way. Tradable energy efficiency – or "white" – certificates are, as of a few years ago, only considered as a market-based tool to foster energy efficiency as opposed to standards and labelling, for example. White certificate schemes create certificates for a certain quantity of energy saved, for example one MWh. Regulated entities must submit enough certificates to show they have met energy saving obligations. If the parties obliged to submit certificates are short, this must be made-up through measures that reduce energy use, or through purchase of certificates.

2.3.3. Best practice examples

The best practice examples in the building sector are focused on the following policy options: White certificate (WC) schemes, capacity building measures and financial measures.

The White Certificate Scheme is an obligation to an energy producer/supplier to deliver energy savings (on the demand side) and thus contribute to the total CO_2 emissions reduction of the country. This system diminishes some barriers, as for example high up-front costs, lack of financing, landlord/tenant split, lack of information and awareness of the end-users, etc.

The White Certificates scheme is a fairly new instrument and numerous issues arise with its implementation in new Member States. One concern is the additionality of the system to other political instruments provided to support energy efficiency activities. For example, under the WC scheme savings are achieved in the energy sector as a whole (including electricity) and due to the potential CO_2 savings there is possible interaction with the European Trading Scheme (ETS). Further, there is a concern about the additonality of the system with some financial tools, such as e.g. income tax rebates and VAT reduction in France and the Warm Front Scheme in the UK. Another concern is the "cherry picking" that in this context means that part of the target group would have implemented the energy efficiency measures also without the policy measure. This is often difficult to control and may be considered a disadvantage.

After implementing energy efficiency measures there arises another concern, regarding the quality of the Monitoring Reporting and Verification (MRV), which may be of low quality and not be able to control the compliance of the energy efficiency measure.

The second best practice example describes the structure of the capacity building programs in different EU countries. This topic was investigated as it covers other barriers related to energy efficiency compared to the WC scheme. In this case, barriers which are being eliminated are, for example, information obstacles and some political and structural barriers, such as lack of detailed guidelines, tools and experts and lack of equipment testing. Moreover, capacity building programs serve as a trigger to raise awareness regarding the overall energy efficiency in buildings.

Financial instruments are one of the most widely applied instruments in the EU to overcome barriers related to energy efficiency in the building sector. For this reason, the third best practice example is focused on the KfW Programs implemented in Germany. The success of the programmes is due to various factors; however it is not possible to conclude that these programmes could be implemented in other countries with the same conditions. This has various reasons: The KfW lends money with low interest rates, which in some countries with generally higher interest rates would not be possible for these conditions because the cost for the country would be too high. Also the communication policy of the KfW programmes is strong. With brands, as for example the KfW 40 or KfW 60 house, the bank created broad awareness in Germany. On the other hand the KfW involves local banks in order to canalize the credits to the consumers. This requires strong communication and information policy, which is possible only with sufficient financial means. The budget has to be there, if this is not the case such programmes could not be successful.The investigation of the KfW programmes illustrates the direct results of a well-functioning program on end energy use and CO_2 emissions reduction, but it also presents the co-benefits which arise with the implementation of such an instrument. The chosen study shows how financial tools can overcome barriers mainly related to financial costs/benefits, such as high up-front costs and lack of financing.

In all investigated cases it was observed that there are certain obstacles which are encountered and cannot be eliminated. Such barriers are, for example, administrative barriers and non-compliance, and these may create a bottleneck for the implementation of energy efficiency projects.

White Certificates Scheme

Objectives of the measure

The White Certificate (WC) system is an instrument which obliges an actor (e.g. an energy supplier or a grid company) to deliver a certain amount of energy efficiency savings which are defined either in absolute terms, as a percentage of yearly sales or as customer number in the case of the residential sector. Additionally, in some countries there is an alternative to certify the savings and trade these in the form of certificates – the so-called White Certificates. This new marketbased instrument alongside other policy tools, such as building codes, tax exemption, etc. aims to deliver energy efficiency improvements in a cost-effective way as it provides freedom to energy market operators to design their own measures and achieve the obligation target in the most efficient manner.

The energy saving projects implemented by the obliged actors can be realized in the industrial, building or transportation sector depending on the regulations stated by the regulator/Government. The investment for the achievement of the energy savings is recouped in the energy bills of the end customers. Due to the incurred energy efficiency activities the energy demand and, respectively the energy bill, of the end user are reduced. With the recoupment of the cost of the energy efficiency activities this reduction is balanced out and the energy bill of the end-consumer remains more or less constant before and after the performance of the energy saving measures.

In the EU legal framework, the effort sharing decision only includes direct emissions, whereas the indirect emissions are captured as part of the EU emission trading system (ETS). It is important to note that WC schemes can potentially target various sectors, including transport, industry, etc. and target both direct energy use and electricity savings.

Efficiency measures that only address savings under the Effort Sharing Decision (ESD) scope include e.g. exchange of heating systems, insulation of envelope and exchange of windows. These measures address fuel savings that are clearly counted under the ESD scope. However this may raise issues regarding the shifting of emissions from one sector to another. From the perspective of the ESD target it would be optimal to replace all heating systems with heat pumps e.g., since all the emissions caused by heat pumps are counted in the power sector (electricity).

Emissions savings that are clearly not counted under the ESD scope are all the emissions that are due to electricity savings, such as e.g. the replacement of inefficient with efficient light bulbs result in emission saving under the ETS and have therefore no effect on the ESD target.

Application of the measure in EU Member States

White certificate schemes have been implemented in several member states including the UK, Italy, France, Denmark and Belgium (Flanders). However, the schemes can be quite complex, and different approaches to implement the schemes have been employed.

Obligations, obliged actors, compliance periods

Obligations can be expressed in primary energy (Italy and Belgium), final energy (Denmark and France) or CO2 emissions reduction (UK- CERT). The compliance periods can be set to every few years, as in the case of France and UK, which have to show their accomplishments at the end of each period. Another possibility is the annual compliance period which is adopted by Denmark, Italy and Flanders. In the case of the multi-annual, which last on average 3 years, compliance targets are set every year in order to ensure stability of the policy and to allow energy suppliers to plan.

The French approach regarding the exclusion of parties whose main business is energy efficiency services is, mainly to exclude savings that would have taken place without the presence of the WC scheme. Also they aim at boosting market development – it pushes energy suppliers to motivate the end energy users to carry out energy efficiency improvements.

Eligible projects, energy types and sectors

In order to achieve their targets, the obliged actors can chose to implement energy efficiency projects or to purchase certificates from third parties. Small energy actors may be excluded from obligations as this might become a burden for them or restrict them from entering the market. Obligations can be imposed on electricity suppliers as is the case in Flanders, both electricity and gas suppliers as in the UK and Italy or as adopted by France, and in Denmark also other energy providers (heating, cooling, LPG).

In the UK there are no restrictions concerning cooperation and type of measures undertaken by the obliged actors. Moreover, there is free competition among the obliged parties, it is possible to transfer the costs on to the end-users and the consumers have the freedom to change the energy supplier on short notice. All these factors lead to innovative and cost-effective solutions to energy efficiency. Such a market can be considered to be at least as effective or even better compared to an open WC market.

The obligations division into fuel type and the obliged actors differs between the MSs as well. Whereas, some countries have appointed obligations on suppliers (retail companies), others have chosen to usher obligations on the distributors (grid owners).

A scheme can have a wide scope regarding end-use sectors (e.g. residential, tertiary and industry) which are covered to achieve the target, project types and/or technologies accepted. The scheme can be either completely open in terms of technologies and sectors or can be restricted. An open policy does not limit the obligation actor and he has the possibility to choose his own path to achieve the obligation goals.

Limitations of the scheme might lead to higher compliance costs and may lead to utilization of a standard package of measures, thus not diversifying the market. A disadvantage of a fully open scheme is that including all project types and sectors might lead to higher costs for the system administrators who employ in monitoring, verification and validation of the energy efficiency measures.

The UK is the only country where there is uplift provided to obliged parties for the development of new standard measures. In the French WC system there is no bonus for innovation measures, but a doubling of the value of the certificates takes place in cases when activities are undertaken in the regions not connected to the continental mainland electricity grid.

In Denmark half of the savings were conducted in the industry and trade where 2/3 of the electricity savings came from these sectors. 1/3 of the electricity and gas distributors' savings were accounted in other energy types and oil distributors reported only oil savings.

France has included training campaigns, use of renewable energies and energy efficiency in buildings in the list of standardized measures which creates diversity in the further development of the system.

Trading

In most MS which have implemented the WC scheme it is possible to trade certificates, eligible measures without formal certification or trade obligations. One exception is Flanders where no trading takes place but in case of over-achievement of the target the excess energy savings can be carried forward to the next compliance period. In France there is no official trading system and there are no plans to implement such, but over-the-counter trade between obliged parties, as well as between obliged parties and project implementers, is possible. In Italy there is an open market which has created business for the energy service companies – they can create and sell certificates on the open market or directly to an obliged party. In France and UK no white certificate stock exchange exists. In Denmark energy efficiency savings can be traded.

Evaluation of the White Certificate Scheme

One of the most important factors to influence the development of given energy saving activities is the life time savings and the rewarding of the measures. Longer calculation periods, as in the UK and France, can make a certain measure more economically attractive because it increases the cost effectiveness of the activity. Such an approach can be used as a regulatory tool to boost the development of particular energy efficiency measures which are considered more important than others. In Italy, on the other hand, there is a maximum 8 years calculation period which makes projects, such as building envelope improvements, an unattractive investment. For example, the largest obliged actor on the Italian market, ENEL (Ente Nazionale per l'Energia eLettrica), has generated a big share of its certificates by distributing CFLs (Compact Fluorescent Lights) for free. A similar approach can be observed in Denmark where there is no differentiation between technical and behavioral measures and a standard life time of 5 years is applied.

Moreover, the rewarding of a certain activity in Italy happens at the same pace as the savings are realized. Thus, a measure can yield certificates for up to 8 years. This and the fact that there are no long-term obligations create uncertainties among the obliged actors. In UK, France and Denmark all savings are rewarded in the first year with the implementation of the energy saving measure.

In several countries measures have been taken to overcome the issue of policy additionality, such as UK and France. In countries with high levels of decentralization of the energy efficiency policies, it is complicated to follow the policy additionality since the energy efficiency obligations are managed by the central administration, while energy efficiency schemes exist on local level, as well, which is the case in Italy. The WC system can be used in combination with other political tools for energy efficiency support, such as e.g. the personal income tax deductions in France and the Warm Front Scheme in the UK. The Warm Front Scheme is a financial tool which targets the reduction of fuel poverty and provides grants for insulation and heating improvements of low-income households. The combination with other policy tools brings the risk of overlapping and therefore non-additionality.

The issue of interactions between the WC schemes and ETS is a major policy concern since the interactions between the two market-based environmental systems are still not clearly defined. It has been proposed to allow trading between the ETS and the WC schemes in Member States. One possible side effect is the double crediting of CO2 savings which will be in place when "two separate carbon allowances are generated from a one-tonne decrease in physical emissions". Thus, the carbon allowances produced in the WC scheme due to over-compliance could be sold in the ETS. It is expected that the WC scheme will not lead to lower CO2 emissions in the EU as a whole except in the case that the reduction in emissions happens in sectors not covered by the ETS, as for example household fuel consumption. This however, refers explicitly to direct fuel use. Thus, reductions in the household electricity consumption through the WC system will not lead to a decrease in the overall CO2 emissions.

Co-benefits of the WC scheme are:

- Enhancement of competitiveness and employment
- Reduction of fuel poverty
- Promotion of technological market transformation
- Abatement of atmospheric pollution
- Improvement of housing stock and comfort level
- Increase in the security of supply

There are a few comprehensive ex-post evaluations of the WC scheme and these do not distinguish between energy and electricity savings. Moreover; the additionality of the system with other political instruments is hard to assess and thus it cannot be estimated if the energy efficiency savings triggered by the WC scheme are additional or if these would have been carried out in the absence of the WC scheme as well.

Lessons learnt

The White Certificate scheme aims to promote energy efficiency in the most cost-effective way. It is observed that most of the achieved savings are in the residential sector. In the case of the UK only savings in the residential sector are eligible in the WC scheme. In France most of the certificates are related to the building envelope, whereas in Italy these are induced mostly by improvement measures for lighting in buildings. As mentioned above France is so far the only country which has included the transport sector in the scheme. In Denmark half of the savings were reported in the retail and industry sector.

- Monitoring and evaluation of the scheme is still underdeveloped. For example, the savings are not disaggregated by fuel and electricity savings and can therefore not clearly be allocated.

- The scheme is observed to function well in both monopolistic and fully liberalized market conditions.

- The success of the scheme is highly dependent on the level of ambition and since the targeted savings have been achieved by all MS so far, more ambitious goals can be set.

- The "rules" of the scheme must be clear and transparent and should not be changed often in order to guarantee regulatory certainty for the energy companies. The functioning of the "rules" of the scheme depends highly on the MS in which it is implemented. In certain countries the adoption of specific rules can act as a drawback, while their performance in other states has been evaluated as excellent. This should be considered before introducing the scheme.

- No independent assessment of the inclusion of transport sector exists. However; there are no technical or practical reasons against this practice. It is also considered that including transportation in the scheme will be a good approach as it will increase the number of players and will therefore raise the liquidity of the market.

- The monitoring and verification, as well as the administration costs can be significantly reduced by applying the ex-ante approach for calculation of the savings. For instance, in the UK the expenditure has been estimated to be less than 1 % of the total energy supplier cost. The disadvantage of this method is that the actual savings are not accounted.

- The evaluation of the lifetime savings should be carefully considered. In Italy the calculation period is set to 5 years which gives the same weight to different measures as insulation of walls and CFL lighting, whereas in the case of UK 40 year-calculation period is assigned to measures, such as insulation which might not be the real lifetime saving of the activity. Adjustment of the calculation periods should be considered depending on the importance of the energy efficiency measure and it should not be enhanced too much in order to avoid "boosting up" of certain activities.

- It is considered that long calculation periods are a good approach in cases when the target is to promote and create a market for specific energy efficiency measures, such as insulation activities.

- A list of eligible measures is an easy approach for evaluation of the energy efficiency activities, but it does not create market for new ideas.

- In order to ensure that consumers of the lower income class who cannot afford to contribute to the expenditure of energy efficiency activities are also included in the scheme, a target group should be established. An example is the system in UK, where 50 % of the obligation has to be achieved in households which receive income-related benefits or tax credits

- The scheme can be designed in a manner that it targets a specific sector, as in the case of UK –residential sector only, or in Denmark – retail and industrial sector.

- The WC scheme creates various benefits for the end users, as they raise awareness related to energy efficiency, eliminate uncertainties and risks concerning technical and financial performance, reduces transaction costs for obtaining reliable information, etc.

- Non-compliance rules and penalties should be established to ensure well-functioning of a scheme. The size of the penalty must exceed the cost of savings realization.

- Currently the scheme seems to function well in general and it is attractive for all actors taking part. Governments are not obliged and the responsibility is passed on the energy producers/distributors. The obliged producers/distributors, despite investing in households, recover their costs from the energy bills of the end-users. And finally, the public is satisfied as they receive energy efficiency improvements at a low price or for free, as in the case of Italy, where CFLs were handed out for free.

- The WC scheme can be considered a good instrument not only for improving the energy efficiency of the current building stock and reduction of CO2 emissions, but also for enhancement of the market development for energy related products and services. As mentioned above though, there are a few comprehensive ex-post evaluations of the scheme and the actual direct energy savings are difficult to estimate due to overlapping with other policy instruments.

- Due to the information available it is not possible to disaggregate the proportion of savings from existing schemes that fall within the scope of the ESD, so results are presented at an aggregated level. Measures, such as exchange of heating systems (efficient gas, oil or a pellet system) or energy efficiency measures, such as insulation would be measures which savings would count under the ESD scope.

The main features of the White Certificate schemes applied can be seen in the next table.

	UK	Italy	France	Denmark	Belgium (Flanders)
Obligation	Lifetime delivered energy/ CO2	Cumulative primary energy	Lifetime delivered energy	Lifetime delivered energy	annual primary energy
Compliance period	multi-annual	annual	multi-annual	annual	annual
Obliged actors	electricity and gas providers with < 15,000 customers in EEC1 and <50,000 in EEC2	electricity and gas distributors with < 100,000 customers (2005-2009) & 50,000 customers (2008)	Energy providers (incl. heating & cooling) with annual sales >0.4 TWh; LPG suppliers with anual sales >0.1 TWh	Energy providers (incl. heating, cooling, LPG)	only electricity providers
Sector and Project types	Only residential sector; all projects related to gas & electricity, coal, oil and LPG	all end-use sectors, incl. CHP, solar water heaters and PV	ETS sectors excluded; the obliged party should undertake savings >1GWh cumac over the lifetime of the project; transportation included	all end-use sectors; no network related or connected to the supply side projects; projects incl. Change of fuel are eligible only if they lead to consumption reduction; transportation is only included in case of internal transport consumption of the company	all residential, non-energy intensive industry and services
Eligible measures	all residential related: wall & loft insulation, glazing, boilers, fuel switching, heating controls, tank insulation & draught proofing	14 categories including households (wall insulation, CFLs, windows, electric wáter heaters, etc.), substitution (e.g. electric water heaters with electronic ignition gas heaters), large end-users (e.g. high efficiency electric motors), supply options (AC, heat pumps, etc.) & analytical measures (CHP, district heating, etc.)	100 eligible measures in the household and comercial sectors, 20 measures in the industry & 5 for the transport	n.a.	Residential sector: low flow shower heads, CFLs, termal insulation of roofs and windows & condensing boilers; nonresidential sector: energy audits, retrofitting energy efficient lighting, variable speed drives, roof insulation, boilers with higher energy efficiency
Lifetime evaluation	long lifetime	lifetime of max. 8 years	long lifetime	Standard lifetime 5 years	n.a.
Rewarding of an activity	in the first year	at the same pace as the reductions are realized	in the first year	in the first year	n.a.
Trading	no WC stock exchange; trading of savings and obligations	open market	no oficial trading system and market; trading of WC exists under the 2 €cent/ kWh penalty price	trading of energy efficiency obligations	no formal certification; no trading
Savings sectors	building sector	building sector (lighting)	building sector (building envelope)	Trade and industry	n.a.

[Bertoldi, 2010; Mundaca, 2008] - Main features of the White Certificate schemes

Capacity building and training in the EU

The Energy Performance Building Directive (EPBD) was implemented in the EU in 2002 and updated in 2010 (EPBD recast). It sets requirements for existing and new buildings. In order to regulate the correct implementation of the directive and to ensure compliance of the MS, a certification system was introduced. This leads to the inevitable issue of training, qualification of the experts and monitoring and verification of the certification efficiency of energy certification assessors (ECA). A comparison between the ECA training programs, ECA qualification and monitoring methods is carried out, assessing the best practice examples, drawing conclusions on the failures and successes in the different MS and thus searching for possibilities to improve the current training system.

It is important to differentiate between training of energy assessors and training of trainers. This text focuses mainly on the energy certification assessor training which takes place in the EU. It is observed that most countries in the EU have some sort of training system for energy auditors which can be voluntary or mandatory.

Application of the measure in EU Member States

There is a large amount of variability in the training programs that are offered in the different Member States. For example:

Austria: Twice a year the Austrian Chamber of Commerce provides a 5-day informal course and the Austrian Energy Agency offered a 17-day specialized course which included e-learning. The cost of these courses varies and is estimated to be between € 400 and € 1,200.

Italy: 7 day training courses are organized by ENEA and FIRE 6-7 times per year since 1992. The cost of such a course is € 1,000. On a regional level in the Lombardy region, Emilia Romagna, Liguria Region and Bolzano Province training courses for ECAs are provided. The costs of these courses vary between the regions. One example is Emilia Romagna Region where the expenses for a training program are between € 850 and € 1,200.

Greece: Several unofficial seminars with short (20-40 hours) and medium (60-120) durations were organized. The professionals who want to obtain an ECA degree must pass an examination which is verified by the Technical Chamber of Greece.

Portugal: The training courses consist of two main parts: technical and certification. In order to obtain a degree the candidates are required to pass both the technical and the certification examinations. The technical part of the program is taught by recognized organizations and costs amount to € 500 – € 1,000, while the certification part, organized by ADENE, costs € 800 – € 1,000. About 100 training programs are provided by ADENE

Spain: There are significant variations between regions. Online courses are offered with durations ranging between 25 and 200 hours. In the regions Castilla and Leon the expenses of a training course are € 60, while in the Madrid Region the courses last 100 hours and the costs are assessed to € 180, whereas 80 % is covered by administration.

Main features of the scheme

Expert availability

With the rising requirements throughout the EU a certain number of energy auditors will be required in order to ensure a well-functioning certification of existing and new buildings.

Data on the necessity and availability of ECAs in Member States is quite limited. However, a comparison of the available data leads to the conclusion that there is a shortage of experts in the field of energy auditing. Monitoring of the ECA capacity should be developed in order to identify the needs of each country and allowing mitigation measures to be developed for a shortages.

Minimum requirements for ECA

The minimum requirements for energy auditors vary widely in the MS, but it is observed that accreditation is given mostly to people with minimal education levels in the field of energy related to buildings. In most countries this level is represented by a degree in architecture, engineering or building physics and additional training is required in order to become an accredited energy expert.

Administration of the training system

There are two types of administration systems – on national and on regional level. The administration is carried out by national authorities in Greece, Portugal, Slovenia, Denmark, France, The Netherlands and Finland.

In Austria, the informal training courses are provided by the regional governments in cooperation with the Chamber of Commerce and the Chamber of Civil Engineers or by regional energy agencies.

In Italy, the main framework is carried out by the central government and the regional authorities have the right to adapt it to their requirements. Due to delays in the drafting of the national framework, a few regions have already prepared legislation concerning minimum requirements and certification of buildings.

The training in Spain is organized by the regional government and regional energy agency.

The training courses in Portugal have to be recognized by a commission which includes the Directorate-General of Energy and Geology, the Portuguese Environmental Agency, the Counsel of the Public works and Transport, the Architects Association, the Engineers Association, the National Association of Engineering Technicians. The commission sets requirements on the training courses, as for example, the inclusion of at least two qualifies experts in the training team.

In Slovenia, the training programs and the common material are organized by the ministry, while in Greece the training courses are established by the Technical Chamber of Greece.

Training obligation

The training can be voluntary or mandatory. Currently, variations within the MS are observed. In Austria and Spain the training courses are voluntary, whereas in Spain the building energy certification can also be carried out from professionals who have not taken part in the training courses. In Austria the training is not mandatory for issuing certification with the exception of energy consultants working for the regional authorities who are obliged to take part in the courses.

Compulsory training is offered in most of the EU countries which were investigated. In Greece, it is planned to implement obligatory participation and a qualifying exam. Currently, only a few informal courses in energy auditing have taken place since 2008. The training system in Portugal is already in function and is mandatory for all persons who want to carry out building energy certification. The program includes recognized courses and is followed by a national examination. The accreditation in Slovenia is given to companies and it is planned to implement mandatory training courses and a qualifying exam. There have been several informal training courses on energy efficiency organized since 2001. In Denmark and France the expert should be nationally accredited and the experts are required to take part in the courses and pass a test.

In France, there are no specific requirements on the participation in the programs, but as the persons who enter the courses also carry out lead-asbestos and termite inspections, it is assumed that the qualification level is high. Building energy certification can be issued for existing residential buildings in Germany from master craftsmen and technicians in the building field, in some cases these have attended a sufficient training course. In Finland, the training program is divided into two parts – technical and electrical energy auditors - and it lasts two days. The participants are required to have an engineering background and the same training is offered to everyone irrespective of their background experience.

In Italy the obligations vary from region to region. In general it is observed that there are no requirements regarding attendance of training courses for qualified HVAC (heating, ventilation, and air conditioning) specialists and building energy auditors.

Quality control

In order to ensure that a certification system functions properly and is credible, certain quality of the information provided by the energy certificates, as well

as performance of the experts in this field is required. The quality control may include a complete check of the audit project including on-site inspection to random check of parts of the audit. The quality monitoring can be subdivided into four main groups:

- No quality control
- Random checks or control of selected audits
- Complete inspection of the audit reports
- Complete inspection of the audit reports and on-site control.

Most countries considered have a central register with the main results of the certificate, but in only a few, a central database exists. In Spain and Greece, there is no monitoring and no official feedback system available so far. In Austria there is no standardized method established and several checks on regional level were discovered to exhibit inaccuracies in the energy performance certificates.

The Ministry of Italy proposed to appoint a public organization which will perform the report checks and/or possible on-site inspections. In Portugal there is an obligatory quality control system for the certification of new and existing residential and non-residential buildings. The level of control varies between the regions from simple checks of the EPC to complete data review of the calculations. Slovenia is still establishing quality assurance system and the main suggestion is to perform regular checks on the calculated or metered indicators. In Denmark, a complete structural validation system is applied for verification of the quality of the energy performance certificates.

Maximizing the benefits

Creation of a common/international European system: To achieve maximum benefit from the training a common system should be established on national level. In some countries there have been discrepancies regarding expert certification in different regions. This issue should be eliminated by creating a national training scheme which has the same “rules” regarding participation and examinations for everyone. A platform with collection of data concerning certified buildings and experts should be established.

Continuous education is crucial: Currently, most training courses take place once and no further training is offered. The system design should include training courses on a regular basis to ensure the existing experts are “up-to-date”.

Mitigation of negative impacts of the measures

Ensure monitoring and verification of certified experts and buildings: Monitoring and verification of the experts’ quality by means of examinations, as well as control of the certified buildings should be guaranteed. A good approach to increase compliance and motivation could be to introduce penalty or loss of license for experts who presented low quality at certifying buildings.

Lessons learnt

With rising requirements on building energy certification an expert capacity problem is expected. This issue can be overcome by, for example, building a large pool in a short time by training available experts from other fields of experts who already do building visitations on a regular basis. This is considered to be an efficient approach with limited costs and it has already been applied in Germany and France. A problem might occur due to the different background experience of these experts which is in many cases not related to energy efficiency of buildings. In this case special attention is to be paid to the training procedures in order to ensure a certain level of knowledge. Nevertheless the French experience appears to be successful so far in cases when the inspectors are provided with adequate tools and training.

Another method for ensuring a rapid fulfilment of the ECA capacity gap is the training of trainers. This approach has the advantage that it builds up a significant amount of experts in a short time. On the other hand, the quality of these experts can be questionable, as the trainers do not have much practical experience themselves. This method is currently applied in Spain, Portugal and partly in Belgium. In Slovenia, there is no training course for trainers. Any person who can demonstrate “adequate professional references in building design, measurements and energy auditing of buildings, knowledge about legislation/regulation on energetic and building construction and knowledge about EU regulations in the field of energy efficiency of buildings" can apply and become a trainer.

Various accreditation systems are observed in the EU. In Denmark and France a national accreditation is given, while in the Netherlands the accreditation is given to a company. In Germany, the accreditation regulations for existing buildings are stated in the national Ordinance, whereas for new buildings these are managed by the Federal States. The national accreditation of single persons has the advantage that the quality is assured directly, but it is also observed to have the highest cost and there is a risk of losing investments in case of job switching. Accreditation of companies, on the other hand, is less dependent on personal career choices and the continuation of the work is guaranteed. This method is less expensive compared to the accreditation of a single person, but it does not ensure a high level of quality of the certification and it should be controlled closely. Finally, there is the option to have specific minimum requirements on the accreditation activities, but no national control. This system can show to be efficient in cases when it is connected to other already existing accreditation systems. Nevertheless, it has the disadvantage that there is no centralized control on the experts' quality

As explained there are minimum requirements for ECAs which differ significantly in the various MS. The observations made in this report are that most countries have minimum requirements set on education, training, practical experience, etc. These requirements ensure a high level of knowledge in a direct manner, but it can lead to expert capacity shortage. Moreover, it does not ensure awareness of the experts on new development in the fields of energy certification and therefore it is recommended to organize training seminars on a yearly basis or provide access to up-to-date information.

With regard to administration, it is considered that administration by regional authorities might lead to difficulties related to a common training level of professionals. An effective tool to overcome this barrier would be the implementation of national quality standards and educational programs which can be applied in training courses organized by private bodies or organizations.

An important issue is the control and verification of the issued certificates. As proposed in there can be two solutions: pro-active and repressive.

The pro-active solutions are:

- Clear guidelines and regulations on how the process is taking place and it provides standardized, constructive and usually simpler methods. According to Hoogelander, Dictus et al. the use of guidelines and standard tools will reduce the number of potential mistakes, saves time and costs and allows people with less experience to perform the calculations.
- An independent organization is in charge of accreditation and control. This ensures that the quality control is independent, but it can also lead to some bottle-necks, such as bureaucracy, more time and costs
- Report checks of energy certification are organized in a centralized system which gives a direct insight into the experts' performance and it can prevent possible low performance at early stages.
- The input data should be collected centrally and the outcomes in a database. This provides a structural insight into the experts' work and the energy certification impact over longer time periods, which enables the tracking of improvements. This also allows adjustments in the policy structure at an early stage
- A feedback mechanism for improvements should be established in order to ensure a continuously enhanced and more effective system.

The repressive solution proposes a penalty, loss of accreditation or insurance in case of low-level performance from the expert's side. This will guarantee a prohibition of experts with bad performance from the market, but might be time-consuming and cause a raise in the experts' incomes and thus increase the certification costs.

In order to achieve a well-functioning building capacity system of energy auditors it is recommended that the following conditions are fulfilled:

- There is an existing well-structured network of independent energy auditors
- Training is mandatory
- The validity of the professional category of the Energy Certification Assessors (ECA) is limited to a certain period and is subject to renewal (e.g. every 5 years)
- Monitoring and control of ECA activities is present
- A central database for certificates is available and it is managed on a national level
- Linkage of the capacity building programs with information campaigns and other soft tools

	Characteristics	Examples	Typical products covered
Loans and Preferential loans	Loans, with better terms and/or reduced interest rates, provided for building energy efficiency improvements Typically finance all or most of an investment	Estonia: The Credit and Export Guarantee Fund (KredEx) (2001 – ongoing) France: Green Loan for Social Housing (2009-2020) Germany: KfW Programme Energy-Efficient Construction (2005 – ongoing)	Windows, heating controls, central heating installations, insulation, ventilation systems, renewable energy technologies, housing access and other modernization features.
Grants / subsidies	Grants / subsidies Grants / subsidies for building energy efficiency improvements Typically grants finance part of an investment	Czech Republic: Green Investment Scheme (2009 – 2012) Hungary: Grants for Renovation & Prefabricated-Panel Residences (2001 - ongoing) Romania: Programs for the thermal rehabilitation of multi-level residential buildings (2002 – ongoing) Poland: Infrastructure and Environmental Operation Programme (2007-2013) Slovenia: Financial stimulation for energy efficiency renovation and sustainable buildings of new buildings (2008-2016). UK: Carbon Emissions Reduction Target (2008-2012)	Renewable energy, insulation, draught-proofing, heating systems (including biomass, heat pumps, thermal regulation, Combined Heat & Power (CHP), solar), efficient appliances, windows and doors, district heating, lighting, fuel switching.
Third Party financing (TPf)	Investment is paid for by third party (e.g., bank, Energy Service Company (ESCO), installer of systems) Building owner has to pay back investment over time Different forms of 3 rd party financing, ranging from pay back as share of savings to financial lease	Austria: Successfully establishing a regional Market for Third Party Finance (2001 – ongoing) Netherlands: More with Less Programme (2008-2020) Poland: Thermo-modernisation and Renovation Fund (1999-2016)	Heating and hot water systems
Tax rebates / VAT reduction	Various forms of personal tax reductions in response to building owners investing in energy efficiency Low VAT rate for energy efficiency products and materials	Belgium: Tax Rebates for Home Improvements (2003 – ongoing) UK: Stamp Duty Relief for Zero Carbon Homes (2007 – 2012) Belgium: Reduced VAT on home refurbishment (2000 – ongoing) UK: Reduced Sales Tax for Energy Savings Materials (2000 – ongoing)	Replacement of old boilers, solar water heaters, roof installation, double glazing, central heating system, energy audit, boiler maintenance, efficient appliances, insulation, draught-proofing, passive houses and zero-carbon houses, draught stripping, heating and hot water controls, solar panels, wind and water turbines, heat pumps, micro CHP, biomass and other transformation/ restoration works
Tax deductions	Deduction of personal income or corporate tax for amounts invested in energy efficiency	Netherlands: Energy Investment Allowance (2004 – ongoing) UK: Landlords' Energy Saving Allowance (2004 – 2015)	Insulation, draught-proofing and CHP. Lists of eligible technologies are frequently updated

Financial measures for building construction and renovation

One of the most commonly applied instruments is the financial tool aiming to support activities related to energy efficiency in buildings. EuroACE identified eight different types of financial and fiscal instruments, each with distinct characteristics. Following table gives an overview of these instruments..

The KfW Programme for the promotion of CO2 emissions reduction from building renovation/ retrofitting can be evaluated as a successful financial instrument with incentive impact and positive macroeconomic effects.

Experiences with the German KfW programmes

The energy renovation of existing buildings is considered one of the most important levers for the climate protection in Germany. Also in terms of economic measures of the federal government in 2009, the building sector plays an important role because investments in energetic renovation (retrofitting) directly contribute to the German building sector and supply industry. The KfW Banking Group (Kreditanstalt für Wiederaufbau), a non-profit public banking group manages the government's funding programmes and has therefore a central role in these investments.

The objective of the KfW programs - energy efficient construction and energy efficient renovation – is to support building owners to finance energy saving construction measures in new and existing buildings.

The KfW banking group has provided preferential loans and grants for energy efficiency measures in the building sector since 1996. The KfW offers long-term low-interest financing with grace periods. It is assumed that the reduction of the interest rate leads to savings of about 7 % to 12 % of the loan. In general, the KfW bank raises funds from the financial market and passes the capital on to the programme applicants. As the KfW is AAA-rated, it faces low-interest rates on the market. Funding from the federal government is also used to reduce the interest rates.

The KfW raises funds from the financial market and transfers this capital, via commercial banks, to programme applicants in the form of lower interest loans. Financing for projects is channeled exclusively through regular banks; private households cannot apply directly to the KfW. The bank receives low interest rates in the financial markets because of its current AAA rate due to the guarantees in accordance with its public status. This does not exclude other private financial institutions in benefitting from clients that are willing to invest in energy efficiency measures. In general, the KfW finances only part of the efficiency measures. The lacking capital needs to be provided from private equity or other financing institutions, or from both. Therefore the private banks benefit from the KfW programmes. Often, the motivation to invest in energy efficiency measures may have been originally generated due to the publicity of the KfW and its positive image in the public. In that sense the KfW programmes with their loans and grants unleash more capital for energy efficiency measures and therefore work as leverage.

In addition, federal funding is also used to further decrease interest rates. Loan repayments are used to pay back the bank's liability on the financial market. KfW programmes include long-term low-interest financing of energy efficiency improvements and CO2 emission reduction measures. Apart from a low interest rate, applicants may be exempted from credit repayment during the first years. Up to 100 % of the investment costs are financed. The maturity period of the long-term loans is up to 35 years. Fixed interest rate periods of up to 15 years are also offered.

The Energy-efficient rehabilitation program (Energieeffizient Sanieren) and the CO2 –reduction program (CO2 Gebäudesanierungsprogramm) with about 363 000 funded dwellings alone in 2009 takes a key position in the National Climate Change Programme. Since 2009 the program Energy efficient renovation continues the previous CO2 building rehabilitation program under a new name and changed support conditions. Eligible criteria have been adjusted to current energy requirements for new buildings. Moreover, now many of the actions are eligible if they have a high energy quality. The current conditions can be looked up on the web (www.kfw.de).

Since 1990, the KfW has been promoting the energy savings and CO2 emissions reduction in buildings. Between 1990 and 2008 about 2.7 million buildings received subsidies in form of low interest loans and grants for actions to save energy and for CO2 reduction. The preferential loan for refurbishment measures is provided via local commercial banks. An additional repayment grant is given if the KfW Efficiency House standard is achieved.

Co-benefits of the measures

Employment effects

In 2009, the total effect of the programs "Energy-efficient rehabilitation" and "CO2 reduction program" on the employment was accounted to 111,000 man-years. Thereof, about 80 % was contributed by loans and 20 % by grants. The indirect effect of these two programs on the employment was estimated to 60,000 man-years for the year 2009.

Heating cost savings

The subsidized cases of the CO2 reduction program and the Energy-efficient rehabilitation program for the years 2005 to 2009 are estimated to lead to heating cost savings of at least 561 million Euros for the building and apartment user. If the heating cost savings from the previous years are also taken into account, the subsidized cases of the years 2005-2009 will reach cumulative heating cost savings of almost 1,450 million Euros at the end of 2010. Even in case of conservative estimations of the energy price development from and a narrow definition of the heating costs, a big share of the investments is profitable for the investors, if the heating cost savings of the tenant are considered.

Lessons learnt

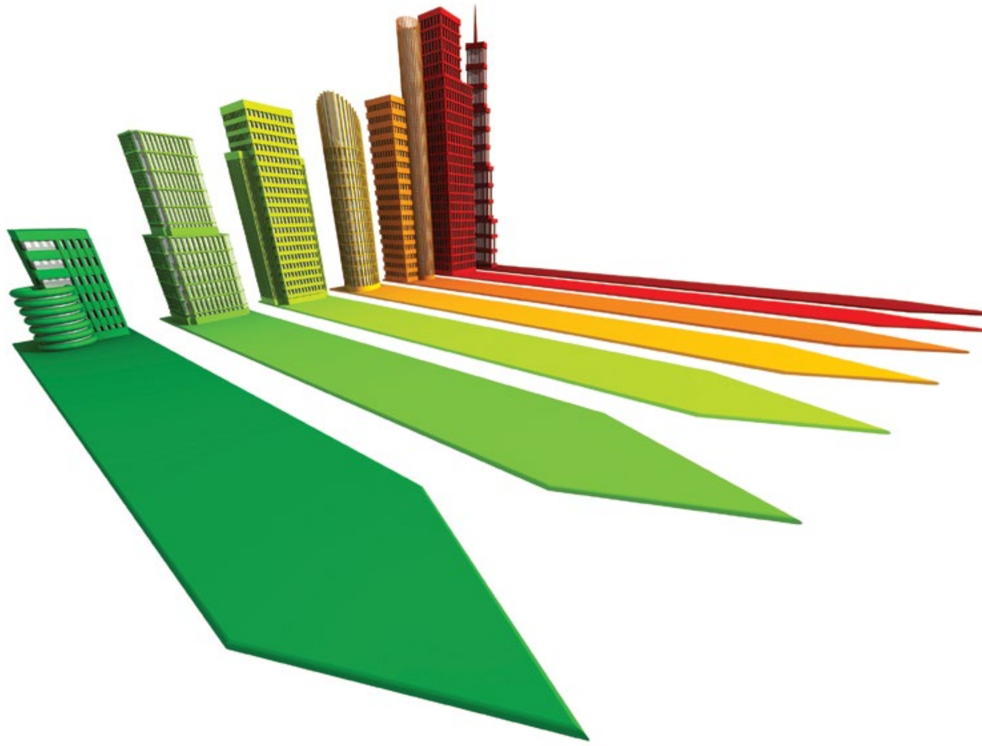
A number of lessons can be learned from the policy examples presented above:

- Financial incentives are an important tool for overcome barriers associated with the upfront costs of measures. However, they are not sufficient in themselves, and other barriers may have an important influence on the effectiveness of financial instruments.

- Accompanying financial incentives with awareness raising campaigns can improve the take up of the schemes, and also allow more efficient delivery. KfW is a good example of a strong communication policy that managed to raise awareness among the building owners to such extent that the KfW standards (such as e.g. KfW 40 house) are well known terms and are used by the banks or the construction companies to advertise their offers.

- For some grant schemes research has found that households eligible for funding are not always aware that they are able to apply. In contrast, other households that are not within the target group do apply for funding. These aspects can be improved with better communication.

- For loan schemes the affordability is a key factor. Interest rates and loan durations therefore need to be balanced to reflect the level of repayments which is compatible with the income of the target group. A study carried out by the Baltic Energy Efficiency Network (BEEN), including 26 different partners from Estonia, Latvia, Lithuania, Poland, Germany, Russia and Belarus, found that the affordability was a key factor influencing the success of loan schemes.



2.4. Transport sector

On the long term, the White Paper on Transport of the EU Commission, based on the fact that the EU needs to reduce emissions by 80-95% below 1990 levels by 2050, in the context of the necessary reductions of the developed countries as a group in order to reach the 2ºC increase limit goal, is based on Commission analysis that show that while deeper cuts can be achieved in other sectors of the economy, a reduction of at least 60% of GHGs by 2050 with respect to 1990 is required from the transport sector, which is a significant and still growing source of GHGs. By 2030, the goal for transport will be to reduce GHG emissions to around 20% below their 2008 level. Given the substantial increase in transport emissions over the past two decades, this would still put them 8% above the 1990 level.

The scope for changing the way transport operates varies across transport segments, as the technological options for each segment are different. In the following, the Commission's vision therefore considers three major transport segments: medium distances, long distances and urban transport. Delivery of this will rely on many actors – the EU, Member States, regions, cities, but also industry, social partners and citizens.

Airport capacity needs to be optimized and, where necessary, increased to face growing demand for travel to and from third countries and areas of Europe otherwise poorly connected, which could result in a more than doubling of EU air transport activities by 2050. In other cases, (high speed) rail should absorb much medium distance traffic. The EU aviation industry should become a frontrunner in the use of low-carbon fuels to reach the 2050 target.

In maritime, the need for a global level-playing field is equally pronounced. The EU should strive – in cooperation with UN agency IMO (International Maritime Organization) and other international organisations – for the universal application and enforcement of high standards of safety, security, environmental protection and working conditions, and for eliminating piracy. The environmental record of shipping can and must be improved by both technology and better fuels and operations: overall, the EU CO_2 emissions from maritime transport should be cut by 40% (if feasible 50%) by 2050 compared to 2005 levels.

In cities, switching to cleaner transport is facilitated by the lower requirements for vehicle range and higher population density. Public transport choices are more widely available, as well as the option of walking and cycling. An important goal is to halve the use of conventionally fuelled cars in urban transport by 2030 and phase them out in cities by 2050.

Another relevant goal is that 30 % of road freight over 300 km should shift to other modes such as rail or waterborne transport by 2030, and more than 50 % by 2050.

On the medium term, the Effort Sharing Decision establishes binding annual greenhouse gas emission targets for Member States for the period 2013–2020. These targets concern emissions from most sectors not included in the EU Emissions Trading System (EU ETS), such as transport (except aviation), buildings, agriculture and waste. The Effort Sharing Decision forms part of a set of policies and measures on climate change and energy – known as the climate and energy package - that will help move Europe towards a low-carbon economy and increase its energy security.

In contrast to sectors in the EU ETS, which are regulated at EU level, it is the responsibility of Member States to define and implement national policies and measures to limit emissions from the sectors covered by the Effort Sharing Decision.

The emissions from transport falling under the ESD arise almost exclusively from road transport. Although evidence suggests that vehicles have become more efficient, these improvements have been outweighed by increases in demand for passenger and freight transport. Consequently, in the absence of further mitigation efforts it is likely that emissions from the transport sector, in a number of Member States, will not be limited to the extent required for the ESD as a whole. This means that either further policy action in the transport sector is needed, or that other sectors will need to deliver a greater proportion of emission limiting efforts.

Within road transport, policy effort to reduce emissions at the European level has largely focused on improving vehicle efficiency (e.g. improved vehicle design, propulsion system and energy system) and reducing the GHG intensity of fuels (e.g. through the Fuel Quality Directive). These existing EU policies are likely to take up a large proportion of the low cost technical abatement measures in the sector. Therefore, delivery of additional savings by 2020 may require the take up of more expensive technical measures, or the further application of non-technical measures.

A report, published by the European Environment Agency, evaluates progress towards targets set by the Roadmap using a core set of indicators, including greenhouse gas (GHG) emissions, energy efficiency and uptake of cleaner fuels. The report considers the impacts of transport use, rather than vehicle manufacture and disposal, including the private, public and freight sectors. Progress is achieved in three ways: avoiding use of transport where possible; shifting towards more sustainable forms of transport and improving the efficiency of transport.

The results demonstrate many positive changes; however, improvements are still needed. GHG emission reductions (excluding maritime emissions, but including aviation) were on track to meet the target of a 60% reduction of CO_2 from 1990 levels by 2050, with average annual reductions of 0.5% since 1990. CO_2 emissions from new cars, following effective legislation, were also on track, and dropped from 140.2 grams of CO_2 per km (g CO_2/km) in 2010 to 135.7 g CO_2/km in 2011.

Overall fuel consumption has fallen by 4.3% since 2007, however, it rose by 0.1% between 2010 and 2011. Since 2009, oil consumption has reduced by 0.3% per year and the percentage share of renewable energy in transport rose by 0.5%. However, neither of these improvements is sufficient to meet 2050 targets if current trends continue.

There are signs of a modest shift towards more sustainable transport; sales of electric cars are increasing and the overall proportion of alternatively-fuelled vehicles (including electric, hydrogen, biofuel, methane and liquid petroleum gas powered vehicles) in the European fleet has doubled, from approximately 2% in 2004 to over 4% in 2010. The report suggests that improved information regarding vehicles and fuels could allow consumers to compare conventional and alternative options more easily, and possible financial incentives may further encourage use of alternative fuels.

Finally, the results showed little evidence of avoided transport use. Passenger demand, mainly in the form of car journeys, has grown steadily since 1995. The year 2010 showed a slight reduction, however, this was probably the result of economic decline and rising fuel prices.

Under these circumstances, the following case studies will focus on uptake of electric vehicles and behavioral change measures. Electric vehicles are currently the preferred ultra-low (direct) emission solution for the passenger car market worldwide, in terms of market penetration and planned vehicle releases. Whilst they are not anticipated to play a significant role in reducing emissions from road transport until beyond 2020, there is a need to provide clear, long-term policy signals to stimulate development of the technology and to incentivize uptake in order to develop the market. On the other hand, policy that aims to impact on transport user behavior has the potential to be very effective. It could also have a very low mitigation cost, i.e. could reduce emissions whilst also saving consumers and governments money. Bearing these points in mind, the examples are:

1. Financial incentive schemes to stimulate uptake of electric vehicles

Financial incentive schemes have been introduced by many Member States in order to stimulate the early market for electric vehicles. The price premium of electric vehicle purchases is one of the most important barriers to uptake. Evidence suggests that consumers may be more responsive to upfront monetary incentives as opposed to those which offer savings post-purchase, even if the total savings are the same.

2. Electric vehicle recharging infrastructure development schemes

It is likely that inadequate charging infrastructure will delay a widespread shift to electric vehicles. Public charging infrastructure is an important means of counteracting “range anxiety”, which is the fear of being stranded due to insufficient battery capacity. Deploying charging points in highly visible, busy public areas provides maximum benefit in terms of psychological reassurance and usefulness to consumers. In general, slow-charging schemes have been found to be cheaper but less effective at stimulating uptake of electric vehicles. A mix of fast- and slow- charging points therefore strikes a balance between cost and effectiveness.

3. Speed management measures

Most European countries impose maximum speed limits on all their roads for a variety of reasons, including safety, traffic management and fuel consumption. However, they are not usually optimized for the latter: a typical passenger car is most fuel efficient at around 80 km/h, but European motorway speed limits are typically 120-130 km/h. At high speeds, when air resistance dominates vehicle resistive force, power demand increases with the cube of speed – so a reduction in speed leads to a significant reduction in fuel consumption. Proper enforcement is necessary to achieve results.

4. Eco-driving programmes.

Eco-driving involves training drivers to modify their driving style in a way that reduces fuel consumption and emissions. This may involve actions such as timely gear changes, smooth deceleration and anticipation of traffic flows – all of which can reduce fuel consumption by up to 25% directly after training. Other elements may include reducing use of air conditioning, minimizing idling and regular servicing. Uptake can be promoted through awareness campaigns, subsidized schemes or mandatory training. It is most effective when incorporated into novice driver training, and this is also one of the cheapest options.

2.4.1. Characteristics of the transport sector

Transport participates in the EU economy by facilitating the mobility of goods, services and individuals. Modes of transport can be categorized into three types:

- Land transport: Road, rail, unpowered (cycling & walking);
- Waterborne transport: Inland navigation, maritime shipping; and
- Air transport: Domestic and international aviation.

Transport volume is driven by demand for passenger and freight transport; energy use is linked to volume and efficiency. Transport can become more energy efficient either by making vehicles more efficient, by transporting more goods or people with the same vehicle movement, or by reducing the need to transport goods or people through system efficiency. Evidence suggests that transport is becoming more energy efficient; however volumes are also increasing, which means that overall energy consumption will not necessarily reduce in the future without further policy intervention.

Transport is responsible for a significant, and growing, proportion of GHG emissions in the EU, the majority of which is CO2 and has the single largest contribution of any sector to emissions within the scope of the Effort Sharing Decision.

Emissions from inter-EU transport fall under the scope of the ESD, where they occur from direct fuel use (i.e. electricity consumption is not included – this is covered by the EU ETS). The exception is aviation (both inter-EU and international), which is covered under the EU ETS from 2012. International maritime shipping is currently not regulated under EU law and is not covered by the ESD. In practice, this means that the main transport modes that cause emissions covered under the ESD are road transport, non-electrified rail transport, and inland navigation.

The 2011 transport white paper ("Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system") sets a 2050 target of a 60% reduction from all transport against the year 1990. The interim target for 2030 is an 8% increase in emissions against 1990 levels (which translates to a 20% reduction on 2008 emissions). But projections indicate that without further policy intervention, transport activities covered under the ESD would not achieve an emissions reduction commensurate with the overall target.

Existing EU policies, in particular regulations on emissions from cars and vans, are expected to drive the take up for the most cost-effective measures in the sector. Indeed, these EU wide regulations are the principle driver of technological improvements in the CO2 emissions performance of vehicles, and this is likely to remain the case up until 2020. Therefore, in meeting their targets under the ESD, Member States may choose to implement relatively few national policies in transport and instead focus on other sectors where more cost effective abatement remains.

However, it is also important to look beyond 2020 to longer term targets, where emissions abatement in transport will be required (along with the take up of more expensive measures). There is therefore a case to implement policies in the short and medium term to achieve long term reductions in emissions.

Policy intervention can be justified where the market is unlikely to deliver the optimal level of abatement without reform. There are a number of reasons why the market may not deliver the socially optimal level of abatement. These can be described in terms of so called 'market failures'. Examples of market failures that apply to the road transport sector can be described as follows.

- Private transport in general is subject to irrational purchase decisions by individuals. Even if a mitigation measure is also economic, individuals may not make the decision because they do not appreciate that savings due to reduced energy / fuel consumption outweigh initial higher capital costs. Alternatively, private individuals may perceive the cost of capital to be too high or instinctively apply a very high discount rate to investment decisions because they value present-day cash very highly.
- Transport decisions made by private individuals are often perceived to reflect status. This may lead to individuals choosing more energy intensive modes of transport, or more energy intensive options within a mode, because of the perceived image.
- Market prices do not reflect the full social cost of environmental impacts. Therefore, businesses and consumers are not currently required to pay for the full external costs of the environmental pollution (e.g. greenhouse gases) they produce. This means that certain measure which have a net societal benefit may not appear cost-effective from a private operators perspective.
- Some abatement, even if cost-effective, may not be taken up because of the structure of the market. For example, road freight logistics may not be optimal because communication and co-operation between the large group of stakeholders (freight operators and their customers) is very difficult. Another example of co-ordination barriers is effective intermodality, both for passenger and freight transport.
- Information failures also present a barrier. Private individuals may not find the information they need to make rational decisions on transport readily available (for example, information on the full costs of different transport options).

There may also be political barriers to changes in the policy landscape. For example, in European countries a large amount of fiscal revenue is generated through taxation on transport (particularly transport fuels). Therefore, policies that seek to reduce fuel consumption or shift it to different fuels may result in a budgetary deficit for national governments. Therefore policies would either need to be designed in order that revenues did not reduce as a result of intervention, or revenue take would need to be increased elsewhere to compensate. This is an important consideration for policymakers, particularly in road transport.

2.4.2. Policy options

Transport is a diverse sector, and as such the range of policy options available to the EU and member states to promote low-carbon transport is varied. Whilst much of the discussion surrounding transport policy focuses on passenger cars, these options are generic to all modes, passenger or freight. They can broadly be grouped into options that:

- reduce demand volume (i.e. avoid travel taking place),
- change the structure of the transport system (usually, shifting travel to more carbon-efficient modes),
- improve efficiency of vehicles (i.e. there are less GHG emissions for the same amount of vehicle travel)
- reduce the carbon intensity of fuels (i.e. increased use of low carbon energy sources)

Some of these options come with important second order or 'rebound' effects which must be managed. For example, increasing the fuel-efficiency of transport is likely to decrease its cost, and as transport demand is often price-sensitive this can lead to an increase in demand for travel. This increased demand would act to compensate for the emissions avoided by increasing fuel efficiency. This issue has been studied by the commission in the documents developed under the project EU Transport GHG: Routes to 2050 II Knock-on consequences.

Policy instruments to stimulate uptake of these options can be categorized into five groups: planning, regulatory, economic, information, and technological.

EU policy landscape

Existing EU policies go some way to address the market failures. The existing EU policy landscape (policies that are in place or soon to be implemented) targets energy performance of vehicles across most modes, and also the carbon intensity of energy used in the transport sector. This includes regulation to improve the energy efficiency of passenger cars, vans and heavy duty vehicles. In addition, there is legislation to reduce the GHG intensity of road transport fuels.

Whilst the stringency of these measures could be increased (at greater cost) the policies (or those under consideration) already cover the major transport emission sources within the scope of the ESD. However, it is clear that looking beyond 2020, further policies will be needed in Europe in order to meet 2050 targets for reducing emissions from transport. This is illustrated by the analysis supporting the 2011 Transport White Paper, which outlines a reference scenario for transport in which emissions in 2050 rise to 35% above 1990 levels, compared with the Commission target of a 60% reduction on 1990 levels over the same period. The same analysis sets out a range of policy areas where action is envisaged at a European level, including further action to reduce the CO2 intensity of passenger cars, modal shift from road freight to other modes, and internalization of external costs in line with the "polluter pays" principle.

A remarkable point is that last January the EU Commission launched the Clean Fuel Strategy, an ambitious package of measures to ensure the build-up of alternative fuel stations across Europe with common standards for their design and use. This intends to overcome the fact that policy initiatives so far have mostly addressed the actual fuels and vehicles, without considering fuels distribution, and efforts to provide incentives have been un-coordinated and insufficient.

Clean fuel is being held back by three main barriers: the high cost of vehicles, a low level of consumer acceptance, and the lack of recharging and refuelling stations. It is a vicious circle. Refuelling stations are not being built because there are not enough vehicles. Vehicles are not sold at competitive prices because there is not enough demand. Consumers do not buy the vehicles because they are expensive and the stations are not there. The Commission is therefore proposing a package of binding targets on Member States for a minimum level of infrastructure for clean fuels such as electricity, hydrogen and natural gas, as well as common EU wide standards for equipment needed.

	Description	Examples
Planning	All measures concerning planning infrastructure of all transport modes.	Integrated public transport, car-free zones, improved linking of rail and maritime freight.
Regulatory	Measures that influence transport demand, vehicle or fuel carbon efficiency, by regulation.	Vehicle restricted zones or lanes, mandatory vehicle emissions standards, fuel quality standards, speed limit enforcement.
Economic	Charges, taxes or incentives to internalize the cost of emitting GHGs or promote uptake of a desired option.	Fuel or vehicle taxes, emission trading, congestion charging, subsidies for alternative fuels \ vehicles \ modes.
Information	Measures to raise public awareness concerning an area of transport in order to stimulate change.	Awareness campaigns, public transport information, travel planning, eco-driving schemes.
Technologica	Measures that advance or promote a change in fuel or vehicle technology to reduce GHG emissions, or promote alternatives to travel.	Support for: vehicle efficiency improvements, alternative fuel vehicles, low carbon fuels, remote working\ teleconferencing.

The main measures proposed are:

Electricity: the situation for electric charging points varies greatly across the EU. The leading countries are Germany, France, the Netherlands, Spain and the UK. Under this proposal a minimum number of recharging points, using a common plug will be required for each Member State. The aim is to put in place a critical mass of charging points so that companies will mass produce the cars at reasonable prices.

A common EU wide plug is an essential element for the roll out of this fuel. To end uncertainty in the market, today the Commission has announced the use of the "Type 2" plug as the common standard for the whole of Europe.

Hydrogen: Germany, Italy and Denmark already have a significant number of hydrogen refuelling stations although some of them are not publically accessible. Common standards are still needed for certain components such as fuel hoses. Under this proposal, existing filling stations will be linked up to form a network with common standards ensuring the mobility of Hydrogen vehicles. This applies to the 14 Member States which currently have a Hydrogen network.

Biofuels: already have nearly 5% of the market. They work as blended fuels (biodiesel and bioethanol) and do not require any specific infrastructure. A key challenge will be to ensure their sustainability. All EU Member States are to achieve a 10 % share in renewable energy by 2020 for all transport (Renewable Energy Directive, 2009/28/EC). It had been expected that this target would be met primarily through biofuels. However there are growing concerns regarding the issue of indirect land use change (ILUC), which may substantially reduce the greenhouse gas emissions savings associated with the use of biofuels produced from crops used for food or feed. In October 2012 the European Commission published a proposal to limit to 5 % the use of food-based biofuels to meet the 10 % renewable energy target of the Renewable Energy Directive. In this case, non-crop-based second generation biofuels would therefore be needed alongside greater use of renewable electricity in transport.

Natural Gas (Liquefied (LNG) and Compressed (CNG): LNG is used for waterborne transport both at sea and on inland waterways. LNG infrastructure for fuelling vessels is at a very early stage, with only Sweden having a small scale LNG bunkering facility for sea going vessels, with plans in several other Member States. The Commission is proposing that LNG refuelling stations be installed in all 139 maritime and inland ports on the Trans European Core Network by 2020 and respectively 2025. These are not major gas terminals, but either fixed or mobile refuelling stations. This covers all major EU ports.

LNG: Liquefied natural gas is also used for trucks, but there are only 38 filling stations in the EU. The Commission is proposing that by 2020, refuelling stations are installed every 400 km along the roads of the Trans European Core Network.

CNG: Compressed natural gas is mainly used for cars. One million vehicles currently use this fuel representing 0.5% of the fleet - the industry aims to increase this figure ten-fold by 2020. The Commission proposal will ensure that publically accessible refuelling points, with common standards, are available Europe-wide with maximum distances of 150 Km by 2020.

LPG: Liquefied petroleum gas. No action is foreseen for LPG, the core infrastructure is already established.

Member States will be able to implement these changes without necessarily involving public spending by changing local regulations to encourage private sector investment and behavior. EU support is already available from TEN-T (Trans-European Transport Network) funds, cohesion and structural funds.

National policies

Recently implemented or planned legislation aims to stimulate the take-up of technical options to make road transport more energy efficient, and to reduce the GHG intensity of existing road transport fuels. There is a compelling argument for setting these policies at a European level, as it will help to reinforce a unified European market for vehicles / fuels that makes it easier for the organizations involved to respond to the policy signals in a cost effective manner. Existing EU policies will likely result in take-up of much of the cost-effective abatement potential in transport covered by the ESD. However, national policies can still deliver important emissions reductions, including targeting areas not currently addressed strongly by EU regulations for a number of reasons:

- It may be easier to implement new policies at a national level.
- Member State policy making can be designed to address country-specific issues, or reduce emissions in a way that is most efficient at a regional or local level and responds to local socioeconomic needs;
- Some areas of transport policy (particularly those that are perceived to constrain mobility) may be contentious at a European level, but in some cases acceptable in specific Member States;
- If there is no issue of market fragmentation, it may be sensible to allow Member States to decide the mechanisms for achieving specific policy goals in a way that suits their transport system;
- It may be more effective for Member States to design policies aiming to achieve behavioral change that address behavioral issues specific to their country / culture.
- Fiscal policy in transport is in many Member States a major source of tax revenue, and setting their own fiscal policy in transport allows Member States to have proper budgetary control.

As previously outlined, road transport is by far the most significant constituent of transport-related emissions that fall under the ESD. In addition, the dominance of road transport is common to all member states.

Within road transport, policy effort to reduce emissions at the European level has largely focused on improving vehicle efficiency (e.g. improved vehicle design, propulsion system and energy system) and reducing the GHG intensity of fuels (e.g. through the Fuel Quality Directive).

There are a number of policy options available to policy makers at a national level that could be used, and some options that would complement those already in place to assure or enhance their success:

- Much of current European policy focuses on policies that impact on energy and GHG efficiency from the supply-side (the vehicle and fuel providers). Another group of policy options exist that aim to improve efficiency of both the vehicles and transport system from the demand side (i.e. encouraging transport consumers to act in a more efficient way). This could include incentivizing more efficient driving, encouraging a shift of demand to more efficient modes of transport or changing mobility patterns to reduce transport volume. Policies in this area must be carefully designed to avoid constraining mobility in a way that damages economic or social development.
- Some emerging technologies that are anticipated to play a significant role in reducing road transport emissions to a level compatible with 2050 targets require early action to overcome technology development and market penetration challenges. This particularly applies to alternative energy system vehicles (e.g. electric and hydrogen power trains). There is therefore a need for policies to be introduced prior to 2020 that stimulate demand and development for these vehicles, even though the emission reduction benefits may not be realized until much later and these policies are very unlikely to result in cost-effective abatement by 2020.
- A shift to an alternative energy system (e.g. electricity, hydrogen, or biofuels) will also require a supporting infrastructure for energy distribution and supply to vehicles. Therefore there is a need for accompanying policy to stimulate infrastructure to facilitate the introduction of alternative fuelled vehicles (the recently announced clean fuel strategy objective).

2.4.3. Best practice examples

Bearing this in mind, the following case study examples are mentioned:

Electric vehicles are currently the dominant ultra-low (direct) emission solution for the passenger car market worldwide, in terms of current market share and planned future vehicle releases. Whilst they are not anticipated to play a significant role in reducing emissions from road transport until beyond 2020 – and are an expensive abatement option in the short term, there is a need to provide clear, long-term policy signals to stimulate development of the technology and to incentivize uptake in order to develop the market beyond 2020. Case studies of policies to stimulate development and uptake of electric vehicles and electric vehicle charging infrastructure:

- Financial incentive schemes including grant programmes such as the UK's Plug-in Car Grant scheme, Luxembourg's PRIMe CAR-e scheme, and Spain and Portugal's grant schemes; and electric vehicle-specific tax incentives offered by many Member States, including Germany, Italy and the Netherlands.
- Infrastructure development schemes in Member States / regions that have installed significant numbers of charging points (e.g. Amsterdam, Berlin, London).

Some Member States have begun to implement policy that aims to impact on transport user behavior. Policy in this area has the potential to be very effective, in that changing inefficient behavior could have a very low or even negative mitigation cost in some situations, i.e. could reduce emissions whilst also saving consumers and governments money. However, policies in this area can be very contentious and the potential economic and social side-effects are numerous and difficult to measure. Case studies of policies that aim to achieve behavioral change leading to more efficient use of the transport system are:

- Speed management measures in road transport which aim to reduce fuel consumption by reducing the average speed of vehicles on the road.
- Policies to encourage more energy-efficient driving of passenger cars.

Policies to stimulate the uptake of electric vehicles

Electric vehicles represent an opportunity to radically reduce the emissions from road transport, if powered by low-carbon electricity. Many independent research studies foresee a major role for electric vehicles in the long-term decarbonisation of the road transport sector, particularly in the passenger car segment. In the long term (i.e. to 2050), the need to significantly reduce emissions from the transport sector means that alternatives to gasoline or diesel powered vehicles will need to be found, and electric vehicles are a very promising option for passenger cars.

The focus of the Effort Sharing Decision is on emissions to 2020; however, electric vehicles are unlikely to play a significant role before 2030 due to their current low market share, which is unlikely to change significantly in the short term.

In order that electric vehicles are able to contribute to long-term emissions targets, action is needed to stimulate the market in the short term. This is due to a number of reasons. Firstly, there is a significant time needed to develop and commercialise the technology, overcome hurdles and learn lessons from trial deployments. Secondly, vehicle lifetimes and subsequent fleet turnover rates mean that there is a substantial delay between a new vehicle technology gaining share in the sales of new vehicles and gaining share in the overall vehicle fleet. Finally, early policy action will send signals to the market actors to prevent investment lock-in to more carbon-intensive technologies – and potentially improve Europe's competitive position in the automotive supply industry in the future.

Electric vehicles are also seen as an important option to meet several other policy objectives, including reducing dependence on fossil fuels and meeting local air quality targets (although again, today they may not be the most cost-effective way of meeting these policy goals). It is believed that without government support, electric vehicles will not gain significant market share unless oil prices dramatically increase (CE Delft, 2011).

The electric vehicle market is still in the early stages, and significant market penetration may not occur until after 2030. The most significant barriers relate to:

- High upfront cost: Currently, the price premium is around €15,000 to €40,000, with the potential to decrease to around €5,000 in the longer term (ETC, 2009);
- Issues relating to charging: "Range anxiety" is the fear of being stranded due to insufficient battery capacity, even though EVs will usually meet the daily needs to most drivers. Typical home charging points take 7-8 hours to charge a battery, which can be inconvenient for users.

Policy options to support the uptake of electric vehicles

In its Communication 'A European strategy on clean and energy efficient vehicles', the European Commission announced some specific actions to support electric vehicles:

- Placement on the market – proposing electric safety requirements and reviewing crash safety requirements;
- Standardization – development of a standard charging infrastructure to ensure interoperability and connectivity;
- Infrastructure – supporting Member States on charging infrastructure deployment. Funding will be made available for electric vehicles infrastructure though the European Investment Bank
- Power generation and distribution – comparing lifecycle emissions and evaluating the impact of the increase in overall electricity demand.

Many policies will be temporary measures to stimulate the early market, and can be withdrawn once production volumes increase sufficiently and consumer acceptance is achieved.

Policy option	Barriers addressed	Policy sub –types
Research and /spending programmes to support new technologies	High price Limited range Time to charge Inconvenient charging No charging points Lack of power or performance Unfamiliarity	Research and demonstration programmes Infrastructure investment National stock targets Public procurement
Information provision, education and public engagement	Unfamiliarity	Information campaigns Car test driving schemes
Voluntary or incentivized negotiated agreements	Unfamiliarity Lack of choice	Agreements have been secured at a more general level with respect to reducing car CO2 emissions.
Market-based (economic or fiscal) instruments	High price	Taxation incentives Direct subsidies Exemptions from congestion charging or road charging
Direct regulations	High price Lack of power or performance Unfamiliarity	Standardisation of charging infrastructure Safety standards Public procurement (Clean and Energy Efficient Vehicle Directive) CO2 regulations – allows manufacturers to gain supercredits for sales of EVs Energy taxation (Directive 2003/96/EC) fixes higher minimum tax rates for transport fuels than for electricity

More detailed examples can be found in the AEA report for DG Clima (available in the website) and in the EEA Tech report 2 2008 (Success stories).

Monetary incentives programmes to reduce the upfront cost of electric vehicles

Monetary incentives programmes to reduce the upfront cost of electric vehicles are widespread in Europe. In 2010, 18 European countries had implemented some form of monetary incentive for electric vehicles and/or low carbon vehicles. Taxes on the general car fleet which are based on emissions of CO2 also favor electric vehicles, as their zero tailpipe emissions mean they satisfy the most stringent limits. The range and magnitude of incentives is particularly wide and may consist of:

1. Reductions in car registration tax: Reductions or exemptions in car registration tax can provide a significant monetary incentive for consumers. Examples from Member States include various scheme designs, including restrictions on the weight or type of vehicle that can qualify or caps on the maximum relief per vehicle.

Ireland has chosen to apply reductions in registration tax for a limited period (until the end of 2012) and have placed a cap on the maximum qualifying amount of €5,000 for electric vehicles and €2,500 for plug-in hybrids. Denmark excludes hybrid vehicles from its scheme, but electric vehicles weighing less than 2,000kg are completely exempt from registration tax.

2. Reductions in annual circulation tax: There are many different methods of calculating annual circulation tax in the Member States, which means the maximum potential incentive differs between countries. Many countries have reformed circulation taxes to link with fuel efficiency or CO2 emissions, so that electric vehicles are implicitly subsidised, but some countries have chosen to explicitly favour electric vehicles.

In Italy, new electric vehicles are exempt from the annual circulation tax for the first 5 years after registration. After this period, they qualify for a 75% reduction of the tax rate compared to the equivalent petrol vehicle. In Portugal, electric vehicles are exempt from the circulation tax, whereas hybrid vehicles benefit from a 50% reduction. In Belgium, electric vehicles pay the lowest rate of circulation tax (€71.28).

3. Grants at the point of purchase: This policy has received much attention in Europe. Grants at the point of purchase refer to bonuses or reductions in price when a vehicle is bought, as opposed to other measures where the consumers claim a rebate back later e.g. through reductions in personal income tax.

In the UK, the maximum level of subsidy is £5,000 (€ 5,720) or 25% of the vehicle purchase price. The total budget is £43 million (€49.2 million), which would support the sales of 8,600 vehicles assuming each EV purchaser receives the maximum subsidy of £5,000. Luxembourg offers up to €3,000 per vehicle, provided the purchaser agrees to buy electricity from renewable energy sources. In Portugal, purchasers of the first 5,000 electric vehicles can receive a premium of €5,000, and could qualify for an additional €1,500 if they simultaneously scrap their old car.

Other types of monetary incentive are possible, including reductions in personal income tax and reductions in company car tax. In addition, the Commission encourages solutions at a national or regional level based on traffic management and planning powers, such as free parking, access to restricted zones, use of restricted lanes and exemptions from local charging schemes.

Maximizing the benefits

Evidence suggests that the form of the incentive is just as important as the total subsidy amount. Previous studies (e.g. see Ecolane, 2011 and Diamond, 2009) indicate that consumers are highly sensitive to upfront costs, and less influenced by total cost of ownership, which may explain why schemes which deliver up-front incentives tend to be more effective than those which offer savings post-purchase. In addition, the incentive amount is usually a clear fixed amount, which avoids having to make calculations such as percentage reductions in tax. For the UK grant scheme, between the start of the grant on 1 January 2011 and 30 June 2011, 680 cars were ordered through the scheme. This is a significant increase over previous levels, where only around 270 ultra-low emission vehicles were registered in the whole of 2010 (Department for Transport statistics, 2011).

For tax-based schemes, incentives based on registration tax may be more effective instrument than circulation tax. The literature suggests that registration tax incentives "seem to have a great impact on vehicle purchase decisions". Historical analysis of European data comparing the level of registration taxes and fuel economy improvements for conventional cars between 1970 and 1998 found that countries which favored smaller cars through purchase tax incentives tended to have more fuel-efficient fleets (Ecolane, 2011). However, a review of current incentives offered through circulation taxes suggests that they are not sufficient to promote a switch to new vehicle technologies, as the band differentials are not large enough to affect purchasing behavior (Ecolane, 2011). They may, however, have a symbolic value.

Further consumer research indicates that consumers are much more attracted to things that are "free" (e.g. tax-free) compared to things which have low cost (e.g. a small rate of tax).

It is well-accepted in behavioral economics that people tend to dislike losses more than they like gains, suggesting that an additional cost penalty for non-electric vehicles would have more of an impact than offering incentives for the purchase of electric vehicles.

Mitigation measures

In order to limit costs, many governments have placed a cap on the number of eligible vehicles or total funding allocation, and it can be expected that monetary incentives will be phased out in the medium or long term. Ideally, manufacturers would have been able to achieve cost reductions so that the reduction in incentives will not affect market uptake.

Subsidies should only be employed when the market is ready to accommodate additional uptake of electric vehicles. Therefore, it may be important to combine monetary incentives with infrastructure investment. At current penetration rates, electricity infrastructure should be sufficient to handle the changes in demand due to vehicle charging. However, in the future, high uptake could exacerbate existing challenges with load balancing.

Infrastructure investments which aim to alleviate problems relating to limited range, inconvenient charging and lack of charging infrastructure.

It is likely that inadequate charging infrastructure will delay a widespread shift to electric vehicles. Public charging infrastructure is an important means of counteracting "range anxiety". Many countries have introduced support for electric vehicle infrastructure, focusing on development of charging networks in major cities that serve as demonstration projects. In many cases, access is controlled by cards which enable users to be billed on a subscription or pay-per-use basis.

Maximizing the benefits

In general, provision of public slow charging infrastructure on its own has not successfully stimulated uptake of electric vehicles. However, fast-charging stations are significantly more expensive. A balance between cost and effectiveness has been achieved by several countries who have deployed a mixture of fast- and slow- charging stations.

It is likely that the bulk of recharging will take place at home or at work, which suggests that a key role of public charging infrastructure is to provide peace of mind. Initial results from trials in Berlin suggest that users mostly rely on home charging, and public charging is mainly used in spots close to their place of work, major shopping areas, or transportation hubs (e.g. airports). This implies that public infrastructure would be most useful if provided in these areas.

It is important to note that the overall costs of the measure depend on several factors, including the type of infrastructure and the charge out rate. Charging subscription models are the most effective way to recover the costs.

Also note that despite the initial enthusiasm associated to battery swapping, the concept of battery exchange has problems due to its high cost and the increased number of batteries needed per car. In addition, car manufacturers appear reluctant to engage with the idea, partially due to the design limitations with respect to where they can place the battery in the car.

Policies that aim to achieve behavioural change leading to more efficient use of the transport system

The category 'behavioural change' could be used to refer to a very wide range of policy options in transport, depending on its definition. In some sense, every policy seeks to change the behaviour of actors in the transport system. This section is restricted however to policy options that seek to change the behaviour of end users of the transport system with the aim of reducing emissions, without the need for a change in the technologies used in transport.

Behavioural change policy options have a number of potential advantages:

• In many cases, successful implementation translates immediately to emissions reductions. This is in contrast to many technical measures, e.g. more energy efficient vehicles, where there is a significant lag-time associated with take-up of the technology until it has achieved significant penetration in the vehicle fleet. This is particularly relevant to action under the Effort Sharing Decision, because of the relatively short time left to achieve emissions reduction targets.

• They are believed to be cost-neutral or even cost-negative to the transport user, and relatively inexpensive to governments. In transport, in particular, analysis of the costs of technical options shows that they are often expensive in comparison.

• Non-technical measures can reinforce the benefits of technical measures, by ensuring low carbon technologies achieve market penetration or high utilization.

However, there are also a number of risks and disadvantages associated with this type of policy option:

• European and national governments are rightly unwilling to compromise on the freedoms of their citizens, especially in the area of mobility. Therefore behavioural change policies need to be carefully designed to avoid placing restrictions on users of the transport system that could compromise their quality of life. Furthermore, policies which are perceived by the public to be restrictive often face stiff opposition, even if objective analysis indicates they deliver societal benefits.

• It is very difficult to predict the impacts of behavioural change policy options, or retrospectively measure these impacts. This is due to challenges in isolating the effects of a single policy from numerous other drivers of behaviour. As a result, there is little quantitative information on the effectiveness of these policies.

Behavioural objectives to reduce transport emissions

Optimise energy efficiency of vehicles (in terms of energy use per km travelled): The behaviour of the drivers of manually driven vehicles can have a large impact on the energy efficiency of travel. This is particularly relevant to road transport modes where the driver has a large degree of control over speed and driving style, as well as other decisions such as gear selection which impact on vehicle efficiency. Policy options include giving drivers the skills to drive more efficiently through training, incentivising efficient driving through information campaigns or price signals, and mandating more efficient driving through speed limits.

Optimise the choice of mode for a particular journey or journey section: Where viable alternatives exist, shifting transport demand to more efficient modes can be an effective way of reducing emissions. There is scope in particular in passenger transport to influence behaviour to shift demand from private cars to public transport or non-motorised modes. Policies can help to provide viable public transport alternatives through infrastructure investment and spatial planning, and incentivise modal shift through price signals and provision of information. A variation of this objective is to shift transport demand to more efficient option within a given mode (e.g. shift demand from less to more efficient passenger cars).

Optimise the utilization of transport vehicles (loading or occupancy): Emissions per unit of service demand can be reduced by ensuring that vehicles are operating as close to their capacity as possible. Policies can support higher utilisation by providing infrastructure that facilitates increased loading (e.g. freight consolidation centres) or by prioritizing highly loaded vehicles (e.g. high occupancy car lanes). Price signals would also be expected to increase loading, particularly in the freight sector where response to price signals is expected to be stronger.

Optimise the use of transport systems (whether / where to travel): Behavioural change can lead to a reduction in the requirement for transport. In passenger transport, individuals can change their behavior to consolidate trips, or choose alternatives that avoid trips entirely. Policy can support this through long-term spatial planning to reduce the need for transport, supporting alternatives to transport (e.g. teleconferencing and telecommuting) and providing price signals to give a disincentive towards unnecessary travel.

The behavioural objectives outlined above can be influenced by policy through a number of levers. Levers to influence behaviour include:

• Planning (spatial planning to reduce the need for transport or to incentivise sustainable options)

• Information, education and public engagement

• Influencing the price of transport options

• Direct regulation

• Infrastructure investment (ensuring there is appropriate infrastructure for preferred travel options and restricting allowances of infrastructure for unsustainable options).

	Optimise energy efficiency of vehicles (in terms of energy use per km travelled)	Optimise the choice of mode for a particular journey or journey section	Optimise the utilisation of transport vehicles (loading or occupancy)	Optimise the use of transport systems (whether / where to travel)
Information, education, public engagement	Eco-driving schemes CO2 information campaigns	Public transport / travel choices information campaigns	Car sharing information campaigns	Travel choice information campaigns Teleworking campaigns Improved public transport information
Direct regulation	Enforced / reduced speed limits Mandate eco-driving (e.g. in driving test, professional driver training)			
Infrastructure investment / restriction	Optimise infrastructure for smooth traffic flow Dedicated infrastructure for public transport (e.g. bus rapid transit)	Investment in public transport / walk & cycle infrastructure Improved intermodal links (passenger and freight) Parking restrictions Bus lanes	High occupancy car lanes Freight consolidation centres Parking restrictions	Communications infrastructure to reduce the need for travel to communicate (e.g. commuting, business meetings)
Spatial planning		Improved spatial access to public transport Amenities accessible by walking & cycling Improved intermodal links		Spatial planning to reduce travel needs (e.g. mixed use developments)
Pricing	Increased fuel price	Increased fuel price Subsidised public transport Congestion charging Vehicle pricing	Increased fuel price Congestion charging	Increased fuel price Congestion charging

The table shows policies available to Member States in each of these policy areas, and their behavioural objectives.

Behavioural change policies may not always be universally applicable across Europe. Whilst some behavioural trends in transport are common across Europe, others vary widely between or within Member States.

Speed management measures in road transport

Most European countries impose maximum speed limits on all their roads, and many also impose different speed limits for different classes of vehicle. These are in place for a variety of reasons, including safety, traffic management and fuel consumption. However, they are not usually optimized for the latter: a typical passenger car is most fuel efficient at around 80 km/h, but European motorway speed limits are typically 120-130 km/h. At high speeds, when air resistance dominates vehicle resistive force, power demand increases with the cube of speed – so a reduction in speed leads to a significant reduction in fuel consumption.

Between March and July 2011, the Spanish Government cut the speed limit on its motorways from 120km/h to 110km/h. Its motivation for doing so was not ostensibly environmental – Spain imports most of its transport fuel, and high oil prices combined with a challenging economic climate within Spain triggered this move in an attempt to reduce the nation's fuel bill. This would in theory lead to a reduction in money leaving Spain to pay foreign oil companies, with resulting economic benefits. The Spanish Ministry of Industry, Tourism and Commerce (2010) announced after the first month of the policy that seasonally adjusted fuel consumption had decreased 8.4% over the same month the previous year, compared with a 1.2% rise in January and a 1.6% decline in February. They estimated that this equated to a saving of 177,000 tonnes of transport fuel, and avoided €94 million of oil imports. Elsewhere in the media it was reported that speeding fines also dropped by 35% in March, and that over the four months of the reduced speed limit traffic accidents have reduced by 15% on the same period in the previous year, though it is not clear how much of this reduction is from motorways. In July, the higher speed limit was reinstated. The policy was always intended to be temporary, and was highly controversial amongst many Spanish stakeholder groups.

Maximising the benefits

According to the EEA, around 40–50 % of drivers (up to 80 % depending on the country and type of roads) drive above legal speed limits. Therefore, enforcement is essential to achieve concrete results.

In addition, current vehicles peak in fuel efficiency around 80km/h. Therefore, the greatest improvements in fuel economy through speed management occur when reducing speed limits on faster roads (usually motorways).

The additional benefits of lower speed limits, including increased safety, reduced noise and air pollution, and improved traffic flow can significantly improve the case for action. Therefore, lowering speed limits on roads where these co-benefits have a positive impact (typically roads in urban and suburban areas) results in an improved benefit:cost ratio. Where heavy goods vehicles make up a large proportion of traffic, reductions in emissions may be limited as these vehicles are often already restricted to lower speeds.

On the other hand, the enforcement technology represents a high investment cost, as well as an annual operating cost. Automatic fines for drivers will remove the need for manual monitoring. Although this technology will aid the recovery of fines, it will be expensive to install and operate.

Speed restrictions on a wider scale and on longer lengths of road could be more effective and the surrounding area should be checked to ensure that traffic is not displaced from the regulated area in an attempt to evade the speed limit.

Eco-driving programmes

Eco-driving involves training drivers to modify their driving style in a way that reduces fuel consumption and emissions. This may involve actions such as timely gear changes, smooth deceleration and anticipation of traffic flows. Other elements may include reducing use of air conditioning, minimizing idling and regular servicing. Uptake can be promoted through awareness campaigns, subsidized schemes or mandatory training. Drivers may reduce their fuel consumption by up to 25% directly after training, with an average saving of 5 – 10% (TNO, 2006). While many studies confirm the

Range of policy options

Policy option	Barriers addressed	Policy sub-types
Research and /spending programmes to support new technologies	Lack of awareness of ecodriving techniques Lack of awareness of the benefits of eco-driving	Eco-driving demonstration programs
Information provision, education and public engagement	Drivers are unwilling to adapt Lack of awareness of ecodriving techniques Lack of awareness of the benefits of eco-driving	Mass information campaigns Targeted campaigns (e.g. driving schools, fleet managers) Training of driving instructors Competitions
Voluntary or incentivized negotiated agreements	Lack of awareness of ecodriving techniques Lack of awareness of the benefits of eco-driving Eco-driving training is unavailable	Voluntary agreements with companies to apply eco-driving programmes (e.g. leasing companies) Voluntary agreement with car manufacturers or dealers to provide a voucher for an eco-driving course to customers
Market-based (economic or fiscal) instruments	Drivers have low skill Lack of awareness of ecodriving techniques Lack of awareness of the benefits of eco-driving Eco-driving training is unavailable Cost of training	Subsidized courses Subsidized tools which assist more fuel efficient driving styles Fuel taxes (indirect)
Direct regulations	Drivers have low skill Lack of awareness of ecodriving techniques Lack of awareness of the benefits of eco-driving Eco-driving training is unavailable	Mandatory inclusion of eco-driving in driving lessons Mandatory inclusion of ICT that facilitiates eco-driving techniques (e.g. EC 661/2009 which mandates the fitment of gear shift indicators)

initial benefits, the long-term effects are less well-documented and are likely to be smaller. Longevity may be increased by follow-up measures.

Ecodriving has enjoyed wide support in Europe. The majority of countries provide some sort of direct training, but other types of policy include competitions, information campaigns, voluntary certification schemes or demonstration projects. Many countries aim policies at drivers of passenger cars, since this tends to be the largest group of road users.

In addition, several Europe-wide initiatives have been introduced, with great success. For example, between 2006 and 2008, a synchronised campaign ran in 9 European countries under the ECODRIVEN project. It aimed at licensed drivers of passenger cars, delivery vans, lorries and buses. Over 20 million licensed drivers were reached, and 1Mton CO2 was avoided between 2006 and 2010. EcoWILL is a large pan-European project running from May 2010 until April 2013, coordinated by the Austrian Energy Agency. Programmes are aimed at both licensed and learner drivers in 13 European countries. It aims to train at least 500 driving instructors, 10,000,000 learner and novice drivers and 10,500 licensed drivers. The expected results are fuel savings of 5 – 10%, avoiding 8 Mtons of CO2 until 2015.

Maximising the benefits

The most cost-effective way of spreading eco-driving is to integrate it into standard driving lessons. TNO (2006) estimates the cost to be around €1 per driver. The training is likely to be more effective for novice drivers, as it establishes eco-driving as a normal way of driving instead of attempting to change habits.

In general, it has been found that half-day courses are very effective, but too expensive for the mass market, so they tend to be reserved for the worst performing drivers only. Costs for a typical 4-hour course are around €50 – €100 (TNO, 2006). (ECODRIVEN, 2008). An alternative which has proven very effective is short-duration "snack" training. Evidence shows that lessons lasting an hour or less can result in substantial improvements – in the EST-Ford study, nearly 500 drivers managed to improve their fuel consumption by an average of 22.5% in lessons lasting 50 minutes (EST, 2008). Even cheaper still are eco-driving simulators, although they tend not to be as effective as on-road training. A pedal, steering wheel and CD ROM together cost around €80, and can be used to convey the key messages (ECODRIVEN, 2008).

The average annual distance of travel is significantly larger for commercial vehicles than for passenger cars; accordingly, the potential benefits per driver could be larger for commercial vehicles. In Austria, more than 1,700 bus drivers were trained in 2007, resulting in an average reduction in fuel consumption of 10.5% (ECODRIVEN, 2008).

Quality standards are also important to ensure confidence in the outcomes. Trainers can be certified after they have completed standard education and their performance should be monitored periodically. In Germany, the German Road Safety Board requires trainers to obtain a formal Driving Instructors Licence, a permission for Driving Intervention Courses, training courses on eco-driving, specific Train-the-Trainer Instructions and a certification according to DIN EN 45013 (Ecodriving Europe, 2004). The certificate must be renewed every four years on the basis of further training.

In terms of promotional efforts, the costs vary depending on the measures used. Introducing eco-driving into standard tuition is a low-cost measure; a mass campaign to reach experienced drivers would be more expensive. In the Netherlands, a mass media campaign included a series of TV adverts that ran for many years. Approximately half of the total programme budget was required for setting up of the communication campaigns (EEA, 2008). A budget of €10 million was allocated for the first phase (1999-2005), rising to €15 million for the second phase. Experience suggests that communication campaigns, supported by information materials, can improve fuel efficiency by around 5% for people who follow the advice (IEA, 2007). For smaller campaigns, cheaper materials can be used such as posters and fliers, which can be scaled to suit any budget. Very often, they will direct people to a website where they can access more in-depth information.

Ensuring co-operation with the training is a difficulty, particularly when attempting to change habits of experienced drivers. Outcomes from programmes in the Netherlands and Belgium suggests that partnering with commercial organisations helps with credibility, because the target groups take these organisations more seriously than governmental organizations (ECODRIVEN, 2008).

Examples of equipment that can support eco-driving techniques include cruise control and fuel consumption gauges. However, few countries have introduced fiscal incentives to stimulate the uptake of instrumentation, as it can be an expensive option. The Netherlands is one example, where incentives achieved uptake of 75% of new cars – but the programme was so successful that it had to be ended because of the unexpectedly large shortfall in tax revenue (IEA, 2007). The scheme did result in long-term benefits, as car manufacturers continued to supply the equipment after the incentives were withdrawn in order to avoid falling behind competitors.

2.5. Industry sector

This section is focused on policies for the industry sector. A clear distinction should be made between the industrial sectors under the EU emissions trading system (EU ETS) and the rest of industrial activities, which are included in the EU effort sharing decision.

2.5.1. The EU Emissions Trading Scheme (EU ETS)

The EU ETS is a cornerstone of the European Union's policy to combat climate change and it's a key tool for reducing industrial greenhouse gas emissions and improving the use of energy in a cost-effective manner. The first - and still by far the biggest - international system for trading greenhouse gas emission allowances, the EU ETS covers more than 11,000 power stations and industrial plants in 31 countries, as well as airlines.

The EU ETS works on the 'cap and trade' principle. A 'cap', or limit, is set on the total amount of certain greenhouse gases that can be emitted by the factories, power plants and other installations in the system. The cap is reduced over time so that total emissions fall. In 2020, emissions from sectors covered by the EU ETS will be 21% lower than in 2005.

Within the cap, companies receive or buy emission allowances which they can trade with one another as needed. They can also buy limited amounts of international credits from emission-saving projects around t he world. The limit on the total number of allowances available ensures that they have a value.

After each year a company must surrender enough allowances to cover all its emissions, otherwise heavy fines are imposed. If a company reduces its emissions, it can keep the spare allowances to cover its future needs or else sell them to another company that is short of allowances. The flexibility that trading brings ensures that emissions are cut where it costs least to do so.

By putting a price on carbon and thereby giving a financial value to each tonne of emissions saved, the EU ETS has placed climate change on the agenda of company boards and their financial departments across Europe. A sufficiently high carbon price also promotes investment in clean, low-carbon technologies.

In allowing companies to buy international credits, the EU ETS also acts as a major driver of investment in clean technologies and low-carbon solutions, particularly in developing countries.

Launched in 2005, the EU ETS is now in its third phase, running from 2013 to 2020. A major revision approved in 2009 in order to strengthen the system means the third phase is significantly different from phases one and two and is based on rules which are far more harmonized than before. The main changes are:

- an EU-wide cap on allowances, as opposed to 27 individual Member State caps, decreasing by 1.74% annually, up to and beyond 2020, providing much greater regulatory predictability and stability
- auctioning as the default system of allocation in phase 3 (2013-2020). In 2013 more than 40% of general allowances will be sold through auctioning, and this proportion will rise progressively in the following years.
- harmonized rules for free allocation, based on performance benchmarks established prior to phase 3
- stricter rules on the type of international credits that are allowed for use in the EU ETS
- replacement of 27 national electronic registries by a single Union registry

While emissions trading has the potential to cover many economic sectors and greenhouse gases, the focus of the EU ETS is on emissions which can be measured, reported and verified with a high level of accuracy. The system covers the following greenhouse gases and sectors:

- Carbon dioxide (CO_2) from:
  - Power and heat generation
  - Energy-intensive industry sectors including oil refineries, steel works and production of iron, aluminium, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals
  - Commercial aviation
- Nitrous oxide (N_2O) from production of nitric, adipic, glyoxal and glyoxlic acids
- Perfluorocarbons (PFCs) from aluminium production

Participation in the EU ETS is mandatory for companies operating in these sectors, but in some sectors only plants above a certain size are included. Governments can exclude certain small installations from the system if fiscal or other measures are in place that will cut their emissions by an equivalent amount.

To address the competitiveness of industries covered by the EU ETS, production from sectors and sub-sectors deemed to be exposed to a significant risk of 'carbon leakage' will receive a higher share of free allowances in the third trading period between 2013 and 2020. This is because they face competition from industries in third countries which are not subject to comparable greenhouse gas emissions restrictions.

Free allowances are in principle allocated on the basis of product-specific benchmarks for each relevant product. The benchmarks are multiplied by a historical production figure and some other factors that are needed to ensure the respect of the annually decreasing total cap on ETS allowances.

For the sectors and sub-sectors included in the 'carbon leakage' list, the free allocation is multiplied by a factor of 1 (100%) while for other sectors the allocation will be multiplied by a lower figure (80% in 2013, reducing every year to reach 30% in 2020). The "exposed" sectors are thus not exempted from the ETS. Furthermore, given that the benchmarks are based on the most efficient installations, only the most efficient installations in each sector receive for free an amount of allowances that may cover all their needs.

For commercial airlines, the system covers CO_2 emissions from flights within and between countries participating in the EU ETS (except Croatia, until 2014). International flights to and from non-ETS countries are also covered. Power stations and other fixed installations have a separate emissions cap from aviation because different types of allowances are issued for the two parts of the EU ETS. Allowances issued for fixed installations are general allowances, while the aviation sector has aviation allowances. Airlines can use both types of allowances for compliance purposes, but fixed installations cannot use aviation allowances.

Altogether the EU ETS covers around 45% of total greenhouse gas emissions from the 27 EU countries.

The example of the EU ETS has inspired other countries and regions to launch cap and trade schemes of their own such as Australia, South Korea and China. The EU aims to link up the ETS with compatible systems around the world to form the backbone of an expanded international carbon market. The European Commission has agreed in principle to link the ETS with Australia's system in stages from mid-2015. A full two-way link between the two cap-and-trade systems will start no later than 1 July 2018, as agreed with the Australian Minister for Climate Change and Energy Efficiency. Under this arrangement, businesses will be able to use carbon units from the Australian emissions trading scheme or the EU ETS for compliance under either system. An interim link will be established from 1 July 2015 enabling Australian businesses to use EU allowances to help meet liabilities under the Australian emissions trading scheme until the full link is established, i.e. no later than 1 July 2018.

Based on a mandate from the Council, the Commission is also negotiating with Switzerland on linking the EU ETS with the Swiss ETS.

The EU ETS legislation allows participants to use most categories of credits from the Kyoto Protocol's Clean Development Mechanism (CDM) and Joint Implementation (JI) mechanism towards fulfilling part of their EU ETS obligations. The EU wants to see JI and CDM further reformed in order to improve their environmental integrity and efficiency e.g. through more use of standardized baselines and alternative ways of assessing additionality. For advanced developing countries CDM offsets should be replaced over time by a new market mechanism covering broad segments of the economy and incentivizing net emission reductions, such a mechanism would go beyond the pure offsetting of emissions and could form a stepping stone towards a system of globally linked economy-wide cap-and-trade systems. The new mechanism would help major developing countries to scale up their efforts to reduce greenhouse gas emissions in the most cost-effective way, while CDM would then be focused on least developed countries.

Currently, the ETS faces a challenge in the form of a growing surplus of allowances, largely because of the economic crisis which has depressed emissions more than anticipated. In the short term this surplus risks undermining the orderly functioning of the carbon market; in the longer term it could affect the ability of the EU ETS to meet more demanding emission reduction targets cost-effectively.

The Commission has therefore taken the initiative to postpone (or 'back-load') the auctioning of some allowances as an immediate measure, while also launching a debate on structural measures which could provide a sustainable solution to the surplus in the longer term. These possible measures include:

• Increasing the EU reduction target to 30% in 2020.

In this case, there would need to be a consequential amendment to the quantity of allowances in the EU ETS either via a permanent retirement of allowances or a revision of the annual linear reduction factor.

This option would not only require changes to the quantity of allowances in the EU ETS but also affect the targets adopted under the Effort Sharing Decision.

• Retiring a number of allowances in phase 3 (2013-2020).

The measure can be effective in addressing the overall supply-demand imbalance over phase 3. It would implicitly increase the numerical reduction target for 2020 and thus (partially) restore the ambition level of the climate-energy package, but it would not directly affect the framework after 2020.

• Early revision of the annual linear reduction factor (set at 1.74% annually).

The Directive foresees a review of the linear factor as from 2020 with a view to the adoption of the decision to change it by 2025. This review could be advanced, lowering the total amount of allowances available and impacting the ambition level after 2020. As such the linear factor could be set at levels in-line with an overall EU target of 30% GHG reductions compared to 1990. The current linear factor leads to a just over 70% reduction in the ETS cap by 2050, which is not consistent with the EU's agreed long term objective of 80-95% reduction by 2050 compared to 1990, as the Commission has pointed out in the 2050 Low-carbon Roadmap.

• Extension of the scope of the EU ETS to other sectors, less strongly influenced by economic cycles (whereas the emissions in the EU ETS decreased in 2009 by more than 11%, in the sectors outside the EU ETS this reduction was only around 4%).

• Limit access to international credits.

The regulatory framework could be crafted in a manner that initially allows for no or much more limited access to international credits. This would create more certainty about the effort to be undertaken in Europe and thus could spur indigenous investment in low carbon technologies, instead of external monetary and technology transfers through the EU ETS. This may, however, have to be balanced against adverse impacts on financial flows and transfer of technology to developing countries.

• Discretionary price management mechanisms.

To achieve the EU goals of promoting emission reductions in a cost-effective manner as well delivering gradual and predictable reductions of emissions over time, the EU ETS is designed as a quantity-based instrument, where a predefined quantity of emission allowances is issued determining the environmental outcome. It is the scarcity of allowances, together with the flexibility provided by the ability to trade, that sets the carbon price in the market in the short, medium and long term. To reduce volatility and prevent price drops due to temporary mismatch between supply and demand, two mechanisms could be conceived as a temporary way of supporting the carbon price:

• As from the third trading period a large amount of allowances will be auctioned, a carbon price floor has been discussed as a feature applied primarily in the primary market, i.e. for auctions. A carbon price floor would create more certainty about the minimum price, giving a better signal for investors.

• A mechanism could be devised that adjusts the supply of allowances, when the carbon price would be affected by a large temporary supply-demand imbalance, by means of a price management reserve. If decreases in the demand were to generate an excessive price decrease below a certain level deemed to affect the orderly functioning of the market, an amount of allowances to be auctioned could be deposited in such a reserve. In the opposite case, allowances could be gradually released from the reserve. The reserve could initially be funded by reducing phase 3 auction volume by an amount corresponding to a substantial share of the accumulated surplus. The rulebook could foresee the permanent retirement of some allowances, in case the size of the reserve would exceed a certain magnitude.

Discretionary price-based mechanisms, such as a carbon price floor and a reserve, with an explicit carbon price objective, would alter the very nature of the current EU ETS being a quantity-based market instrument. They require governance arrangements, including a process to decide on the level of the price floor or the levels that would activate the reserve. This carries a downside in that the carbon price may become primarily a product of administrative and political decisions (or expectations about them), rather than a result of the interplay of market supply and demand.

2.5.2. The Effort Sharing Decision and the industry sector

The following section of the report focuses on policies within the industry sector (as far as not covered by the EU Emission Trading Scheme). A series of case studies illustrate examples of existing best practice policies.

2.5.2.1. Characteristics of the industry sector under the ESD

The ESD excludes greenhouse gas emissions covered by the (consolidated) Directive 2003/87/EC (establishing a scheme for greenhouse gas emission allowance trading within the Community) from its field of application. For the industry sector this implies that the most energy-intensive installations such as blast furnaces, cement kilns, glass furnaces etc. are not covered by the ESD. However, even if larger emitters are excluded, this does not imply that the ESD only addresses small and medium-sized companies. The industry sector covered by the ESD is certainly made up of a large number of small and medium-sized enterprises (SMEs), which have particular characteristics, but also features larger companies which have thousands of employees but are less energy-intensive, such as those in the engineering and transport equipment sectors.

It is also important to underline that, whilst a variety of policies and measures addressing the sector typically consider all emissions (including emissions from electricity consumption), only direct combustion emissions will (in most cases) be captured by the ESD.

It is though important that savings from electricity consumption are also taken into account when considering policies. While the EU ETS is an important driver of emissions reductions associated with electricity consumption, the price signal from the EU ETS alone may not sufficient to deliver large reductions in consumption. Therefore, additional policies addressing specific barriers to electricity savings in industry can be justified, beyond the price signal from the EU ETS.

Industrial emissions covered by the ESD cannot be estimated as easily as emissions from other sectors due to uncertainties about the split between industrial emissions falling within the scope of the ESD and those within the scope of the EU ETS. An estimated 46 % of industrial GHG emissions (out of this around 73 % CO_2-related, and around 62 % due to energy-related CO_2) were captured by the ESD, but due to the current wider scope of the EU ETS after 2012, this has fallen to 37 %.

The analysis of the emissions shows that the industry sector under the ESD is smaller than the transport and buildings sectors, but has relatively rapidly increasing emissions for the time horizon of 2020. But most of the potentials in the non-ETS industries are cost-effective and equally split across Member States.

Energy efficiency options are the most important fields of action in the non-ETS industries. Actions to reduce emissions from non-traded industries include lowering the space heating demand (some non-ETS industries have 50 % space heat shares), more efficient industrial steam boilers (around 30% of industrial fuel use is for generating steam), improved furnaces and dryers and improved industrial processes.

There are large indirect reduction potentials in non-ETS industries due to electricity savings. Although the issue of indirect emissions from electricity use spans every sector, it is particularly relevant for the non-ETS industries. These potentials include measures that are cost effective (where the savings arising outweigh the costs) but their take up may be hampered by non-economic barriers. The price signal from the EU ETS, which is realized through higher electricity prices to industrial end users, provides a further financial stimulus to companies. However, the existence of these non-economic barriers means that this stimulus alone is not sufficient to deliver the full potential and further policy interventions are required.

The need for policy intervention

Energy efficiency has been identified as a major way to reduce emissions from ESD industries alongside the introduction of more low- or zero-carbon fuels in the sector. Theory and practice have identified a variety of barriers to these options in industrial companies which may justify policy intervention:

• According to Jaffe and Stavins (1994), the barriers to such options can be separated into non- market-failure barriers (private information costs, high discount rates, heterogeneity among potential adopters, hidden costs, access to capital) and market-failure barriers (such as imperfect information, principal-agent relationships, split incentives and adverse selection).

• Behavioral science points to barriers such as the form of information available, the credibility of information sources, inertia, and culture or values.

• Organizational theory identifies as barriers the power or status issues within an organization associated with energy efficiency and its management.

• Further barriers are indicated by transaction cost economics and behavioral economics (Golove and Eto, 1996; Sorrell et al., 2004).

Focusing on ESD industries, in particular the high share of SMEs, such barriers translate as:

• lack of knowledge and market surveys of energy managers, particularly in SMEs, as well as of consulting engineers, architects, installers, bankers;

• high transaction cost of the energy manager (searching for solutions, tendering, decision preparation and decision-making). Due to their size and the low share of energy in their expenditure, the transaction costs of searching for funding for energy-saving measures are too high in SMEs;

• lack of own capital, fear of borrowing more capital for off-site investments (banks: risk of liquidation; companies: future possible change in production);

• technology producers or wholesalers often pursue their own interests which may contradict the possible innovative steps of efficient solutions; and

• 80% of companies based their decisions only on risk measures (payback period), but not profitability indicators (e.g. internal interest rate). Therefore, profitable options are rejected in the decision-making process.

The ESD industry comprises a heterogeneous group of companies and policy instruments need to be tailored to address these different groups of companies and their specific barriers along the product cycle, as well as the barriers for other actors to the diffusion of low-carbon technologies (technology suppliers, intermediaries such as wholesalers etc.):

• SMEs may need a special coaching process to adopt energy-efficient solutions as well as special tool boxes to reduce their transaction costs. In order to overcome the investment barriers, it is important to promote such activities more strongly, e.g. via energy efficiency funds.

• Larger companies under the ESD may suffer less from investment barriers but may be subject to non-economic barriers such as split incentives or lack of information/motivation.

2.5.2.2. Policy options

It is important to distinguish between economic and non-economic barriers to low carbon and energy-efficiency options. In order to map policies, we have to distinguish different levels:

• fuels and electricity (this separation is relevant to distinguish the ETS/non-ETS parts of industry, although there are strong interactions, e.g. through fuel substitution).

• the type of industrial energy use:

• Industrial cross-cutting technologies (such as electric motors and electric motor systems: pumps, ventilation, compressed air, industrial steam generators, etc.) which are used in many industrial branches;

• cross-cutting technologies with specific branch characteristics (in particular industrial dryers and furnaces). These can be applied in different industrial branches but are not exactly identical and need to be adapted to the sector's specifications;

• process technologies (e.g. chemical or metallurgical reactors, etc.) which are specifically adapted for a particular industrial branch.

• the size of companies (from small to very large).

• the complexity of energy use.

• the type of barriers to be overcome by the policy instruments (in particular the distinction between economic barriers and non-economic barriers).

• the exposure to international and national competition.

The large number of dimensions may help to explain why it is more difficult to tackle the industrial sector with a comparatively small number of instruments than is the case for other more homogeneous sectors such as the building sector.

EU policy landscape

A variety of instruments exist to promote low-carbon technologies in the ESD industries at EU level; the most important instrument, the EU ETS, is not directly relevant for non-ETS industries, except that it provides a carbon price signal to companies outside the EU ETS as well via the price of energy carriers covered by the ETS, including electricity. However, the present low level of the carbon price signal has limited indirect impacts on company choices. The carbon price signal occurs in the context of general energy taxation within the EU and the carbon price for non-ETS industry is responsible for only a small part of the energy carrier retail price.

Other EU policies relevant for ESD industries comprise:

• Community framework for the taxation of energy products and electricity (Directive 2003/96/EC), which sets minimum taxation levels. However, at present, a larger number of companies benefit from tax exemptions but have to provide in exchange more or less relevant efforts in the form of voluntary approaches to enhance energy efficiency and/or reduce emissions. Such tax exemptions tend to be increasingly linked to energy efficiency measures, or at least to the introduction of energy management in companies.

Note that the European Commission on 13 April 2011 presented its proposal to overhaul the outdated rules on the taxation of energy products in the European Union. The new rules aim to restructure the way energy products are taxed to remove current imbalances and take into account both their CO2 emissions and energy content. Existing energy taxes would be split into two components that, taken together, would determine the overall rate at which a product is taxed. The Commission wants to promote energy efficiency and consumption of more environmentally friendly products and to avoid distortions of competition in the Single Market.

• Regulation on Combined Heat Power (Cogeneration) (Directive 2004/8/EC). An update of this directive through the Energy Efficiency Directive is focused in high efficiency cogeneration.

• Integrated Pollution Prevention and Control Recast through the Industrial Emissions Directive (Directive 2010/75/EU), which has some, albeit weak, provisions for energy management.

• The Energy Performance Directive for Buildings (EPBD), which sets standards for buildings and is particularly relevant for ESD industries because in some sectors space heating represents 50 % of the energy consumption of the branch (e.g. in the engineering sector).

• The Eco-design Directive sets standards for a variety of products also in the industrial sector. These concern mainly electricity uses (e.g. minimum standards for electric motors) but some thermal cross-cutting applications in industry such as small to medium-size boilers not covered by the ETS and industrial ovens are also included.

• The Energy Efficiency Directive establishes the introduction of mandatory audits and energy management schemes.

So far, most of these policies have had a limited impact on ESD industries in the Member States.

National policies

National polices have been implemented at Member State level to reinforce existing EU-wide initiatives, to provide additional policy stimulus at national level and to reflect national circumstances.

The following policies are applied to the industry sector:

• Financial/ fiscal incentives

• Regulations for industrial energy efficiency

• Legislative- although measures such as the setting of minimum energy performance standards for industrial cross-cutting technologies are now mostly the domain of the European Commission)

• Legislative-informative measures: mandatory energy managers/audits/reporting of energy consumption and energy saving measures

• Information provision/education/ training measures

• Voluntary/negotiated agreements (cooperative measures)

• New market-based instruments

Two important options to overcome economic and non-economic barriers further described are: financial/ fiscal incentives and voluntary/negotiated agreements, respectively, which are widespread across countries. The next sections provide a brief introduction to the other instruments relevant for ESD industries (Eichhammer 2009).

Regulations

Regulations for industrial energy efficiency play a role in setting minimum energy performance standards (MEPS) under the Eco-design Directive (which is now mainly handled at EU level) and in the field of mandatory energy managers, mandatory energy audits, mandatory reporting of energy consumption and energy-saving measures. In addition, there may also be regulation promoting industrial CHP. In general, however, this tends to be done through financial incentives and special tariffs. These two main groups of measures will be briefly discussed in the following.

Minimum energy performance standards for industrial cross-cutting technologies are implemented under the EU Eco-design Directive (2005/32/EC) and the follow-up Directive 2009/125/EC of 21 October 2009 which establishes a framework for ecodesign requirements for energy-related products (recast), the most important regulative measure for energy efficiency in the industrial sector. This framework obliges manufacturers of energy-using products to reduce at the design stage energy consumption and other negative environmental impacts occurring throughout the product life cycle. The Eco-design Directive introduces minimum efficiency standards for up to 40 products which cover – besides the industrial sector – the tertiary and the building sectors as well. The standards for electric motors and pumps and for ventilation fans are very influential in the industrial sector, but these are related to electricity consumption. Directly relevant for the ESD are regulations being prepared for boilers, industrial ovens, central heating products other than CHP (relevant for industrial space heating) and local room heating products.

There have been some doubts about the efficiency of regulatory measures for the industry sector because the norms set are often well below the levels set by the Best Available Technology. This can also be observed for the Eco-design Directive to some degree. In many cases it has been found that the full impact of the Directive will only be reached after seven years. Also a further tightening of the standards seems possible. Therefore, the major impacts from the Eco-design process in industry can only be expected and evaluated some years from now. The standards comprise dynamic elements. If these elements are further strengthened and tightened, the Eco-design Directive could become a very powerful instrument.

So far, mandatory energy management is not a widespread measure and does not play a very prominent role in practice. One reason for this may be that large companies have energy managers while SMEs, where this is most relevant, have staffing problems with the activities. Also mandatory energy audits do not seem to be widespread. The energy efficiency directive faces this situation but the disadvantages of mandatory audits include producers' perceptions of the mandatory nature of the instrument as an administrative burden rather than as a process helping them to reduce costs or become more competitive.

Information, education, training

Informational measures are considered relevant complements to other measures despite the fact that their direct impacts are considered to be low. Despite this, these measures tend to be implemented by most EU MS for the industrial sector. In recent years, more information programmes have been directed at the industrial sector – these programmes are generally part of more general information campaigns across all sectors.

The information offered can cover a broad range of issues such as energy cost mentoring by energy advisers for smaller companies, information on financial assistance, guidance documents, educational road shows and training energy managers.

Market-based instruments

There are three main types of new market-based instruments:

- EU Emission Trading Scheme
- Use of the Clean Development Mechanism (CDM) and Joint Implementation (JI) for improving energy efficiency, mostly in countries outside the EU, and accounting for the savings under the Kyoto Protocol
- Energy Efficiency Obligations/White Certificates

The EU ETS is considered to be one of the most important instruments for the reduction of greenhouse gases in the energy sector and the industrial sector but does not cover all industries. In order to meet their emissions reduction targets under the EU ETS, firms can also conduct CDM and JI projects. These have been set up as flexibility mechanisms under the Kyoto Protocol to save greenhouse gas (GHG) emissions, and in particular energy, outside the EU.

A White Certificate is both an accounting tool which proves that a certain amount of energy has been saved in a specific place and time and a tradable commodity which initially belongs to the person inducing the savings, and which can then be traded according to the market rules, but with only one owner at a time. However, White Certificates are mostly focused on the residential sector and are used less to improve industrial energy efficiency, although there are exceptions like Denmark, where 60% of the measures concentrate on the industrial sector.

2.5.2.3. Best practice examples

Four important areas have been identified:

- Financial support and incentive programmes for industrial energy efficiency are present in many Member States and constitute the most widespread type of instrument in the industrial sector. They help to overcome the upfront investment barrier which is relevant for many companies, despite the fact that many energy-efficiency measures are economic and pay back over time. An important issue is to secure stable financing to compensate for erratic state budgets, especially in times of budget rigor.

- There is a particular gap with respect to smaller companies, both about information on their energy consumption as well as with regard to support for realizing measures. Specific financial instruments for SMEs are being developed in some Member States (such as, for example, the SME Special Fund in Germany).

- Voluntary/negotiated schemes to improve energy efficiency and reduce GHG emissions in the industrial sector have been implemented in many Member States with varying degrees of success. Key to the success of these instruments was to link the option to the intrinsic motivation of companies and to complement the measure with further policy options, such as subsidy schemes, audit schemes and information.

- An important gap appears with respect to today's practice of energy efficiency in medium-sized companies: that is, the perception of transaction effort and of motivation of companies to save energy and to implement low-carbon options. This gap may be suitably covered by the newly developed instrument of Learning Energy Efficiency Networks. This instrument helps to lower transaction costs for the companies, is at present developed in Switzerland and Germany.

Financial/fiscal measures and cooperative measures (in particular voluntary/negotiated agreements) are among the most widely adopted types of measures.

In order to shed further light on gaps in policy intervention, the new provisions under the Energy Efficiency Directive state the following:

- With respect to energy audits, the Energy Efficiency Directive requires regular mandatory energy audits for large companies. However, voluntary actions are admitted as a substitute for mandatory audits. The Directive also lays down a series of requirements of energy companies regarding metering and billing, and specifies that Member States shall develop programmes to encourage small and medium-sized enterprises to undergo energy audits and the subsequent implementation of the recommendations from these audits.

- With respect to White Certificates/Energy Saving obligations, the Energy Efficiency Directive requires Member States to establish national energy-efficiency obligation schemes to ensure that either all energy distributors or all retail energy sales companies operating on the Member State's territory achieve annual energy savings equal to 1.5% of their energy sales, by volume, in the previous year in that Member State, excluding energy used in transport. The amount of energy savings to fulfil the obligation shall be achieved by the obligated parties among final customers, designated, as appropriate, by the Member State or, if Member States so decide, through certified savings stemming from other parties.

Policies to overcome economic barriers

This section is focused on policies to overcome economic barriers such as, for example, the upfront investment barrier, low payback as compared to usual company requirements, etc. It is necessary in this case to adapt the instruments to the size of the company (amount of energy consumption) and to the complexity of the energy-consuming system.

In terms of the size of the companies/ amount of energy consumption:

• Larger companies (if carbon-intensive) are subject to the emission trading scheme which provides (in principle) an economic signal to the actors, if the cap is low enough and the carbon price sufficiently high.

• Medium-sized companies may be supported through the introduction of White Certificate schemes and the organization of energy services markets, e.g. based on energy performance contracting. They may also be supported in realizing measures through energy efficiency funds.

• Smaller companies may benefit from special soft loans and grants to carry out energy- efficiency measures which do not contradict state aid provisions.

Cross-cutting to the instruments which are adapted to the size of the companies, there is the instrument of energy taxation (including the issue under which conditions companies may be exempted from taxation, e.g. if they carry out certain types of energy-efficiency measures).

Financial and fiscal incentive measures constitute the most frequent type of measures used in the industrial sector to overcome economic barriers. Subsidies help to overcome investment barriers, and are particularly important where measured energy savings have a high upfront capital cost. They are often used in combination with other types of measures, e.g. energy auditing, which increases their efficiency. Fiscal incentives, however, may not overcome other barriers to energy efficiency, such as information deficits. Hence, these measures are often implemented in combination with other measures, such as information campaigns.

Currently available financial and fiscal incentives cover a broad range of industrial applications, with cross-cutting technologies generally better covered than process-specific technologies. It is also notable that certain technologies are subject to a special focus, for example, combined heat and power (CHP). There are two main reasons why cross-cutting technologies are better covered in subsidy schemes than process-specific technologies, in particular:

• First, for the public bodies providing the subsidies it is much easier to define the cases which are relevant for the subsidies in a standardized way. Process-specific improvements are generally only possible in combination with detailed energy audits, frequently to be provided by external auditors.

• Second, a number of companies refrain from initiating detailed external audits on process technologies because they consider them to be at the heart of their business and are reluctant to accept external energy audits. This barrier is intended to be overcome by mandatory audits, according to the Energy Efficiency Directive, or by audits based on voluntary agreements.

Most programmes are generally targeted towards all companies. However, there are differences in the number of incentives that can be received by large companies in contrast to SMEs. This is restricted by competition laws (within the EU and internal agreements through the World Trade Organization WTO). Generally, it is much easier to give aid to SMEs than to large companies. The state aid cases for environmental investments fall into different categories, such as investments to exceed standards or to accelerate the introduction of standards.

According to Article 87(1) of the Treaty, aid measures that satisfy certain criteria are, in principle, compatible with the common market. Articles 87(2) and 87(3) of the Treaty specify a number of cases in which State aid could be considered acceptable (the so called “exemptions”). The Commission has adopted “frameworks”, “guidelines” or General Block Exemption Regulation (GBER) setting out the criteria that are to be applied in particular to:

• Aid for climate change and for other environmental protection;
• Aid for research and development and innovation;
• Aid for small and medium-sized enterprises;

The following table shows some relevant cases where state aid is admitted and the conditions for state aid as set by the GBER (EC, 2008).

Table: Some categories of measures, aid amounts and aid intensities applicable under the General Block Exemption Regulation with relevance for ESD industries

Type of aid measure	Maximum allowable aid amount under the GBER	Aid intensity ceiling under the GBER
Aid for investment in energy saving measures	7.5 m EUR per undertaking per project	Two ways to calculate: 1. extra investment costs (net): • Large enterprise: 60% • Medium enterprise: 70% • Small enterprise: 80% 2. extra investment costs (gross): • Large enterprise: 20% • Medium enterprise: 30% • Small enterprise: 40%
Aid for investment in high efficiency cogeneration	7.5 m EUR per undertaking per project	• Large enterprises: 45% • Medium enterprises: 55% • Small enterprises: 65%
Aid for investment in the promotion of energy from renewable energy	7.5 m EUR per undertaking per project	• Large enterprises: 45% • Medium enterprises: 55% • Small enterprises: 65%
Aid for environmental studies	N/A	• Large enterprises: 50% • Medium enterprises: 60% • Small enterprises: 70%
Aid for the environment, in the form of tax reductions	N/A	No intensity (only allowed if at least Community minimum is paid, for maximum period of 10 years)
Aid for early adaptation to future environmental standards for SMEs	7.5 m EUR per undertaking per project	If implementation more than 3 years before standard enters into force: • 15% for small enterprises • 10% for medium enterprises If implementation between 1-3 years before standard enters into force: • 10% for small enterprises
Aid for investment to go beyond Community standards for environmental protection or increase the level of environmental protection in the absence of Community standards	7.5 m EUR per undertaking per project	• Large enterprises: 35% • Medium enterprises: 45% • Small enterprises: 55%

Source: EC (2008)

As an example the aid concerning energy saving specifies for:

• Investment aid: Eligible costs: Strictly limited to the extra costs directly related to energy saving and a level of energy saving higher than Community standards are both identified. Furthermore, the operating benefits and operating costs arising during the first three years of the life of the investment (for SMEs), first four years (for large undertakings outside of the EU ETS) or first five years (for large undertakings which are part of the EU ETS) are deducted and added respectively. Eligible investments can be made in land, buildings, plant equipment and technology transfer.

• Operating aid: The aid is limited to compensating for net extra production costs taking into account the benefits resulting from the energy saving. Investment aid granted is deducted from the production costs. It is limited to five years.

Barriers to uptake

Table: Economic barriers to uptake of low-carbon options in ESD industries

Company type Barriers	SMEs	Larger companies
Access to capital/upfront investment barrier	Medium to high	Low
Low payback as compared to usual company requirements / high discount rates	High	High
Heterogeneity among potential adopters	High	Medium
Private information costs	High	Medium
Hidden costs	High	Medium

Policy options to overcome economic barriers

The specific policy instruments selected for more detailed examination are:

• A broader view of financial support and incentive programmes which aim to address the first major barrier to uptake of upfront costs, and are a popular measure in many European countries.

• A specific view is provided of the German KfW SME Fund for Energy Efficiency which aims to alleviate the more specific barriers of small and medium-sized companies mentioned above.

Financial support and incentive programmes

Objective of the measure

Financial support and incentive programmes in general aim to support or give companies incentives to emit less greenhouse gas (GHG) emissions, i.e. to save more energy and become more energy- efficient or to introduce increasing amounts of low-/zero-emission fuels. Since firms, particularly SMEs, often face diverse barriers to investments in this context, financial aid from the state is to help overcome these barriers and invest in energy-saving measures, e.g. in industrial processes.

Another objective of this type of measure is to give aid or incentives to accelerate the introduction of standards or to exceed standards. For instance, financial aid might target R&D to develop new, more energy-efficient technologies, thus making industrial processes less energy-intensive.

A considerable number of such programmes were introduced after the year 2000 across most Member States. The majority of these measures give direct financial support to companies that invest in some way in energy saving or low-/zero-emission fuels. Incentives through subsidized interest loans or tax deductions are less common.

The range and magnitude of incentives is particularly wide and may consist of reductions in taxes, exemptions from taxes, soft loans or grants. Some countries use a combination of different measures; combining for example voluntary agreements with exemptions from energy/electricity taxes. A selection of the most popular policies is detailed here to highlight the different ways in which financial schemes can be implemented, namely:

1. Grants / subsidies;

2. Soft loans for energy efficiency, renewables and CHP;

3. Tax exemption / reduction / accelerated depreciation;

4. White certificates/energy efficiency obligations

	Overview	Examples
Grants / subsidies	Such grants/subsidies support companies to become more energy efficient or to introduce increasing amounts of low/zero-emission fuels. Financial aid from the state is to help overcome investment barriers. Another objective is to give incentives to accelerate the introduction of standards or to exceed standards or to target R&D to develop new, more energy efficient technologies.	Portugal provided from 2000 to 2006, under the Incentives Programme for the Modernisation of Economic Activities (PRIME), financial support to projects designed for the rational use of energy, the conversion of consumption to natural gas and the production of electric and thermal power from renewable sources. Projects with a minimum eligible investment of 25,000 euros (e.g. installation of systems and equipment with high energy efficiency and the installation of energy management or power bill reduction systems) could be supported with a nonrefundable or refundable incentive (up to 40 % of eligible expenses (Agência para a Energia 2005).
Soft loans for energy efficiency, renewables and CHP	Soft loans are loans provided below the market rate of interest. Sometimes soft loans also provide other advantages to borrowers, such as long repayment periods or grace periods where the loan does not have to be repaid.	Under the BEERECL (Bulgarian Energy Efficiency and Renewable Energy Credit Line), the European Bank for Reconstruction and Development EBRD and the Bulgarian government extend loans to banks which on-lend to private sector companies for industrial energy-efficiency projects and small renewable energy projects. A key part of the BEERECL is the free consultancy services provided by DAI Europe and EnCon Services to help eligible projects. Services include energy pre-assessment of companies, financial analysis, risk assessment, development of business plans, formulation of loan applications and presenting them to participating banks.
Tax exemption / reduction / accelerated depreciation	Tax exemptions may be granted for corporate taxes, but also for CO2 or energy taxes to companies. However, increasingly action with respect to energy efficiency is required of companies if the exemptions are to be granted	Tax exemption for reinvested profit of companies in Estonia. Since 2000, the Income Tax Act stipulates the exemption from the corporate income tax for the profit re-invested within the company, while distributed profit is taxed. This measure had an important impact on energy efficiency investment (NEEAP2 Estonia, measure IN04). In Germany, discussion is underway to link exemptions from energy taxes to the introduction of concrete measures for energy efficiency.
White certificates/ obligations	Financing obligations on energy suppliers/ distributers	Examples exist in the UK, France, Italy, Flanders, Denmark, and Poland

Concerning the evaluation of financial support and incentive programmes, only limited information is available in studies dealing with this type of measure. However, what can be concluded from the analyzed policy cases is that the effectiveness of this type of programme seems to be mixed – impacts on energy and GHG saving vary considerably among different measures. For instance, the experience with subsidies shows that they often lead to energy savings. Yet they frequently crowd out private investments, i.e. the investment would have been made anyway, even without the subsidy (IPCC 2007).

Empirical evidence shows that many financial measures nowadays are combined with other types of measures. Such a combination of measure types in one programme seems to be more effective in terms of energy and GHG-saving impacts.

Nevertheless, some of the impacts observed are:

- the competitiveness of companies is largely enhanced.

- Marginal cost to administer is relatively low for tax-based schemes, as the arrangements are already in place. Higher costs to administer subsidy schemes, soft loans or obligations.

- Greater than expected response can be costly if suitable limits are not put in place in the case of direct subsidies or taxation.

- Subsidies may crowd out private investments, i.e. the investment would have been made anyway, even without the subsidy.

- Stimulates the early market for highly energy-efficient process and cross-cutting technologies in industry (e.g. high-efficiency industrial steam boilers).

- Potential savings for consumers are significant.

- Increased uptake of low-carbon options can stop once the incentive is taken away. It can be expected that monetary incentives will be phased out in the medium or long term. Ideally, manufacturers would have been able to achieve cost reductions so that the reduction in incentives will not affect market uptake.

- Loss of revenue from taxes (company tax) can extend over the lifetime of the energy-efficiency option.

- Subsidizing low-carbon options may lead to the crowding out of more innovative technologies from other fields with larger potential for economic growth.

- Indiscriminate payment of incentives may subsidize non-European manufacturers, leading to loss of European jobs.

- The enhanced development of energy management systems in conjunction with financial subsidies will also benefit electricity savings, hence leading to a reduction of indirect emissions from the power sector.

- Subsidies contribute to increase state deficits and are hard to maintain in times of economic crises. Hence the need to link them more strongly with sources independent of budgetary cycles.

- Environmental policy and industrial policy strongly interact, as low- carbon and energy-efficiency technologies increasingly contribute to the overall competitiveness of a country, directly through the development of new technology fields, and indirectly through improved supply security.

- Energy-efficiency options in the industrial sector can be mobilized in a fairly short time frame especially concerning cross-cutting technologies.

Maximising the benefits

Evidence suggests that the form of the incentive is just as important as the total subsidy amount. This is also relevant for the industrial sector. Studies in the transport sector indicate that consumers are highly sensitive to upfront costs, and less influenced by total cost of ownership, which may explain why schemes which deliver upfront incentives tend to be more effective than those which offer savings post-purchase.

Linking subsidy schemes to erratic state budgets will lead to a stop-and-go policy in promoting energy efficiency and low-carbon options. It is therefore important to open stable financing sources. Examples are the forthcoming energy efficiency fund in Germany financed by the EU ETS income, as well as financing from energy efficiency obligations and White Certificate schemes. Another example for environmental tax recycling is the National Fund of Environmental Protection and Water Management of Poland which among others addresses the efficient use of energy and highly efficient co-generation facilities. According to the National Fund of Environmental Protection and Water Management (http://www.nfosigw.gov.pl/en/), "it is supplied, mainly, with the income from the fees and fines for the use of the environment, service and concession fees, fees following from the Energy Law, the act on recycling of end-of-life vehicles, income from the sales of Assigned Amount Units for greenhouse gas emissions and many other sources".

Frequently, the upfront investment barrier is accompanied by non-economic barriers such as lack of information. Energy management schemes (EMS) are important elements to recognize such non-economic barriers.

Each intervention in the industrial sector is linked to a distortion of competition. For this reason, strict state aid rules have been set up. On the other hand, without large-scale programmes, investments in low-carbon and energy-efficiency technology will not be undertaken. State aid rules need therefore to carefully check how aid can be maximized while avoiding distortion in competition.

As far as possible, measures should not introduce additional burdens on companies but be recognized as a benefit by the companies. For example, administration for subsidy schemes should be standardized and the load on the companies reduced. On the other hand, if data collection is necessary it should be used to provide further information to companies, e.g. on their position as compared to others, through benchmarking approaches.

Special fund for energy efficiency in SMEs in Germany

Special fund for energy efficiency in SMEs in Germany is also a financial scheme to promote energy efficiency in industry. However, it provides a better insight into the policies to overcome barriers for small and medium-sized enterprises (SMEs).

This fund was launched by the Federal Ministry for Economics and Technology (BMWi) and the KfW Förderbank in November 2007 and became effective in 2008. It promotes energy-efficiency investments in small and medium-sized companies (Fraunhofer ISI 2008). The fund consists of two parts: first, it supports the advice about potential energy savings in SMEs, providing a grant of up to 50% for an independent energy consulting. Second, financial support is given for the resulting investments to exploit the saving potentials by means of low-interest loans.

All European countries have gaps in promoting energy efficiency in SMEs due to the relatively strong presence of barriers. It is therefore important to develop and finance more standardized instruments to support audits in SMEs and enhance implementation of the proposed measures by developing adequate financing schemes.

The cost-effectiveness of the German programme for firms and the low share of public expenditure underline its value in the German energy-efficiency policy mix and suggest its expansion in Germany as well as in other countries

The energy audit programme was launched by the German Ministry of Economic Affairs in 2008 and was designed on the basis of a market study completed in 2006. The target group comprises all SMEs (defined as firms with less than 250 employees) in all sectors as well as self-employed. The programme comprises two kinds of audits which can be combined or used separately. These are:

- An "initial" or screening audit taking one or two days which covers a short check of the energy- using equipment and records the energy consumption, existing deficits as well as recommendations for improvement; for this type of audit 80 % of the total cost are granted.

- A "comprehensive" or detailed audit of up to 10 days with a detailed inspection of one or more energy consumption areas and suggestions for related Energy Efficiency Measures (EEMs); subsidies cover up to 60 % of the audit cost.

For both types of audits, a standardized template for the audit report is provided that assures that all important aspects of firms' energy consumption are analyzed. Besides the templates, the programme does not provide any standardized tools for the assessment. The (supported) cooperation between the auditor and the firm ends with the delivery of the audit report. Further follow-ups are not foreseen in the programme, but they sometimes take place. The auditors themselves do not require a particular training nor do they need to fulfill an assessment to be approved as auditor under this programme.

The programme is managed by the KfW, the German Promotional Bank owned by the federal republic and the federal states. It is responsible for approving applications and paying out grants. The communication with the companies is delegated to "regional partners", mainly chambers of trade and commerce, but also business development institutions or energy agencies. They check and process the applications to the KfW. A searchable database of qualified and independent consultants is provided by the KfW on the internet, which should enable interested companies to find a suitable consultant in their region. The KfW checks consultants' qualifications before listing them in the online database.

The KfW also provides soft loans to implement EEMs. However, the audit is not a precondition to receiving a loan. The programme does not comprise additional elements like voluntary targets or obligations on energy management schemes.

During the evaluated period from March 2008 to June 2010, in total 10,400 audit grants were approved by the KfW. Of these, 80% were initial audits and 20% comprehensive audits. The monthly approvals remained around 400-500, after an initial increase at the start of the programme in 2008.

According to the KfW statistics, the mean participating firm has around 38 employees, while 50 % of the firms have less than 20 employees. The share of larger firms is particularly low and only 10% of firms have more than 100 employees. On the other hand, the 10% of the largest firms account for more than 30% of energy demand, whereas the firms below 25 employees only account for 20% of energy demand, although they represent about half of the firms in the sample.

Most implemented EEMs can be characterized as cross-cutting technologies. They are relatively easy to identify for the external auditors, because the energy end-uses they address are similar (e.g. heating and hot water, lighting, compressed air, electric motors…) and the EEMs often show a large degree of standardization. Furthermore, most of the recommended EEMs only show a limited degree of innovation. Several of the measures are standardized and have been applied for many years.

The evaluation of the audit component shows that the German energy audit programme for small and medium-sized companies provides a way to improve energy efficiency in firms cost-effectively. However, particularly financial barriers still prevail despite the programme. The programme is very cost-effective and shows a net present value of 4 to 23 € per MWh saved, which implies net earnings for firms. Each euro of public expenditure for audit grants induced 17-33 euros of private investment. On average, the firms adopted 1.7 to 2.9 measures, which they would not have done without the programme, and saved 3 to 5% of their energy consumption. The implemented measures show an average payback period of 6 years. Particularly building-related measures account for the large share of implemented measures. Building insulation has the highest average payback period of 10.6 years, while for example EEMs to improve compressed air systems only have 2.4 years on average. Assuming that the audit programme continues at the present activity level, it would accelerate the (average long-term) energy-efficiency progress in industry and service sector.

Maximizing the benefits

SMEs require a more specific focus in the design of subsidy schemes. They need more simplified and standardized procedures to learn about energy efficiency opportunities and they may require stronger support to carry out measures, especially also in industrial buildings which is an important share of energy consumption in SMEs.

For SMEs, the upfront investment barrier is higher than for larger companies. It is therefore necessary to compensate larger parts of the cost differential with less energy-efficient options.

Policies to overcome non-economic barriers

This section is focused on the policies to overcome non-economic barriers for industries such as, for example, information deficits, split incentives (e.g. in the case of intermediate constructors of machinery), the use of inadequate investment calculations (risk instead of profitability) etc. In this case it is also necessary to adapt the instruments to the size of the company (amount of energy consumption) and to the complexity of the energy-consuming system.

In terms of the size of the companies/ amount of energy consumption:

• Larger companies can afford to have systematic energy management schemes, such as DIN EN 16001. They may also be required on a voluntary or mandatory basis to implement certain measures. This may also comprise companies which are part of the EU ETS and shows that in the case of non-economic barriers they may be subject to additional measures, even if they are part of the EU ETS. The economic signal from the EU ETS may not be sufficient to provide enough incentives to overcome the barriers. This is particularly the case of electricity-saving measures in the industrial sector.

• Medium-sized companies may be organized in so-called "Learning Energy Efficiency Networks" where a certain number of companies (15-20) from different sectors work together in networks which set themselves voluntary targets and have a structured approach to realizing the energy-efficiency measures. This is specifically adapted to medium-sized companies with a certain amount of energy consumption. They do not have the experience in energy management of the more energy-intensive companies, but use enough energy to have a structured approach, so that transaction costs can be kept at reasonable levels. This is a new instrument which is not yet widely introduced in Europe.

• The smaller companies use too little energy to carry out full energy audits. However, they may benefit from the knowledge provided by benchmarking systems (both at the level of process energy and cross-cutting technology). They may also be supported via special funds in carrying out (simplified) energy audits because usually the amount of energy consumption is too small to justify in-depth audits.

In terms of complexity of the process, this generally increases with the size of the company, but not exclusively. Especially industrial cross-cutting technologies have system aspects also in smaller companies and require system optimization rather than only efficient components. Hence it is important to develop, for example, benchmarking instruments which are able to reflect the system optimization aspects, e.g. in the case of steam generation and distribution, compressed air generation and distribution etc.

Common to all the different sizes of the companies there are the minimum standards set by the eco-design directive and labelling schemes. This applies mostly to components (individual boilers for steam raising) rather than complex systems (e.g. steam piping).

The following table shows non-economic barriers to uptake of low-carbon options in industries covered under the Effort Sharing Decision (ESD).

Company type Barriers	SMEs	Larger companies
Split incentives (e.g. in the case of intermediary constructors of machinery)	Medium to high	Medium
Behavioral barriers, such as the form of information available, the credibility of information sources, inertia, and culture or values	High	High
Organisational barriers: the power or status issue within an organi- sation associated with energy efficiency and its management.	High	High
Transaction cost barriers	High	Medium
Use of inadequate investment calculations	High	High

Among the policy options available to overcome non-economic barriers the text presents:

• A broader view of voluntary or negotiated agreements which aims to address non-economic barriers to the uptake of low-carbon and energy-efficiency options in many European countries.

• A specific view of the German Learning Networks for Energy Efficiency and Climate Protection which aim to reduce the transaction cost barrier and a variety of non- economic barriers for medium-sized companies.

However, there are a variety of further good examples to overcome non-economic barriers. Just as one further particular example to mention here is the Carbon Reduction Commitment (CRC) Energy Efficiency Scheme, which is a mandatory scheme aiming to overcome non-economic barriers. The sectors targeted by the Carbon Reduction Commitment scheme generate over 10% of UK Carbon Dioxide (CO_2) emissions, around 55 Mt CO_2. The Carbon Reduction Commitment scheme aims to reduce carbon emissions from these organizations by at least 4 million tonnes of carbon dioxide per year, by 2020. It features the following main elements:

• Emissions reporting requirement: Participants in the CRC will need to measure and report their carbon emissions annually, following a specific set of measurement rules.

• A new carbon price: Starting in 2012, participants can buy allowances from Government each year to cover their emissions in the previous year. This means that organizations that decrease their emissions can lower their costs under the CRC. The price of allowances was set at £12 per tonne of carbon dioxide in the 2011 Budget.

• Ranking of participants in a performance league table: A publicly available CRC performance league table will show how each participant is performing compared to others in the scheme. If an organization is a good carbon performer, the league table will help give a significant boost to the organization's reputation, demonstrating its success in cutting emissions. An organization's league table position each year will be determined by performance in three metrics:

* Early action metric: 50% of the company score is based on what percentage of the organization's electricity and gas supplies is covered by voluntary automatic meter readings (AMR) in the year to 31 March 2011. The other half is based on the proportion of the CRC emissions certified under the Carbon Trust Standard or an equivalent scheme.

* Absolute metric: The percentage change in the organization's emissions, compared to the average of the previous five years (or number of years available until 2014/15).

* Growth metric: the percentage change in emissions per unit turnover, compared to the average of the previous five years (or number of years available until 2014/15).

The weighting of these three metrics will change over time. In the first year, early action will count for 100% of the organization's league table score. Over the first few years of the scheme, the early action metric will gradually fade in importance until the absolute and growth metrics receive 75% and 25% weightings respectively in 2014/15 and thereafter.

Voluntary or negotiated agreements

Voluntary or negotiated agreements are mainly aimed at companies to encourage them to voluntarily engage in energy-saving and energy-efficiency measures. In order to make participation in such measures more attractive to firms, incentives, such as tax reductions/exemptions, may be provided in return to agreeing to take part in the measures.

Voluntary agreements have the advantage that firms can choose to participate in them, for example, according to their cost-benefit ratio arising from the programme. If the costs of engaging in energy saving or increasing energy efficiency are lower than the benefits from the incentive (e.g. a tax reduction), then the company will benefit from participating in the programme. Therefore, particularly firms with relatively low costs of reducing their energy consumption are attracted by such measures.

Frequently, voluntary or negotiated agreements are considered as a trade-off for other types of measures, in particular taxation measures. An example for this is the Norwegian programme for energy efficiency in industry, where companies of the energy-intensive pulp and paper industry may apply to participate in a programme for energy savings and therefore will be given a full exemption from the electricity tax. Such voluntary schemes may also provide policy options in case Member States decide to exclude installations between 20 and 35 MW from the application of the ETS, where MS have the freedom to choose.

More countries from the EU-15 have applied this measure than from the EU-12, while some of the latter are also developing this instrument. Within the EU-15, however, three countries have made particular use of this type of measure: Finland, Sweden and Spain, the first two of them have long traditions using this instrument. Some new EU MS, such as Hungary, are also mentioning it in their National Energy Efficiency Action Plan (NEEAP) to complement existing financial incentives.

An overview of the implementation of this policy within the Member States since the year 2000 shows that some voluntary or negotiated agreements address energy efficiency more generally, while others target specific technologies or appliances. Thereby electric motors in industry appear as a relevant objective to improve energy efficiency, but also CHP, lighting and buildings. There are far fewer voluntary or negotiated agreements than financial incentive measures implemented in the Member States.

There are three types of voluntary and negotiated agreements. First, agreements can be stand-alone (but backed up by a well-managed structured process from the public side), further there are those with a threat of future regulation and finally, ones that are implemented in conjunction with existing taxes or regulations, with subsidy schemes and/or audit schemes.

Completely voluntary agreements are relatively low-cost incentive programmes, whereas the second type uses further incentives for participation, such as relief from additional regulation. The last type relies on a voluntary programme, on the one hand, and in some cases a penalty of non-compliance, and the use of a GHG tax or such instruments like the EU ETS, on the other hand.

In the following paragraphs, specific national voluntary and negotiated programmes are presented to illustrate these cases.

Stand-alone VAs with a strictly structured process from the public side

Stand-alone voluntary agreements have proved successful in cases where the government sets up a well-structured process. In other cases when the government agreed on low- level targets, little success was achieved beyond business as usual.

Example: Netherlands - Long-term Agreements with the Industry, third phase

The third generation of these long-term agreements (LTA 3) is an expansion of the second one, which aimed at energy savings in the whole product chain. The first phase, in contrast, focused on improving process efficiency. The LTA are targeted at small and medium-sized enterprises – larger firms that are energy-intensive and subject to the EU ETS do not take part in them, but instead in the so-called Covenant Benchmarking Energy Efficiency. The LTA 3 likewise helps smaller companies to work towards reaching ambitious energy-efficiency targets (SenterNovem 2009). The explicit goal of LTA 3 is a 2 % average efficiency improvement per year until 2020, i.e. for the period between 2005 and 2020 an overall improvement in energy efficiency of 30 %. 20 % thereof are to be achieved within plant limits, and the remaining 10 % outside, e.g. by less material use or by recycling. In order to achieve these goals, participating firms are supposed to develop energy-efficiency plans, to implement them and to report about the results. In return for signing an LTA, a company is more likely to be granted the environmental permit that it needs to operate (Energy Research Centre of the Netherlands 2010). At the end of 2008, 31 sectors participated in the LTA, of which 18 industrial sectors representing 58 % of the energy consumption of all LTA sectors and 15 % of all industrial energy consumption. In the period between 2001 and 2008, in the industrial sectors 11 million tonnes of CO2 reductions were achieved through energy efficiency improvements. In the years between 2005 and 2008, the ambitions were largely exceeded by the results (SenterNovem 2009). Overall, the instrument has been judged as very successful, making an essential contribution to the high level of energy efficiency in the Netherlands. Beyond its energy-efficiency impact, it has positive side effects for participants: it raises the awareness of structural energy savings and contributes to better working-relations between government and industry (SenterNovem 2005).

VAs to replace threat of future regulation

Frequently, VAs are proposed as an alternative to regulation or other measures supposed to be less flexible or burdened with higher cost. Experience has also shown that VAs may be used to “play on time” if the public counterpart does not have a clear vision of results to be achieved or agrees on low-level targets.

Example: Germany - Voluntary Agreement on CHP. The voluntary agreement for the promotion of CHP, made by the federal government and German business in 2001, is an addition to the voluntary agreement on climate protection. Its goal was to decrease industrial CO2 emissions with the help of diverse measures by 45 million tonnes per year until 2010, of which 23 million by CHP. The agreement was a substitute for an originally planned quota scheme and is supported by a law on CHP, which entered into force some months after the start of the agreement (Fraunhofer ISI 2006). The impact of the voluntary agreement on CHP is evaluated to be relatively low for two reasons: a considerable amount of CO2 reductions by CHP will already be achieved by the market – the autonomous extension of CHP capacities for economic reasons is very probable in German industry – and there are other measures that increase the profitability of industrial CHP (Fraunhofer ISI 2006).

VAs in combination with other instruments

These voluntary framework agreements between industry associations, companies and communities, on the one hand, and government on the other hand are to reduce specific energy consumption and introduce operational methods that help making energy efficiency an integral part of companies' and communities' operations.

Example: Finland - Voluntary Energy Conservation Agreement in Industry (1997-2007). The two principal measures of the agreement are energy auditing and analyses, and conservation measures. Industry associations engage in promoting energy-saving and participation in the agreement among their members, firms and communities make use of energy audits and analyses, set up their own energy conservation plans and implement cost-effective conservation measures. The government subsidizes investments in energy saving and energy auditing/ analyses (MOTIVA 2006). In its first implementation, the Voluntary Energy Conservation Agreement ran from 1997 to 2007. Subsequently, it was extended from 2008 to 2016 under the name Energy Efficiency Agreement. Energy savings made under this agreement by the end of 2006 altogether lowered heat and fuel consumption by 4.3 % and electricity consumption by 2.6 %. The Finnish Voluntary Energy Conservation Agreement was extended for another eight years until 2016 (MOTIVA 2006).

When making an evaluation of the measure, the experience with voluntary agreements has been mixed, according to independent assessments. Some of the earlier programmes seem to have failed to achieve their targets, whereas more recent voluntary agreement programmes are better designed and therefore more successful. Features of such improved programmes are, for instance, an implicit threat of future taxes or regulations, or the conjunction with an energy or carbon tax. Such measures are cost-effective and can provide energy savings beyond business-as-usual (IPCC 2007). Additionally, they have important longer-term impacts including:

- changing attitudes towards and awareness of energy efficiency
- reducing barriers to innovation and technology adoption
- creating market transformations to establish greater potential for sustainable energy-efficiency investments (IPCC 2007).

The most effective agreements are those that set realistic targets, include sufficient government support as well as a real threat of increased government regulation, or energy or GHG taxes if targets are not achieved (Price 2005), (IPCC 2007).

The specific Member States cases mentioned above reflect this mixed success of voluntary agreements. While the Finnish and Dutch agreements were so successful partly because they provided important benefits for participating firms, the German agreement's low impact arises mainly from the fact that it was crowded out by the market and by other measures that were aimed in the same direction.

The Finnish voluntary agreement was combined with other measures, which explains its effectiveness and high impact. Empirical evidence shows that many voluntary or negotiated agreements nowadays are coupled with other types of measures. Such a combination of measure types in one programme seems to be more effective in terms of its energy and GHG-saving impacts.

Some of the identified generic impacts are:

- Given the fact that mainly economic options for energy efficiency and low-carbon technologies are implemented, the competitiveness of companies is largely enhanced.

- Costs to administer voluntary schemes are comparatively low, but not negligible if the agreements are taken seriously.

- Smaller companies may have more difficulties finding their way into voluntary schemes as they lack staff.

- Stimulates the early market for highly energy-efficient process and cross-cutting technologies in industry (e.g. high-efficiency industrial steam boilers).

- Increased uptake of low-carbon options may stop if the participation in voluntary schemes is finished. Hence the importance of implementing a new culture for energy efficiency in companies through an efficient implementation of energy management schemes.

- The environment success of voluntary agreements depends largely on three factors: the integration with the general culture of companies, the willingness of public bodies to set ambitious targets, and the combination of the agreements with other measures such as financial measures, audits and strong regulation.

- The enhanced development of energy management systems in conjunction with voluntary schemes under the ESD will also benefit electricity savings, hence indirectly emissions from the power sector.

- Environmental policy and industrial policy strongly interact as low- carbon and energy-efficiency technologies are increasingly contributing to the overall competitiveness of a country, directly through the development of new technology fields, indirectly through improved supply security.

- Energy-efficiency options in the industrial sector can be mobilized in a fairly short time frame especially concerning cross-cutting technologies.

Energy-efficient plants and machinery require significant investment and therefore higher capital cost than their less efficient options, but they also generate savings in energy costs. This substitution of energy cost by more capital-intensive efficiency investments is often not adequately considered and explained by technology manufacturers to their customers.

When launching voluntary approaches, a favorable institutional setting is an important factor. The initiating institution should have the trust of local organizations such as the chamber of commerce, the local municipality or utility, or a regional industrial platform, energy agency or trade association. The chances for successfully initiating agreement are extremely low if the companies have a lack of confidence in the initiating institution or person.

Frequently, there are several non-economic barriers in parallel or along the life cycle of energy-efficient options. Removing one barrier alone may not be enough.

When voluntary approaches are constructed from the top down (i.e. through head associations), frequently they adapt to the slowest ship in the fleet. It is important to identify forerunners and to construct the agreements with them. This helps to avoid building up voluntary approaches "just for show".

Provide rewards to active participation in the forms of financial rewards and visibility for the company (e.g., see the energy efficiency award of the German energy efficiency agency ("dena") or the reward for innovation and climate ("iku") provided by the Confederation of German Industries BDI in cooperation with the German Ministry of the Environment).

Learning Networks for Energy Efficiency and Climate Protection

Learning Networks for Energy Efficiency and Climate Protection in Germany is based on voluntary approaches to promote energy efficiency in industry and provides a better insight into the policies to overcome specific non- economic barriers in medium-sized companies.

In energy efficiency networks (EENs), 10 to 15 regionally based companies from different sectors share their experiences in energy-efficiency activities in moderated meetings. After an initial consultation and identification of profitable energy-efficiency potentials in each company, all participants decide upon a joint energy-efficiency and a CO2 reduction target over three to four years. Information on new energy-efficient solutions is provided by experts during these meetings and the performance of each company is monitored on an annual basis. A typical network period contains up to 16 meetings, after which the companies decide whether or not the EEN should be continued.

The main goals of an EEN are to reduce transaction costs, to overcome existing obstacles, to raise the priority of energy-efficiency aspects within the company, particularly in cross-cutting technologies and, hence, to reduce their energy costs. Results from 70 networks in Switzerland and more than 20 networks in Germany show that the participating companies can double their energy efficiency improvements. Almost every company has a profitable efficiency potential (internal rate of return > 12 %), at between five and 20 % of its present energy demand.

To foster the idea, a "30 Pilot Networks" project was initiated by Fraunhofer ISI in 2008 and funded by the German government. Besides implementing 30 EENs, the main goal of the project was to improve an existing network management system (MS) to operate EENs to a high quality standard. The MS consists of an EEN manual with helpful documents (e.g. contract templates, checklists, technical manuals, presentation of energy-efficient solutions) and about 25 software-based techno-economic calculation tools which are being developed under a joint user interface. The MS, labelled as LEEN (Learning Energy Efficiency Network) is intended to offer several elements needed for the European Norm 16001 (energy management systems). EENs are financed and operated mainly by industry itself. They represent an innovative approach for medium-sized companies, being applicable in any industry with minor adaptations.

All European countries have gaps in promoting energy efficiency in medium-sized companies, due to the relatively strong presence of barriers, in particular also the information and motivation barriers. It is therefore important to develop suitable instruments to help overcome transaction costs in the companies.

The first successful locally organised energy efficiency networks – called EnergyModel – was observed in Switzerland in the late 1990s (Bürki 1999, Graf 1996, Kristof et al. 1999, Konersmann 2002). The creation of the Swiss Energy Agency in 2002 within the context of the CO2 law for industry provided an additional incentive for further network generation. One major role of this agency is to act as an intermediary in the CO2 reduction target negotiation between companies and the federal government. Companies that reduce energy-related CO2 emissions within the framework of a negotiated target, and accept an annual evaluation, can be exempted from a surcharge on fossil fuels currently set at 36 CHF (or 25 €) per tonne CO2. Around 70 energy efficiency networks are now working in Switzerland. About 2,000 companies are involved in this scheme, representing 3.9 million tonnes of CO2 which is more than one third of the total CO2 emissions of the Swiss industry and service sector. The target agreements are mostly based on energy-efficiency improvements over a given period of time, e. g. four years, or on fossil fuels substitution by options such as industrial organic waste, renewables, or electricity (which in Switzerland is almost CO2 free due to the hydro and nuclear mix). The target agreements achieved until 2010 amount to more than one million tonnes of CO2 or 29 % of a fixed efficiency development since the year 2000 (EnAW 2011). The energy-efficiency networks are financed by the participating companies with individual contributions of some 2,400 to 15,000 € per year, depending on the size or the annual energy costs of each company. The average annual energy cost savings after four to five years of operation are 165,000 CHF (or 120,000 €) per company.

The idea was transferred to Germany in 2002. Currently, 50 EENs are operational in Germany. The idea of learning networks was also taken up by the State Grid Corporation of China (SGCC) in order to fulfil requirements to save 0,5% of their distributed electricity annually.

The cost-effectiveness of the German programme for firms and the low share of public expenditures underline its value in the German energy efficiency policy mix and suggest its expansion in Germany as well as in other countries

Consultant engineers usually return from on-site visits at companies with substantial energy-efficiency potentials that are easy to realize and usually have high rates of internal return (Romm 1999). The limited realization of profitable efficiency potentials has been the subject of discussions about obstacles and market imperfections for more than a decade (e. g. IPCC 2001 and 2007), and the heterogeneity of these obstacles and potentials has been tackled by sets of several policy measures and instruments (Levine et al. 1995, DeCanio 1998).

Profitable energy-efficiency potentials are often not exploited in industry, since management does not focus on energy issues. Energy efficiency is not considered to be a strategic investment (Cooremans 2010). Furthermore, there are various obstacles to energy efficiency (DeGroot 2001): (1) In medium- sized companies, there is often no adequately informed energy manager. He may also lack time to gain the necessary knowledge, as energy issues are only one of several tasks. (2) Efficiency investments often have relatively high transaction costs compared to the capital investment. This aspect may be decisive for small efficiency investments (Ostertag 2003). (3) Energy costs are often treated as overheads and not allocated to individual production lines or departments of the site. This reduces the incentive to invest in energy-efficient technologies as the profit center will not earn the full benefit of such an investment.

Another obstacle emerges if the buying department is focused exclusively on reducing the investment instead of minimizing the life cycle cost. This leads to wrong decisions, as the capital cost of energy- related investments often has a share in life cycle cost of five to 20 %, while the energy cost is between 50 and 90 %. Furthermore, decisions on energy-efficient investments are taken by 85% of industrial companies solely on payback period calculations often limited to two or three years (ISI 2009). Given normal life times of these investments of between 10 and 20 years, this decision process systematically discriminates against the long-term energy-efficiency investments. Furthermore, the co- benefits of energy-efficient new technologies are rarely identified or included in the profitability calculations by energy or process engineers. This is due to the lack of a systemic view of the whole production site and possible changes related to the efficiency investments (Madlener & Jochem 2004). Social relations such as competitive behavior, mutual regard and acceptance not only play a role between enterprises, but also internally within a company. Efforts to improve energy efficiency are influenced by the intrinsic motivation of companies' actors and decision-makers, the interaction between those responsible for energy and the management, and the internal stimuli of key actors and their prestige and persuasive power (InterSEE 1998, Schmid 2004).

The question arises, as to how these obstacles and market imperfections could be alleviated and social processes used more beneficially by designing an appropriate instrument. One answer for medium-sized companies seems to be local learning networks of energy managers. The major components of the underlying framework of learning networks can be summarized as follows:

- To compensate for a lack of knowledge and market awareness, each participating company is given an initial consultation and all participating energy managers are informed of new and reliable efficiency technologies by a senior engineer. Advantages and limitations of the new energy- efficient solutions and changes to the production and product quality at the production site are then discussed among the participating energy managers, identifying risks and co-benefits.

- Based on the concept of innovation research, and in an atmosphere of trust, the exchange of experiences about energy-efficient solutions leads to lower transaction costs of the followers and late applicants compared to the costs of the first movers. The different attributes associated with the company size of participating network members – the large ones with their potential to hire specialists and the small ones with close contact between the energy manager and the management - leads to new ideas of how to handle energy-efficiency investments and organizational measures within the companies.

- Finally, the framework also integrates social and individual psychology concepts: (1) a knowledgeable energy manager receives social acceptance from his colleagues during the regular meetings; (2) once a common efficiency and CO_2 reduction target of the network has been agreed upon, social cohesion and responsibility motivates the energy managers, who can also argue within their company that it has to contribute to the joint targets; (3) there is low competitive behavior within the network as an allied group; (4) individual motivation through professional career enhancement is supported by fast learning opportunities and obvious successes in reducing the energy cost validated by the yearly monitoring by the consultant engineer; (5) the motivation of management to achieve high public reputation as a company striving for a sustainable production status. (Schmid 2004, Flury-Kleubler et al. 2001).

Starting from the positive Swiss experiences, an initial learning energy-efficiency network (LEEN) was launched in mid 2002 in Germany, in the Hohenlohe region by the government of Baden- Württemberg. This network was accompanied by a scientific evaluation (Jochem & Gruber 2004). As the results of this pilot network were very positive regarding the reduction of energy cost and CO_2 emissions by overcoming the various obstacles (Jochem & Gruber 2007), additional efficiency networks have been launched since 2005 by various institutions, reaching a total of 40 networks by the end of 2010.

The main activities of the energy-efficiency networks are (1) an initial consultation for each company by an experienced engineer, (2) an agreement on a common target for energy-efficiency improvement and for CO_2 emission reduction of the network with a time horizon of three to four years on the basis of the results of the initial consultation, (3) regular meetings (four times per year) with presentations on technical and organisational issues by invited senior experts and exchange of experiences among the energy managers, and (4) an annual monitoring of energy-efficiency progress and the reduction of energy-related greenhouse gas emissions for each company and the network.

These major elements are embedded in a sequential process:

- The network establishment phase (Phase 0) is a pre-phase to the network. Normally, it takes three to nine months to acquire the dozen companies required for a network. Existing energy or environmental working groups of a chamber of commerce or a regional industrial platform may minimize the efforts of this phase.

- The energy-efficiency network starts operating with Phase 1 (so called initial consultation phase): the consultant engineer conducts an initial consultation for each company of the network. The consultation normally takes about eight to ten days per company, depending on its size. It starts with a questionnaire which is completed by the company that may also add energy-related material such as power demand profiles or planned energy-efficiency investments. This information provides the engineer with an overview of the company's energy use and management before carrying out an on-site inspection (one to two days). Together with the energy manager, the consultant engineer identifies energy-efficiency and eventually energy substitution options. The engineer then writes a report evaluating the possible measures, describing the technical characteristics of the solutions suggested and their economic risks and profitability (net present value, internal rate of return). Based on the aggregated results of these (confidential) reports, the engineer suggests a common energy and CO_2 reduction target with a three or four years time horizon. The energy managers of the network discuss the suggested targets and decide upon them.

- After the target setting, the network enters Phase 2 (networking phase). Energy managers of the companies meet on a regular basis (typically three to four times per year). These meetings incorporate a one hour site visit of the company hosting the meeting in order to give each colleague an overview of the production and energy related plant and machinery. During the meeting, which is moderated by a LEEN-trained moderator, a senior expert reports on an energy efficient technology or organizational measure that had been previously agreed by the energy managers. The expert is usually chosen by the moderator and is not committed to the network. The presentation may be co-refereed by one or two energy managers from the participating companies and the topics cover cross-cutting technologies, such as heat generation and distribution, electrical motors, compressed air, ventilation, air conditioning, process cooling, illumination, heat recovery, green IT, energy management systems, green electricity and gas supply, modern forms of wood use and use of organic wastes, etc. Organizational measures and competences are also the topic of a meeting (e.g. profitability calculations, co-worker motivation, cooperation between the energy manager and the procurement department of the company). Implemented measures and investments will be reported and discussed in an environment of mutual exchange and personal trust. This point is vital to the network, giving the other participants first-hand information on practical observations, failures and benefits. Furthermore, a telephone hotline for spontaneous questions and technical advice is set up for the whole network period by the consultant engineer and the moderator.

• During Phase 2, the consultant engineer and the moderator jointly conduct an annual monitoring of implemented measures and investments (bottom-up analysis) and the total performance of the site (top-down analysis). They track the energy-efficiency progress and the CO2-emission reduction of each company (confidential reporting) and the progress of the total network in its aggregated form. In order to maintain the independence of the consultant engineer, the implementation of the measures remains the responsibility of the company which is able, but not required, to realize measures with the help of the engineer.

• The internal and public communication on the network's activities and achievements is the final module of the network, which may include press releases or press conferences (e.g. when the target is set or reached) or mutual exchange of experiences in seminars and conferences with members of other energy-efficiency networks.

The LEEN management system supports all these tasks and activities by providing the engineer, the moderator and the energy managers with appropriate documentation, suggested text elements of contracts, reports and press releases as well as calculation tools for investments and the annual monitoring. These useful elements and tools have been and still will be developed by Fraunhofer ISI and partners in two publicly funded projects between 2006 and 2008 (Bauer et al. 2009) and 2008 to 2013 (ISI 2010). The LEEN management system aims to guarantee a minimum professional standard for the initial consultation, the annual monitoring, and the moderation of the meetings as well as to minimize the cost for all related tasks.

The confidence that develops between the participants fosters the general (and increasingly free and trustful) exchange of experiences and ideas during the network meetings and associated bilateral communication. When a network reaches the end of Phase 2, the companies may decide to terminate the network, to continue it, or to change the moderator or the consultant engineer. Experience with various networks illustrate that participants normally decide to continue the network for several years. The oldest network in Germany has been operational since 2002, and the oldest in Switzerland since the late 1980s.

The cost of the network's operation (initial consultation, moderation of the meetings, annual monitoring of the companies and the network, and the project management) is around 60,000 to 80,000 € per year assuming 10 participating companies and a three to four year operation of the network. 6,000 to 8,000 € are generally paid by each company each year. Sometimes sponsors such as local utilities or chambers of commerce take over the role of the network manager and of the moderator and, in some cases, the cost of operating the networks is sponsored by federal states of Germany or by the federal government.

The initiator of an energy-efficiency network may be a chamber of commerce, the environmental department of a city administration, a moderator or consulting office, a regional utility or a regional industrial platform. The initiator may or may not take on the role of the network manager depending on the interest of the institutions participating in the acquisition phase. In contrast to Switzerland, where no utility manages energy-efficiency networks, more than one third of the current 45 networks in are operated by utilities (i.e. one large utility (EnBW) and a few municipalities). The consultant engineer is either selected before the acquisition phase starts or is chosen by the companies of the new network in a limited tendering process.

The achievements described in this section are mainly based on the following projects:

- EEN Hohenlohe (2002 – 2006): implementing the initial German energy-efficiency network in Hohenlohe.
- Environmental communication and energy efficiency in SME (2006 – 2009): development of an energy-efficiency network management system and establishing and evaluating five EENs (Bauer et al, 2009).

- 30 pilot networks (2008 – 2013): establishing 30 networks nationwide and enhancing the initial management system for EENs (ISI 2010).

After the initial network was established in the region of Hohenlohe, a second demonstration project was launched in Germany with funding from the German Federal Foundation on the Environment, two federal states and three private companies. The project's main objectives were: (1) to evaluate different network managers from an institutional point of view (including a large German utility company) and (2) to develop a network management system that guarantees a minimum performance standard for the activities of network managers, moderators and engineers in Germany.

After this demonstration project was completed with positive results, the German government decided to fund a nationwide network project, the so-called 30 pilot networks. The objective of this project is to disseminate knowledge on how to generate and operate efficiency networks for medium-sized companies over all 16 federal states. Another objective is to enhance and extend the management system for EENs and further develop investment calculation tools operating under a joint user surface.

The achievements observed in five energy efficiency networks over a period of two to four years (between 2004 and 2008) look promising and first conclusions could be drawn reflecting similar results as found for Swiss industry (Kristof et al. 1999, Konersmann 2002):

- On average, the companies participating in the efficiency networks agreed upon an efficiency target of around 2 % per year which is double what the average industry achieved during the last five years. This joint target was met by all five networks. However, the authors observed substantial deviations for individual companies for very different reasons (e.g. substantial or no new investments, high growth or decline in production, low or strong support from the board; Bauer et al. 2009).

- The results of the reduction of specific CO2 emissions were a little less than 2 %, as electricity demand with its higher specific CO2 emissions increased its share in all networks. However, in one network (Ulm), the CO2 emissions dropped by 24 % between 2004 and 2007 due to a substantial substitution of a gas-fired cogeneration plant to wood chips.

- After three to four years, the energy cost savings of a company ranged in the order of 120,000 € per year and 500 tonnes CO2 reduction per company (average).

- Six companies out of the 48 companies participating in four networks received an award for high efficiency performance or environmental protection within three years.

- Since 2005, the third largest German electricity utility initiated 16 energy-efficiency networks with 200 companies until March 2011 which is one third of all presently operating energy-efficiency networks.

- An interesting observation was (and still is) that several participating companies started checking their products for higher efficiencies (e.g. high efficient ventilators, gear boxes) or developing new products and systems (e.g. energy management systems); other companies approached their technology suppliers asking for improved and high efficiency solutions (e.g. lower weights of transport lines, better insulation and control techniques of kilns).

- While 100 measures were planned and implemented, 60 new ideas – mostly more complex and sophisticated – were born and developed for further improvement of the companies' energy performance.

The authors concluded in 2008 that the learning EENs represent a new effective instrument for energy and climate change policy, which is in the core of the interest of industry, given the high profitability of many efficiency solutions. In addition, the EENs could be considered as an instrument of innovation and industrial policy, given the increasing demand for high energy-efficient solutions and related cost reductions if thousands of companies would ask for them. It would strengthen the investment goods industries and their potential for exporting those solutions to the world market.

Status and preliminary results of the 30 Pilot Networks project in Germany

The project 30 Pilot Networks has two main goals: to implement 30 energy-efficiency networks in Germany, and to further develop a network management system to set up and professionally operate energy-efficiency networks which may number 600 to 700 by 2020. The latter contains several elements:

• A network establishment manual that describes how potential medium-sized companies can be acquired for a network. This supplies the initiator of an efficiency network with (1) valuable references about how existing work groups attracted companies, (2) assistance on how to set up an informative meeting (e.g. timetable, agenda) and (3) gives instructions how to describe the network to potential participants in a meeting.

• A manual for the initial consultation phase that describes the typical course of such a consultation. However, the main support is given by a design report incorporating the results of the consultation and a variety of technical tools that help the engineer to calculate energy savings (currently existing, high efficiency motors, boilers, compressed air, CHP). About 15 other tools are in various stages of development, all of which will run under a single-user interface which is also under development. As the calculation method and used equations are documented in detail, the whole process is transparent to the engineer and company. The identified measures are summarised in one table. This table gives the company an overview of each measure, informing them of its energy- and CO2 reduction and its profitability. All measures are aggregated to provide the company with an overview of the overall investment cost and cost savings when all profitable measures are implemented.

• A manual for the network meetings helps the moderator to prepare these meetings. It contains samples of agendas, e. g. an agenda for the first meeting where the order of technical topics of the following meetings is defined, and an agenda for the meeting where the reduction targets are set. Furthermore, the moderator is given a list of technology experts for presentations during the meetings, with contacts if required.

• A fourth part of the manual describes the communication process within the network. On the one hand, it focuses on the flow of information in the network by giving advice on how to present the results of the initial consultation to the Board, how to motivate the staff and co-workers, or how to communicate the activities and success. On the other hand, it supports the public relations process of a network, e. g. with suggestions for press conferences, press releases, flyers, and other possible publications.

These four manuals are the core of the handbook for energy-efficiency networks. The handbook is enhanced by samples of contracts, presentations, check lists, guidelines and other information documents to implement and carry out a network.

The last few networks of the planned 30 pilot networks are still being acquired. Due to the economic crisis in 2008/2009, it was difficult to convince companies to participate in long-term projects like the EEN. As of April 2011, 26 of the 30 networks are operating. Eight of these networks have finished the consultation phase. The first analysis of two networks resulted in nearly 420 measures where 330 were found to be particularly profitable with an internal return rate of higher than 12 %, based on 10 to 20 years lifetime. These measures require an additional investment (compared to a standard investment) of about 5.3 million € which lead to energy cost savings of about 2.1 million € per year. Hence the average rate of return is nearly 40% and the net present value of the energy savings over 20 years (i=10%) outnumbers the investment by a factor of 2.5. The annual CO2 reduction of the profitable measures is equivalent to nearly 10,000 tonnes per year which is about 7.6 % of the total emissions of the company. All in all, the consultation of 23 companies indicated a highly profitable energy-efficiency potential.

The first results of the analysis of the 30 Pilot Networks project on the potential energy savings and profitability of different technologies are based on the examination of nearly 50 initial consultancy reports. Lighting and compressed air have the best economic evaluations. Nearly 90 % by number are profitable and the low difference of the profitability between profitable and all measures indicate that only a few are less profitable. Space heating reveals a different picture. Many, especially larger, investments are not profitable, at least when applying company criteria. Only 64 % of the investments indicate profitable measures. These results are preliminary, as they are based on the initial consultancies. Nevertheless, there is strong evidence that a high number of identified measures are profitable and profitability of different technologies varies. For the non-profitable measures applying company rules or for measures that might become economic under increased energy prices it is important to consider how such type of measures can be supported financially to make them viable for companies.

Maximizing the benefits

The creation of Learning Energy Efficiency Networks can be optimized by creating momentum through the involvement of important stakeholders that can organize and moderate larger number of networks such as electricity distributors or generators, industrial associations for trade and commerce etc.

The functioning of the networks may benefit from the combination with financial subsidy schemes in particular for energy audits. Further, the results from the networks must be publicized to promote the reputation of good performers. An instructive example is the performance league table as established under the CRC Energy Efficiency Scheme in the UK.

Non-standardized procedures, which create additional barriers for companies, present a risk to the effective functioning of the networks. For this reason it is important to set up standardized network procedures as for example the LEEN Standard in Germany set up for the Learning Energy Efficiency Networks (http://www.leen-system.de/leen-de/inhalte/ueber-uns.php).

2.6. Cross cutting issues and public awareness

2.6.1. Energy Services Companies (ESCOs)

This section will focus on the Energy Services Companies (ESCOs), the ESCO market, the factors influencing the developments, specific barriers and potential policy interventions to increase energy efficiency investments and to exploit energy saving potentials through ESCOs across Europe. It is based on the 2010 status report by the Joint Research Center – Institute for energy for the European Commission.

ESCO markets in Europe have been found to be at diverse stages of development. Certain countries (like Germany, Italy and France) have large number of ESCOs, while in most countries there are only a few ESCOs established and often complemented by engineering consultancies and energy efficiency technology providers offering solutions with some “ESCO elements” such as equipment leasing and performance guarantees. A strong market growth has been revealed during 2007-2010 in Denmark, Sweden and Romania and to a smaller extends, in Spain, Italy and France. The most common trend across all countries is, however, a slow market growth. The financial crisis and economic downturn are identified as partly responsible for the slow growth in a number of countries. Changes towards a more favorable legislative framework focused on energy conservation, increased activity in the refurbishment of public buildings, financial incentives for refurbishment and modernization of private real estate, and a stronger environmental awareness have been able to counterbalance the negative effect of the financial crisis in some cases.

Energy service projects focus at the deployment of comprehensive solutions for improving energy efficiency and increasing the utilization of renewable energy sources. Energy service contracts help to overcome financial constraints to energy efficiency investments by paying off initial costs through the future energy cost savings resulting from reduced energy consumption. Energy service providers offer an opportunity to curb increasing energy demand and control CO2 emissions while capturing market benefits by decreasing clients’ energy costs and making profit for themselves. Energy service companies have been operational on a large scale since the late 1980s-early 1990s. However, the energy service market in the European Union and neighboring countries is far from utilizing its full potential even in countries with a particularly developed ESCO sector.

It is relevant to state some definitions:

• Energy performance contracting: a contractual arrangement between the beneficiary and the provider of an energy efficiency improvement measure, verified and monitored during the whole term of the contract, where investments (work, supply or service) in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement or other agreed energy performance criterion, such as financial savings

• Energy service company (ESCO): a natural or legal person that delivers energy services and/or other energy efficiency improvement measures in a user's facility or premises, and accepts some degree of financial risk in so doing. The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements and on the meeting of the other agreed performance criteria

• Third-party financing (TPF): a contractual arrangement involving a third party — in addition to the energy service provider and the beneficiary of the energy efficiency improvement measure — that provides the capital for that measure and charges the beneficiary a fee equivalent to a part of the energy savings achieved.

• In contrast to an ESCO, "Energy Service Provider Companies" (ESPCs) are natural or legal persons that provide a service for a fixed fee or as added value to the supply of equipment or energy. Often the full cost of energy services is recovered in the fee, and the ESPC does not assume any (technical or financial) risk in case of underperformance. ESPCs are paid a fee for their advice/service rather than being paid based on the results of their recommendations (WEEA 1999). Principally, projects implemented by ESPCs are related to primary energy conversion equipment (boilers, CHPs). In such projects the ESPC is unlikely to guarantee a reduction in the delivered energy consumption because it may have no control or ongoing responsibility over the efficiency of secondary conversion equipment (such as radiators, motors, drives) and over the demand for final energy services (such as space heating, motive power and light).

The European ESCO Status Report 2007 described a noteworthy difference in the development paths of the European member states, while the general trend is a steady growth with some stagnant domestic ESCO markets. A number of European Directives (such as the Energy Service Directive (2006/32/EC) and the Energy Performance of Buildings Directive (2002/91/EC)), European projects (such as Eurocontract and Change Best) have been promoting the ESCO and EPC market. A number of national governments have also been promoting energy savings through direct and indirect measures such as carrying out information and promotion campaigns, demonstration projects, development of guidelines, setting up standards and in some cases the establishment of public ESCOs.

Most of the EU ESCO markets grew in 2005-2007 in comparison to 2004-2005 when the first European ESCO Status Report was prepared. A typical origin of ESCOs was heating and building control equipment manufacturers and retailers. Many multinational companies were active on the EU market. The most popular technologies used in ESCO projects as of 2007 were CHP, street lighting and heating.

The 2007 Status Report reconfirmed Germany as the largest and most advanced market, followed by France, UK, and Spain. In these countries the ESCO market expansion remained stable between 2005 and 2007. In 2007 the ESCO market had only recently emerged in the Czech Republic with the industry being significantly strengthened by concerted efforts of local actors (government, agencies and the providers) as well as international financial institutions. In 2005 the Swedish ESCO market was affected by a lack of trust due to previous negative experiences in the ESCO market together with Slovakia and Estonia. However, by 2007 Sweden had undergone a spectacular increase in ESCOs activities thanks to a focused and comprehensive strategy designed for the local circumstances. In 2007 the ESCO market was still on the starting ground in Greece, Portugal, Ireland, Romania, Bulgaria and Estonia, while no significant ESCO activity existed in Poland, Slovenia, Cyprus and Malta.

The European ESCO Status Report 2007 listed 10 major barriers in Europe:

• Low awareness of and lack of information about the ESCO concept;

• Mistrust from the clients;

• High perceived technical and business risks;

• Public procurement rules and accounting rules (including off balance sheet regulations);

• Lack of accepted standardized measurement and verification procedures;

• Administrative hurdles and consequently high transaction costs;

• Principal/agent dilemma with split incentives in the housing sector;

• Aversion to outsource energy;

• Lack of appropriate forms of finance;

• Low priority of energy efficiency measures.

Driving factors enabling the development of the ESCO market were also identified. The liberalization of the gas and electricity markets and increasing energy prices together with governmental support and capacity building were highlighted as having an important impact on the market development. Successful governmental support came in the form of dissemination of information, availability of subsidies for energy efficiency investments and dedicated state funds, and a supportive and favorable legislative framework (mandatory audits, energy efficiency certificates, climate change policies). Capacity building was found to be important in order to build a comfortable and confident market by creating standardized contract models, terminology and procedures, as well as establishing an accreditation system and bundling projects in order to overcome high transaction costs related to small size of projects.

The Status Report 2010 introduces a detailed description and analysis of national ESCO markets. After setting the local context, the country overviews start with basic information on the national ESCO market where available, including the number and type of ESCOs, most important clients and preferred technologies and investment areas. The most common financing mechanism and contract types are investigated, too. Furthermore, the crucial barriers and key success factors are presented, with an indication of what could be done in order to successfully overcome the obstacles and enhance the ESCO markets. It covers all EU member states, european countries that are not in the EU, the European part of the Commonwealth of Independent States (CIS Countries) and Non-EU South East Europe countries (Non-EU SEE).

The main findings and conclusions of the report are explained below.

Latest developments:

1. Increasing awareness

The awareness and understanding of energy efficiency services has increased and providers are met with a lower degree of mistrust compared to previous years. The rise in energy prices (increasing the importance of energy consumption in cost efficiency) and a shift in mind sets related to defining energy efficiency as both a competitive advantage, tool to improve the green image of an organization and moral obligation related to environmental awareness are all factors for the raised awareness. The knowledge of the ESCO concept has also increased, creating more confidence in the market, where potential clients start to consider energy efficiency services more business-as-usual than as a specialty. In some countries, financial institutions have acquired more experience in financing energy efficiency projects and in taking into consideration the guaranteed savings offered by some ESCOs and energy performance contracting. For instance in France, finance institutions can cover the risk of the guaranteed savings by insuring the savings. Yet, low awareness of the specifics of the ESCO model and scepticism towards its advantages among both clients and financiers remains one of the most commonly reported barriers to the deployment of ESCO projects in the large majority of countries surveyed.

2. Enabling public procurement rules

Public procurement rules and evaluation criteria in the public tendering process remain the main barrier for ESCO project development in the public sector. However, significant improvements have been achieved in some countries in removing these barriers and/or by establishing procedures that favour ESCOs. For instance in Spain, until October 2007 when the new national procurement law was approved, procedures were not adapted to long term service contracts. With the entry into force of this law, public contract are limited to 20 years. The new Energy Efficiency agreements 2008-2016 in Finland aim at ensuring that the Municipalities are able to use ESCO services when implementing energy efficiency investments.

In an increasing number of countries local authorities can retain the financial savings generated from energy saving projects, which has a crucial impact on their ability to enter into contractual arrangements with ESCOs.

3. Active public support

Public authorities have been increasingly active in supporting the development of an ESCO market in some countries by preparing ESCO model contracts, opening credit lines, working with public banks and preparing calls for tender to implement energy services in public buildings. In Sweden, to spur EPC projects, the Swedish Energy Agency (STEM) is pursuing a "portfolio of flexible mechanisms" which include the formation of an ESCO network, customer oriented information, guidelines for the procurement process, model contracts, and project evaluation. The role of public support is to enhance both the demand for energy services and the supply of services, including by establishing appropriate framework conditions that channel private financing in the sector.

4. Economic downturn

The financial crisis and economic downturn have had important impacts, both positive and negative, on the initiation and development of ESCO projects. The economic downturn made ESCO clients more unstable, reducing their activity, increasing the difficulty in ensuring energy savings and raising the risk of insolvency. The economic downturn has also raised the importance of contractual flexibility. On the other hand, the financial crisis and economic restrictions have focussed the attention on achieving cost reductions through energy efficiency measures and taking advantage of the flexible financing mechanisms offered by ESCOs. In order to counterbalance the economic downturn, many projects have been initiated in the public sector with financial incentives for projects in the private market (especially related to building refurbishment).

The shift in new projects from the industrial sector to public buildings has been related to the tightened access to finance in the private sector and higher investment risks.

5. Diverse market trends across national markets

Problems related to the stalling of the ESCO market in the larger part of the New Member States often depend on the problematic access to finance, cross-subsidised energy prices and the unavailability of energy consumption data to construct baselines. In other states (such as Finland, the United Kingdom and Norway) the awareness and understanding of the ESCO market has increased, but without experiencing any rise in project implementation or market volume. The main barrier in these markets is the access to finance, which can be partly related to the economic downturn and financial crisis.

In 2007 a number of countries outside the European Union, such as Turkey and Ukraine had ESCO markets in an embryonic state. By 2009 they had established a market with a high number of active market actors. In these countries the market transformation is related to changes in the legal framework and the availability of grants for project financing. Some European member states, such as Sweden, Italy, Spain and Denmark, have undergone a significant growth over the past years. The drivers for this strong growth differ among countries, but can be associated with improved efforts and tools to develop the ESCO market (some related drivers will be highlighted in the following section on success factors).

Common barriers

Barriers that hamper the deployment of the ESCO concept and EPC are identified below.

1. Ambiguities in the legislative framework, including the public procurement rules, remain one of the most important barriers. Procurement procedures are often complex and time consuming, which adds up to the transaction costs of projects, undermining their viability. In some jurisdictions the public tendering regulations require the applicants to have experience in all relevant project specific sectors, which hinder the entry of new and less established market actors. In France, the legally regulated contractual agreements for project development in the public sector are seen as a major hurdle for the introduction of the energy performance contracting.

Moreover, in most countries lifecycle costs that also account for maintenance and energy costs are not used in public procurement, which poses a disadvantage to EPC projects that may have a higher initial investment cost. Direct cost comparison of different energy supply options is often difficult.

The legal definition of the product provided by ESCO-type of contracts may have important adverse impacts, especially related to the taxation status of ESCO projects. For instance, in Croatia the ESCO model is not recognized by the authorities as an individual business model providing a service, but as contract delivering goods. Consequently, ESCOs need to pay VAT on the total equipment value at the moment of putting the energy saving equipment in operation.

2. Low and fluctuating energy prices decrease the economic potential for energy savings.

3. The lack of reliable energy consumption data makes it difficult to establish baselines and hence provide reliable data on actual savings.

4. The financial crisis and economic downturn has made access to finance more difficult in the large majority of countries. In Spain, Belgium, Finland, Denmark, Czech Republic, Poland, and Ukraine this has been identified as the most common barrier.

The financial crisis has influenced the initiation and development of projects due to the tighter access to loans, higher interest rates, stronger securities needed (for instance in Spain), reduced investment budget of clients, higher insolvency risk of clients and reduced the availability of providers to engage in long term contracts (Czech Republic).

In some countries, the economic crisis lead to freeze in refurbishment and upgrading investments, blocking a number of projects under development and the initiation of new ones.

In addition, despite an increased knowledge of energy efficiency projects, lending remains primarily asset-based. Financial institutions are still cautious with cash-flow based lending.

5. Real and perceived high business and technical risks remain strong barriers. The business and technical risks are related to the following issues:

- the perceived risk that the energy efficiency interventions might compromise the production or operation processes related to the core business;
- the aversion to outsource energy management, especially where in-house technical expertise exists. Yet, energy efficiency investments are rarely high on the corporate agenda, which often hinders the actual implementation of measures in-house;
- the lack of flexibility and long commitment required with ESCO contracts;
- small size of projects.

In the Netherlands, intervention that could compromise the core business such as energy management in SME and "non-standard" energy use in the commercial sector are met with skepticism. In specific industrial sectors, ESCO projects are restricted to areas outside the core process. In Austria and Spain, outsourcing energy management is often met with resistance from the technical department and internal project development is preferred when the financial resources and know-how are available (or delayed when either of these is not available).

6. In some countries, there is still a high level of mistrust in the ESCO model both from customers and from financing institutions. The lack of standardization is perceived as the most important motive for this mistrust. In addition (and partly related to the lack of standardization) the following issues have been identified as reasons for mistrust:

- inhomogeneous ESCO offer, which makes standardization of contracts difficult;

- lack of competition in some market segments;

- lack of experience of clients, ESCOs and financial institutions;

- absence of widely disseminated best practices with a clear client focus;

- unclear definitions and failed contracts;

- lack of standardized measurement and verification of project savings;

- complex contracts.

Although the level of awareness has increased during the last years, a certain level of mistrust from the customers still remains. The mistrust has many origins. In Austria, mistrust from the clients is mainly based on bad experience with energy consultants. In Sweden, the lack of confidence is created by the absence of credible and visible reference cases with a clear client focus. In the Czech Republic, mistrust (perceived as the main barrier) is based on the skepticism by management towards energy efficiency investments, the complexity of the ESCO solutions, unclear definitions and failed contract. In the Netherlands and Poland a low level of confidence is present in the market due to the absence of standardization and a specific legal framework for energy performance contracting.

In addition, the complex definition of a baseline with external factors influencing energy consumption hinders the establishment of simple contractual agreements, particularly for contractual agreements including shared savings. The monitoring required by energy performance contracting is considered costly and time consuming, especially for projects of smaller scale. On the other hand, no performance can be guaranteed in the absence of a sound monitoring system.

The lack of or insufficient competitiveness to meet the costumers' needs has been identified with the lack of skilled staff (Sweden, Spain, Turkey, etc.). ESCOs need to gain further experience, improve their technical, financial, management and marketing abilities in order to develop the market.

Local financial institutions often lack the experience in project financing and the financing of energy efficiency measures, and the evaluation of new concepts (such as guaranteed savings) restricts the access to finance. Experience in a few countries shows that financing institutions only build up or scale up their expertise when they start seeing energy efficiency businesses as a promising market niche.

7. Collaboration, commitment and cultural issues are still seen as an important limitation for the development of the ESCO concept.

The high level of collaboration required between the client and the provider can be perceived as resource consuming, while the commitment issues are largely related to the long contractual terms and low flexibility that characterize the ESCO model. The cultural clash has mainly been observed within Scandinavia, where the concept of energy efficiency measures is strongly connected to concept of "moral obligations". Therefore a business idea where the provider earns money from the energy savings of a second organization is not well accepted.

Success factors

There are various enabling and driving factors, which support the creation and growth of ESCO markets in the different countries. The number of policies and actions set up with the objective of directly supporting the ESCO market are limited. However, a number of legislative, structural and market related changes have fostered some national ESCO markets by producing indirect effects on the supply of and the demand for energy efficiency.

1. Supportive policy frameworks and implementing measures

Relevant supportive policies and measures have been implemented on national and European level. A number of legislative acts discussed in this report address energy efficiency and have direct or indirect impacts on the demand for Energy Services. The purpose of this legislation is make the end use of energy more economic and efficient by establishing indicative targets, incentives and the institutional, financial and legal frameworks needed to eliminate market barriers and imperfections which prevent efficient end use of energy. The EU directives create the conditions for the development and promotion of a market for energy services and for the delivery of energy-saving programmes and other measures aimed at improving end-use energy efficiency.

Energy consumption for buildings-related services accounts for approximately one third of total EU energy consumption. With initiatives in this area, significant energy savings can be achieved. The European Performance of Buildings Directive (2002/91/EC) and its recast 2010/31/EU of 19 May 201099 (EPBD) lay down requirements as regards the common general framework for a methodology for calculating the integrated energy performance of buildings and building units, the application of minimum requirements to the energy performance of new buildings and new building units, and of minimum requirements to the energy performance of existing buildings, building units and building elements that are subject to major renovation, building elements and technical building systems whenever they are installed, replaced or upgraded. The EPBD also introduces requirements related to national plans for increasing the number of nearly zero energy buildings, energy certification of buildings or building units, regular inspection of heating and air-conditioning systems in buildings, and independent control systems for energy performance certificates and inspection reports.

The repealed CHP directive 2004/8/EC establishes a common framework to promote and facilitate the installation of cogeneration plants where demand for useful heat exists or is anticipated. There are already examples of regulatory developments in some Member States, such as Belgium (green certificates and cogeneration quotas), Spain (a decree on the sale of cogeneration electricity) or Germany (a law on cogeneration). And the energy efficiency directive states in its article 14 "Member States shall adopt policies which encourage the due taking into account at local and regional levels of the potential of using efficient heating and cooling systems, in particular those using high-efficiency cogeneration. Account shall be taken of the potential for developing local and regional heat markets".

The Eco-design directive (2009/125/EC) provides EU-wide rules for reducing the environmental impact of products, including energy consumption throughout their entire life cycle. Apart from the user's behavior, there are two complementary ways of reducing the energy consumed by products: labeling to raise awareness of consumers on the real energy use in order to influence their buying decisions (such as labeling schemes for domestic appliances), and energy efficiency requirements imposed to products from the early stage on the design phase. Eco-design aims to improve the environmental performance of products throughout the life-cycle by systematic integration of environmental aspects at a very early stage in the product design. The directive does not introduce directly binding requirements for specific products, but does define conditions and criteria for setting requirements regarding environmentally relevant product characteristics (such as energy consumption) and allows them to be improved quickly and efficiently. It will be followed by implementing measures which will establish the eco-design requirements. In principle, the Directive applies to all energy using products (except vehicles for transport) and covers all energy sources. A set of regulations have already been enforced among others for household refrigeration appliances, electric motors, external power supplies and lighting products in the domestic and tertiary sector.

The opinions about European policy as a driver differ. While some countries merely transpose the European legislation, others implement the spirit of the legislative acts, using them to establish ambitious action plans and implement concrete policy packages. Actors active on the Finnish market consider the EU legislation to be important ESCO market drivers. In addition, the function of the government to develop reference projects has an important value in creating legitimacy and lowering the perceived risk for projects.

The implementation of comprehensive national policy frameworks of complementary measures needs to be emphasized too: in Sweden the importance and profitability of energy efficiency measures has increased thanks to policies such as energy certification for buildings, the subsidy scheme for public building owners (KLIMP103), and a set of market instruments (CO2 taxes, green certificates, electricity tax for energy intensive companies (PFE), etc.). In France, the action plan "Le Grenelle de l'environnement" has created an ESCO market in the public sector with public-private partnerships and private investments. In Slovenia, the decree setting limits on environmental pollution, the building and lighting legislation, the voluntary agreements of CO2 taxes, the availability of structural funds, as well as various financial incentives are expected to contribute to the ESCO market growth in the forthcoming years. In Italy, the growth of the ESCO market is strongly connected to the introduction of White Certificates. In 2009, 44% of the Energy Services Enterprises obtaining White Certificates declared to have the ESCO activity as their main business profile.

2. Structural and market related changes

The change in mindset towards the outsourcing of services such as energy management (e.g. Sweden and Czech Republic) and public building facilities management (e.g. Spain and Ireland) has increased the attractiveness of ESCOs.

In addition the refurbishment and modernization needs (especially in the buildings sector) have increased the number of projects implemented by ESCOs. In Sweden, building owners show a growing preference to outsource operation and maintenance services. In the Czech Republic, the increased freedom in decision making of building and facility managers and owners together with the high operational costs and obsolete energy infrastructure have been important market drivers.

3. The steady rise in energy taxes

The energy price is one of the main factors influencing the demand of energy efficiency investments and therefore ESCO services. The steady rise in energy taxes has improved the payback time of energy efficiency investments and increased the importance of energy efficiency in cost competition. The rise in energy prices has also increased the interest in energy conservation for non-energy intensive energy consumers. For instance, in the Netherlands the introduction of substantial energy taxes raised the energy price for households and small companies, resulting in more profitable energy saving measures.

4. Competitive pressures

The effects of cost competition together with the need to improve cash flows and use off-balance sheet solutions for energy efficiency investments have been strong in most countries surveyed, most notably in Finland, Denmark, and Belgium.

5. Market liberalization

The liberalization of the energy markets has been underway since the last decade and is considered an important enabling factor in order to create the right market conditions for ESCOs to operate. The liberalization of gas and electricity markets has transformed the semi-public energy sectors of some Member States into sectors with competing market oriented companies thus creating more room for value-added services.

6. Environmental awareness

The environmental awareness and climate change policies have had a spin-off effect with the implementation of favorable legislative frameworks and concrete implementing measures, as well as gaining political support. Several international programmes promote cooperation, technical assistance and financial aid for energy efficiency and conservation projects such as the Covenant of Mayors, the Clinton Climate Initiative for Cities and the European Local ENergy Assistance (ELENA), among many others.

7. The establishment of an ESCO association

The establishment of ESCO associations has partly been supported by public authorities. The creation of ESCO association enables a market establishment with important activities, such as standardization and quality control efforts, dissemination of information and capacity building lobbying.

The Belgian Federal authorities' energy service company and third party investor Fedesco and the established Belgian ESCO association Belesco facilitate energy performance contracting in the public sector. Fedesco is also creating a "Competence centre for energy services and financing of energy efficiency and renewable energy" and striving to establish a dedicated regulatory framework for ESCO projects in collaboration with Agoria (Belgium's largest employers' organization and trade association).

The Swedish Energy Agency is pursuing a "portfolio of flexible mechanisms", including the formation of an ESCO network, customer oriented information, guidelines for the procurement process, model contracts, EU-IEE projects and project evaluations in order to spur energy performance contracting projects. In addition, the coordinated actions of a public authority disseminating information and advising potential project participants gives more legitimacy to the business model and to the energy performance contracting providers creating confidence on the market.

Recommendations for a further market development

A number of lessons can be drawn from the present analysis of the factors influencing the different market developments. The effect of the different factors is strongly dependent on the particular national circumstances and market maturity. This section points to important factors and actions that have had a positive impact in establishing and growing national ESCO markets.

1. Focused policy support and supportive policy frameworks

It is essential to have a sound legislative framework that enables ESCO type projects and policies and measures that promote energy efficiency investments. In order to promote ESCO projects in the public sector a number of important steps are necessary.

Firstly, adaptation of the public procurement laws in order to facilitate the evaluation of EPC providers and adapting the project cost evaluations in order to take into consideration lifecycle costs, including maintenance and energy costs. Secondly, update the procurement regulations by allowing group tendering by consortia and EPC providers to be evaluated on other grounds than previous EPC projects would facilitate the entrance of new and smaller actors in the market. Third, allow the inclusion of energy efficiency in technical tender specifications and use of lifecycle costing in public tender specifications. Clear, practical and ready-to-use guidelines on how to apply energy efficiency criteria in public procurement procedures are needed in order to improve the practical implementation of energy efficient public procurement. The availability of working tools such as internet based calculators, databases and handbooks, along with dissemination of information and training, would facilitate the implementation of new assessment criteria in the procurement process and base it on lifecycle cost assessment. Cleary allocated responsibility is needed in order to prevent overlaps and to ensure competence.

The European Commission has developed a Green Public Procurement Tool Kit which covers a number of practical issues for public purchasers. The kit includes training modules and concrete examples of environmental criteria which can be readily introduced in tender documents. This kit addresses, among others, products falling within the construction, transport, and electricity sectors. The Green Public Procurement Tool Kit is available on the following link: http://ec.europa.eu/environment/gpp/toolkit_en.htm.

A favorable policy framework can shorten the payback time of energy efficiency investments and raise the awareness of energy efficiency measures, lowering investment risks. Certification, such as the energy performance certificates of buildings, is important in order to increase the demand for energy audits and monitoring requirements, facilitating energy saving estimations available through proper statistics and increase awareness. Improving the legal basis for the removal of specific barriers has been shown to affect the perceived risks of contractual arrangements. For example, in the Czech Republic the law supports the right of an ESCO to collect payment related to their customers' energy savings. In Hungary, local governments that have a contract with an ESCO can 'freeze' their energy costs in the budget. In contrast, in some countries the legal framework does not allow municipalities to retain the savings derived from implementing energy efficiency projects.

Concerted effort is needed in order to legitimate the business model and to overcome the real or perceived risk aversion through financial instruments. This could be achieved via loan guarantees by recognizing the contractual model and the establishment of funding mechanisms, such as revolving funds that co-finance projects at lower interest rates.

The cases of Sweden and Austria show that energy agencies' active engagement in advising clients on energy services and in participating in pilot projects can have an important role in legitimizing the business model.

2. Project bundling

Successful project bundling strategies can help overcome many of the key barriers to financing of ESCO projects. To achieve sufficient scale, a strategy is required that allows for the aggregation of individual projects, technologies, service offers, and investments into a larger and more comprehensive lots, which could be interesting for ESCOs financial institutions. As demonstrated by the uptake of energy performance contracting in Germany and Austria, targeting public institutions and facilities for large-scale retrofit programmes can kick-start market activity.

Public-private partnerships are also encouraged. In Italy are public-private ESCO consortia developed where the public party is responsible for the aggregation of demand, for guaranteeing and implementing the energy saving measure(s), and for the compensation for the risk of financial losses. Energy saving becomes an instrument of aggregate finance. Typically local and regional commercial banks are ready to take part in such a consortium.

3. Accreditation and standardization to build market confidence

The establishment of a national legal framework for the identification and the establishment of quality standards and certification schemes for ESCOS is essential in order to boost the ESCO markets and maintain confidence in the. The standardization of common core contractual provisions including clear frameworks, definitions, measurement and verification standards (such as the International Performance Measurement & Verification Protocol) and an accreditation system is essential in order to raise the confidence on the market.

4. Facilitating the access to appropriate forms of financing

The engagement of financial institutions is crucial for the establishment of a successful ESCO market. In immature ESCO markets public authorities or development financing institutions (DFIs) - including public banks - may need to promote customized financing products to respond to the specific barriers to energy efficiency financing present in each national market. For example, special purpose credit lines and/or revolving funds may be appropriate tools when there are liquidity constraints in the banking sector or the need to provide long-term credits to finance institutions. A guarantee scheme or other risk mitigating tools may be appropriate when the financing sector perceives that the risk of ESCO projects is too high.

There is a wide range of instruments that can be employed and/or scaled up to promote the access of ESCOs to financing, including:

- Guarantee programmes that expand access to debt, thereby lowering the cost of financing and enabling more comprehensive energy efficiency project development;

- Special purpose credit lines or revolving funds to mitigate liquidity constraints in the banking sector and/or provide long-term credits to finance institutions and subordinated debt instruments to close an existing equity gap.

- Engaging development financial institutions (DFIs) – including public banks – as they are able to structure and competitively fund customized energy efficiency programs and financing initiatives;

- Expanding partnerships between financing sources and utilities, city agencies, and ESCOs, which have longstanding relationships with customers, to rapidly identify energy efficiency opportunities.

5. Establishing bankable ESCO project pipelines

Financing is not a panacea in itself and further enabling policies are needed. Ensuring mechanisms for project development and delivery is instrumental in generating a steady flow of investment ready projects. The range of further tools available for ensuring bankable ESCO project pipelines includes:

- Targeted communication about the profitability of energy efficiency investments;

- Programmes and technical assistance facilities that build the capacities of market participants to develop and structure finance for projects, most notably providing training for feasibility study and business plan preparation across a range of possible project proponents. These facilities can target both public authorities and private actors (such as ESCOs and SMEs) and can be channeled via appropriate local authorities or chambers of commerce.

- With a view to the need to create bankable project pipelines and the significant differences among Member States in terms of taxation and accounting regimes, procurement, budgeting etc., there is a need to developing member states specific packages that can assist and guide project proponents – especially local authorities – through specific issues and procedures related to e.g. energy performance contracting and public procurement in their national context. This process can build on the outputs from various Intelligent Energy Europe (IEE) projects (EESI, Eurocontract, ClearSupport, Change Best, etc.). Such national packages can unleash a significant replication potential across local authorities once successfully implemented in one city/region. One communication channel for such an option can be the Covenant of Mayors.

- Further supplementary policies, such as energy audit mandates (introduced by the energy efficiency directive) or monitoring of energy consumption of public entities and large private energy users with a possible commitment and/or incentive to implement economically feasible projects.

6. Establishment of an ESCO association and the collaboration with national energy agencies

An ESCO association can act as a reference point for ESCOs customers and suppliers and, by grouping and concentration of ESCO professionals, can represent the point of view of the industry with a unified voice. Two European ESCO associations, EFIEES and EU-ESCO are promoting the ESCO concept and acting as a reference point for its members.

In addition, the establishment of an association or a similar platform or forum could concentrate resources in information dissemination and capacity building. The association can create a support network for potential clients with capacity building, give direct advice, and access to information. The association could organize workshops and knowledge sharing events with ESCOs, potential clients (municipal representatives, facility managers, etc.) and financial institutions in order to increase the knowledge of how ESCOs engage in projects and what benefits can ESCOs bring to project management from a risk reduction, financial and environmental perspective.

An ESCO association would also be a useful reference point for collaboration opportunities between ESCOs. The establishment of independent market experts can provide confidence in the market and performs the function of a reference point for all stakeholders such as ESCOs, clients and decision makers.

2.6.2. Green Public Procurement

"Green Public Procurement (GPP) is a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured." (COM (2008) 400 Public procurement for a better environment).

Public authorities are major consumers in Europe, they spend approximately 2 trillion euros annually, equivalent to some 17% of the EU's gross domestic product. By using their purchasing power to choose goods and services with lower impacts on the environment, they can make an important contribution to sustainable consumption and production.

Green purchasing is also about influencing the market. By promoting and using GPP, public authorities can provide industry with real incentives for developing green technologies and products. In some sectors, public purchasers command a large share of the market (e.g. public transport, construction, health services and education) and so their decisions have considerable impact.

Benefits of GPP

Political:

- GPP is an effective way to demonstrate a public authority's commitment to environmental protection and sustainable consumption and production.

Environmental:

- GPP allows public authorities to achieve environmental targets
- GPP sets an example to private consumers
- GPP raises awareness of environmental issues

Social/Health:

- GPP can improve quality of life both directly and indirectly
- GPP helps establish high environmental performance standards for products and services

Economic:

- GPP provides incentives for industry to innovate
- GPP promotes green products and environmental technologies
- GPP saves money when the lifecycle cost of products is considered

National Action Plans (NAPs) are the means by which Member States implement GPP. These plans have now been adopted by a majority of the EU-27. They are intended to address the environmental, and in some cases also social, impacts of public procurement.

Many countries report that political support is extremely important in driving this area forward. Many NAPs reflect high levels of stakeholder engagement, including procurers, government representatives, suppliers and trade associations. Identification and prioritisation of product groups is usually performed by considering the level of government spend on a particular product group, together with the level of environmental impact that the product group has. In many cases NAPs contain ambitious targets and specific measures to promote and implement GPP and give an overview of training, communication, monitoring and other activities undertaken by Member States in the field of GPP.

Common EU GPP criteria

The basic concept of GPP relies on having clear, justifiable, verifiable and ambitious environmental criteria for products, services and works, based on a life-cycle approach and scientific evidence base.

Technical reports are available for each product group, outlining scope; technical characteristics; key environmental impacts during production, use phase and end of life of products; existing technologies; related legislation; market availability and cost considerations.

Based on these reports, core and comprehensive criteria are developed for each product/service group. The core criteria can be applied with minimal effect on cost or verification effort, whereas the comprehensive criteria aim for the best environmental performance available. All documents undergo extensive external and internal consultation before the final GPP criteria are adopted.

GPP criteria follow the procurement process. They include definition of the subject matter, minimum technical or functional specifications, selection criteria related to the capacity of bidders to perform the contract, award criteria for the comparison of offers and contract performance clauses. They are translated into all official languages. Procurers are free to use the EU GPP criteria directly in tendering documents.

On 25th October 2011 the European Commission published a fully revised version of Buying Green! – A Handbook on green public procurement. The handbook is a concrete tool to help public authorities to buy goods and services with a lower environmental impact. It is also a useful reference for policy makers and businesses responding to green tenders. This second version of the Handbook includes:

• Guidance on how environmental considerations can be included at each stage of the procurement process
• Examples drawn from contracting authorities across EU Member States
• Sector-specific GPP approaches for buildings, food and catering services, electricity and timber

As of april 2013, the following EU GPP criteria are available in the GPP website (http://ec.europa.eu/environment/gpp):

• Copying and graphic paper
• Cleaning products and services
• Office IT equipment
• Construction
• Transport
• Furniture
• Electricity
• Food and catering services
• Textiles
• Gardening products and services
• Windows, glazed doors and skylights
• Thermal insulation
• Hard floor-coverings
• Wall panels
• Combined heat and power (CHP)
• Road construction and traffic signs
• Street lighting and trafficc signals
• Mobile phones
• Indoor lightning

Diferent types of contract require their own approach to GPP. Key elements of GPP implementation for construction and office IT equipment are presented here, with examples of their application.

Construction works

The substantial environmental impact of the construction sector (for example, buildings account for approximately 36% of EU greenhouse gas emissions and 40% of final energy demand) makes it an important area of focus for GPP.

Implementing GPP in the construction sector may involve the following elements:

• Selection criteria for architects and engineers based on experience in sustainable building design, and for contractors in applying appropriate environmental management measures on site.

• Minimum energy performance standards, with additional points available for performance beyond the minimum.

• Preference for designs which incorporate renewable energy systems.

• Restrictions on hazardous substances in building materials and incentives for the use of sustainable timber and materials made of recycled content.

• Contract clauses related to waste and resource management and transport of construction materials to site which minimise environmental impact.

Example: In Malta, specifications for a new school building required it to be energy self-sufficient through the use of on-site renewable energy production. Tenderers were able to present different solutions for achieving this goal. Minimum levels of energy and water efficiency were specified, with additional points available for even better performance during the award stage.

Office IT equipment

Public authorities are major consumers of office IT equipment and the potential to achieve savings in this area while helping to shift the market to higher environmental standards is great. GPP approaches to IT equipment typically encompass:

• Energy-efficiency requirements in operational, stand-by and off-mode. Central government authorities must apply the latest energy-efficiency criteria set out in the EU Energy Star Regulation as a minimum. Higher marks may be available at award stage for energy performance which exceeds the prescribed minimum.

• Design which ensures durability and facilitates the upgrade or replacement of components, e.g. readily accessible memory cards, and easy disassembly to facilitate recycling of parts

• Restrictions on substances which have been identified as hazardous to human health or the environment

• Restrictions on noise levels

Example: In 2010, Stockholm County Council introduced GPP requirements for computers which specify very low energy consumption, the use of recycled plastic in new products and the elimination of lead, mercury and halogenated flame retardants from new computers. By the end of 2014, the County Council expects to have lessened the climate impact of its computers - including during their use phase - by 40%, reduced the weight of hazardous substances by eight million kilograms and cut the County Council's CO_2 emissions by two million kilograms.

Additional resources

The EU GPP website has been developed as a central point of information on GPP where the following information can be found:

• Common EU GPP Criteria and Technical Background Reports

• The Buying Green! Handbook on Green Public Procurement giving advice to purchasers on legal and practical aspects of GPP

• A GPP Helpdesk to respond directly to stakeholders' enquiries

• A News-Alert featuring the most recent GPP news and a number of examples of GPP implementation in Member States

• Information on LCC (Life Cycle Costing) methodologies, eco-labels and other sources for GPP criteria development

• A list of responses to Frequently Asked Questions (FAQs) and a glossary of key GPP terms and concepts

• Latest information on GPP National Action Plans and policies

• Studies, projects, videos, court cases, legal and policy background and training materials

3. MONITORING OF EU AND NATIONAL ENERGY EFFICIENCY TARGETS

Energy policy-making always consists of setting objectives, which include an increasing number of energy and climate policy targets. During the last years, the need for reliable data and indicators for the monitoring of such targets has grown considerably both at the national level and at the level of the EU. At EU level, there are obligations to regularly report the development of the energy efficiency progress as part of the national energy-efficiency action plans (NEEAPs) to implement the directive on energy end-use efficiency and energy services (ESD; 2006/32/EC). The new European Energy Efficiency Directive (EED) from 25 October 2012 even provides for annual as well as more comprehensive reporting obligations at three year intervals.

3.1. Description of the ODYSSEE- MURE project

It is obvious that such monitoring processes need suitable tools to support the monitoring obligations of the national Governments. The ODYSSEE database on Energy Efficiency Indicators (http://www.odyssee-indicators.org) and the MURE database on energy efficiency policies and measures (http://www.muredatabase.org), which are coordinated in a joint project financed by the Intelligent Energy Europe Programme by ADEME (France) with the technical support of Enerdata and Fraunhofer, make important contributions to the development of EU-wide monitoring tools to analyse policy issues arising in the context of energy efficiency and its links to global climate change. Both tools have been recognized in the use made of their results by the European Commission and many Member States.

ODYSSEE provides a comprehensive and detailed technical and economic database on energy data, energy-related activities and energy efficiency indicators at the level of the whole economy and all end-use sectors (residential, tertiary, industry and transport). The geographical coverage comprises the EU-27 countries plus Norway and Croatia. It includes time-series from 1990 or earlier until 2010, which are regularly updated (1-2 times per year).

MURE is a database on energy efficiency policy measures for all end-use sectors and its main purposes are:

- To gather and organize information on energy efficiency policies in the EU-27 countries, Norway and Croatia
- To gather information on qualitative and quantitative impact evaluations
- To be a useful tool for the identification and analysis of the policy measures included in the national energy-efficiency action plans (NEEAPs) under the ESD.

MURE also provides a simulation tool for the bottom-up modelling of energy efficiency policies and measures.

The ODYSSEE-MURE project is ongoing in several phases since 1994. The last project lasted from May 2010 until November 2012. The project "ODYSSEE MURE 2010" was aimed to achieve the following objectives:

- Evaluate and compare the energy efficiency progress by sector for EU Member States and for the EU as a whole, and relate the progress to the observed trend in energy consumption
- Evaluate energy efficiency policy measures in the EU MS and the EU as a whole.
- Monitor EU and national targets on energy efficiency.

The next phase of the ODYSSEE-MURE project is planned to start in April 2013.

3.1.1. ODYSSEE database

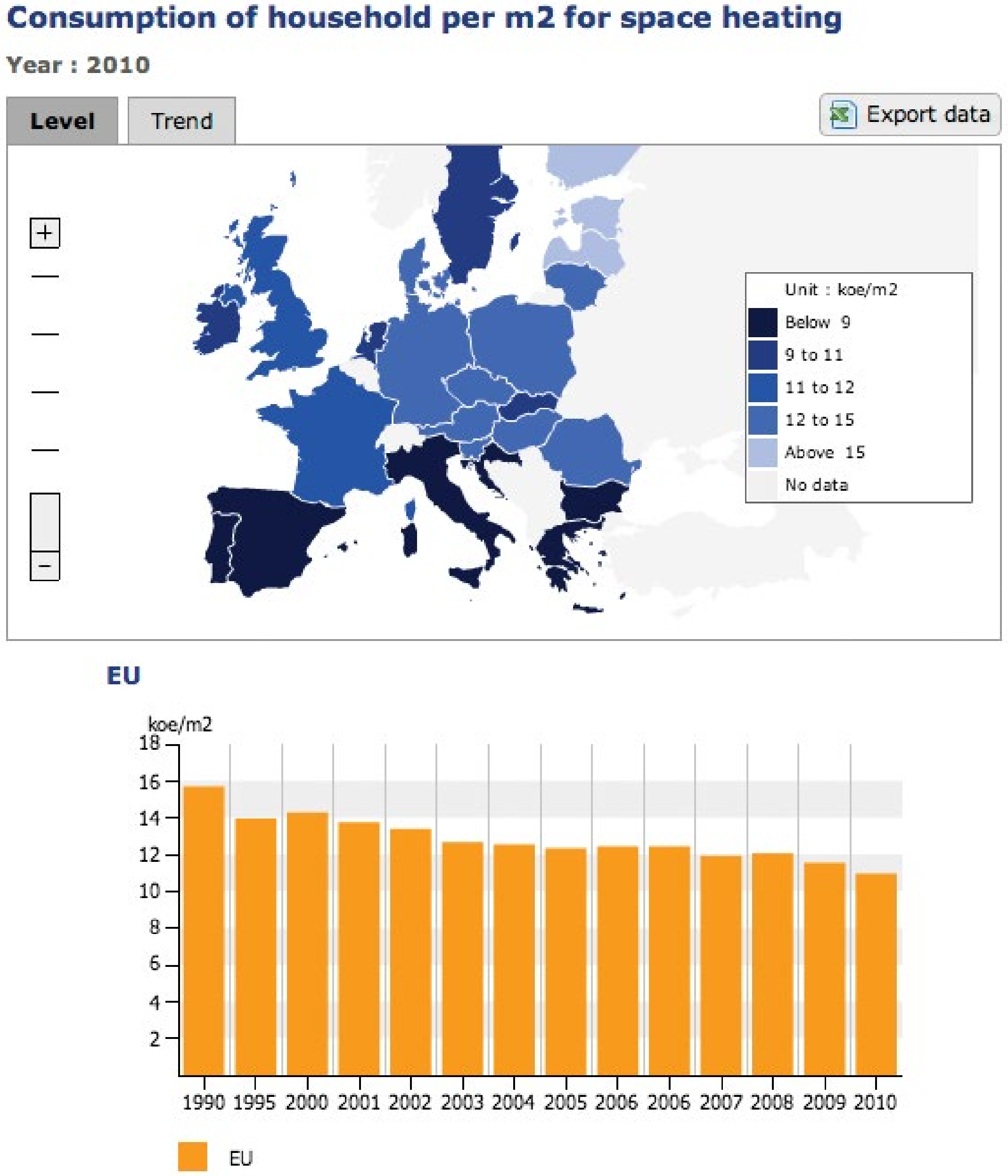
For nearly two decades, the Odyssee project (Online Database for Yearly Assessment on Energy Efficiency) has provided valuable and detailed energy efficiency indicators, for the EU-27 members plus Norway and Croatia, and has become a leading reference database monitoring detailed energy consumption and assessing the energy-efficiency performance of European Union member countries.

Odyssee's unique collection of historical-based data enables a review and benchmark of each EU member's progress in energy efficiency improvement and an access to information by sector, end-use, and impact on CO_2 emissions reduction.

ODYSSEE website presents a large set of publications such as country profiles (synthetic document presenting energy efficiency trends and policies by country), sectoral profile (selection of graphs by sector presenting energy efficiency trends in EU), national reports (analysis of energy efficiency trends and policies by country) and free indicators through data mapper.

This web database presents for free access a selection of around 30 key energy efficiency indicators developed within the ODYSSEE MURE project together with energy efficiency data from 1990 until 2010. In this online interface the user can browse the different categories (macro, industry, transport, households and services), click on the desired category and indicator to view the appropriate charts, view the consumption per country and click and export annual values of the indicators on Excel with the data used to calculate them, as shown in the following example.

The indicators are grouped by categories according to the following table.



Sector	Indicators
Macro	• Overall energy efficiency gains • Final intensity • Primary intensity
Industry	• Energy efficiency gains in industry • Intensity of industry • Intensity of manufacturing • Adjusted intensity of manufacturing • Specific consumption of steel • Specific consumption of cement • Intensity of chemicals • Specific consumption of paper
Transport	• Energy efficiency gains in transport • Unit consumption of air transport • Unit cons. of road transport of goods • Unit cons. of road transport per car eq • Specific consumption of cars • Specific consumption of new cars • Share of public transport for passengers • Share of rail and water for freight
Households	• Energy efficiency gains in households • Consumption per dwelling • Cons. per dwelling for elec. appliances • Consumption per dwelling for heating • Consumption of per m² for heating • Consumption per dwelling at EU climate
Services	• Consumption of services per employee • Electricity cons. of services per employee • Energy intensity of services • Electricity intensity of services

3.1.2. MURE database

MURE (Mesures d'Utilisation Rationnelle de l'Energie) provides information on energy efficiency policies and measures that have been carried out in the Member States of the European Union and enables the simulation and comparison at a national level of the potential impact of such measures. The MURE database is therefore an important tool to show "demonstrable progress" as requested by instruments such as the Kyoto Protocol. It has been designed and developed by a team of European experts, led and coordinated by ISIS (Institute of Studies for the Integration of Systems, Rome) and the Fraunhofer Institute for Systems and Innovation Research ISI (Germany).

MURE is part of the ODYSSEE MURE project coordinated by ADEME and supported under the Intelligent Energy Europe Programme of the European Commission. This project gathers representatives such as energy Agencies from the 27 EU Member States plus Norway and Croatia and it aims at monitoring energy efficiency trends (ODYSSEE part) and policy measures (MURE part) in Europe

The development of the MURE database was also supported by national funding in each EU Member State. A permanent network of correspondents within energy efficiency agencies established in all EU Member States guarantees the continuous updating of the database. The MURE Database is structured by energy end-use sector, and allows browsing the energy efficiency measures of this sector. A 5th database contains information on general energy efficiency programmes and on general cross-cutting measures

- Household
- Transport
- Industry
- Tertiary
- General cross-cutting measures

The database is available on the website www.muredatabase.org and lets the user make specific queries by countries, sectors and type of measure, such as in the following example.

Result provided by the MURE database to a query on all sectors of the EU and EU related measures:

Code	Title	Status	Type	Starting Year	Semi-quantitative Impact	NEEAP Measure	EU-related Measure	Quantitative Evaluation	Description
AU22	EU-related: Energy Labelling Office Equipment (Energy Star) - prova 123	Unknown	[illegible]	[illegible]	Unknown	No	YES	No	No
AU1	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - EU-related Energy Labelling of Household Appliances (Directive 92/75/EC)	Ongoing	[illegible]	[illegible]	Medium	Yes	YES	YES	YES
AU21	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy Certificates for Buildings (Energieausweis für Gebäude)	Ongoing	[illegible]	[illegible]	High	No	YES	No	YES
BEL15	Minimum efficiency requirements for new central heating boilers	Ongoing	Legislative/Informative, Legislative/Normative	1998	High	No	Yes	No	No
BEL16	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Federal Government - Labels on electrical household appliances	Ongoing	Legislative/Informative	1998	High	Yes	YES	No	YES
BEL29	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Flanders - Insulation and energy performance regulation for buildings	Ongoing	Legislative/Informative, Legislative/Normative	2006	High	Yes	YES	YES	YES
BEL8	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Wallonia - Thermal regulation for buildings	Ongoing	Legislative/Normative	2008	High	Yes	YES	YES	YES
BEL25	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Brussels - Act structurally on the demand through progressive reinforcement of the requirements of the EPB (building energy performance) regulations - Inspection of technical fac…	Ongoing	Legislative/Informative, Legislative/Normative	2008	High	Yes	YES	YES	YES
BG7	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy Performance Standard for Buildings	Ongoing	Legislative/Normative	2005	Medium	Yes	YES	No	YES
BG9	EU-related: Performance of Heat Generators for Space Heating/Hot Water (Directive 92/42/EEC) - Update of the legislative requirements for the efficiency coefficient at nominal power and partial power of boilers, working with liquid and/or gas fuel	Ongoing	Legislative/Normative	2005	Medium	Yes	YES	YES	YES
BG10	EU-related: Ecodesign Directive for Energy-using Products (Directive 2005/32/EC) - Mandatory measures for efficient lighting	Ongoing	Legislative/Normative	2005	Medium	Yes	Yes	YES	YES
BG11	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Mandatory energy labeling of electrical appliances	Ongoing	Legislative/Informative	2006	Low	Yes	YES	No	YES
BG12	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Minimum efficiency standards for electrical appliances	Ongoing	Legislative/Normative	2006	Medium	Yes	YES	No	YES
BG1	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - National Program for Renovation of Residential Buildings in the Republic of Bulgaria, 2006-2020	Ongoing	Financial	2007	Medium	Yes	YES	YES	YES
BG17	EU-related: Performance of Heat Generators for Space Heating/Hot Water (Directive 92/42/EEC) - Mandatory energy efficiency control for boilers and air-conditioning systems - Households	Ongoing	Legislative/Normative	2008	High	Yes	YES	No	YES
BG18	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Mandatory energy efficiency certificates and labels for buildings - Households	Ongoing	Legislative/Informative	2008	High	No	YES	No	YES
CY3	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Governmental financial support schemes for investments in RES/RUE/EE	Ongoing	Legislative/Normative	2003	High	Yes	YES	No	YES
CY9	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Information, awareness campaigns, workshops , seminars for energy savings	Ongoing	Information/Education, Legislative/Normative	2004	Medium	Yes	YES	No	YES
CY1	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Law for the enegy performance of buildings	Ongoing	Legislative/Informative, Legislative/Normative	2007	High	Yes	YES	No	YES
CY4	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Efficiency requirements for energy using produsts	Ongoing	Legislative/Normative	2011	Medium	Yes	YES	No	YES
CY2	EU-related: Revised Directive for Labelling of Energy-related Products (Directive 2010/30/EU) - Energy labelling and relevant information of household appliances	Ongoing	Legislative/Informative	2012	Medium	Yes	YES	No	YES
CZ4	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Mandatory control system of heating (Povinné øídící systémy vytápìní)	Ongoing	Legislative/Normative	2001	Unknown	No	YES	No	YES
CZ17	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - (Energetické štítkování domácích elektrospotøebièù)	Ongoing	Legislative/Normative	2004	Low	Yes	YES	YES	YES
CZ5	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Periodic mandatory inspection of boilers (Povinná pravidelná kontrola kotlù)	Ongoing	Legislative/Informative, Legislative/Normative	2006	Unknown	No	YES	No	YES
DK6	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - EU energy labelling of electric appliances	Ongoing	Legislative/Informative	2000	Low	Yes	YES	YES	YES
DK32	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Energy Labeling Buildings	Ongoing	Legislative/Normative	2005	High	Yes	YES	No	YES
DK8	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Revision of thermal building code (2005/2006)	Ongoing	Legislative/Normative	2006	Low	Yes	YES	No	YES
DK31	EU-related: Performance of Heat Generators for Space Heating/Hot Water (Directive 92/42/EEC) - Statutory inspection of boilers and heating installations	Ongoing	Legislative/Normative	2011	Unknown	Yes	YES	No	YES
EST1	EU-related: Performance of Heat Generators for Space Heating/Hot Water (Directive 92/42/EEC) - Efficiency requirements for boilers	Ongoing	Legislative/Normative	2004	Medium	No	YES	No	YES
EST3	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Energy efficiency requirements for electrical appliances	Ongoing	Legislative/Normative	2004	Medium	No	YES	No	YES
EST4	EU-related: Revised Directive for Labelling of Energy-related Products (Directive 2010/30/EU) - Energy labelling of household electric appliances	Ongoing	Legislative/Informative	2004	Medium	No	YES	No	YES
EST16	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy performance of buildings	Ongoing	Legislative/Informative, Legislative/Normative	2008	High	Yes	YES	No	YES
FIN16	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Energy Labelling Law	Ongoing	Legislative/Informative	1995	Unknown	Yes	YES	No	YES
FIN6	EU-related: Performance of Heat Generators for Space Heating/Hot Water (Directive 92/42/EEC) - Building code D7: Orders for boiler efficiency	Ongoing	Legislative/Informative, Legislative/Normative	1998	Unknown	No	YES	No	YES
FIN24	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Periodic voluntary inspections of household boilers	Ongoing	Information/Education	2007	Low	No	YES	No	YES
FIN32	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Mandatory energy efficiency certificates for buildings (dwellings)	Ongoing	Legislative/Informative, Legislative/Normative	2008	Low	No	YES	No	YES
FRA3	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Minimum energy performances of boilers	Ongoing	Legislative/Normative	1994	Low	Yes	YES	No	YES
FRA2	Labels on electrical households appliances	Ongoing	Legislative/Informative	1995	Medium	No	Yes	No	YES
FRA38	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Boiler maintenance and periodic control	Ongoing	Legislative/Informative, Legislative/Normative	1998	Low	Yes	YES	No	YES
FRA14	Minimum efficiency standards for refrigerators and freezers	Completed	Legislative/Normative	1999	Medium	No	Yes	No	YES
FRA39	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Inspections of air-conditioning and reversible heat pump systems	Ongoing	Legislative/Normative	2002	Low	Yes	YES	No	YES
FRA34	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy performance diagnosis	Ongoing	Legislative/Informative	2006	High	Yes	YES	No	YES
FRA50	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Thermal Regulations for existing buildings	Ongoing	Legislative/Informative, Legislative/Normative	2008	Medium	Yes	YES	No	YES
FRA48	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Building codes " RT 2012"	Ongoing	Legislative/Normative	2013	High	Yes	YES	YES	YES
GER78	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Energiebetriebene-Produkte-Gesetz – EBPG (revised version)	Proposed(advanced)			High	No	YES	No	No
GER18	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Energy Consumption Labelling Ordinance (Energieverbrauchskennzeichnungsverordnung)	Ongoing	Legislative/Informative	1998	High	Yes	YES	YES	YES
GER6	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy Savings Ordinance (Energieeinsparverordnung - EnEV)	Completed	Legislative/Informative, Legislative/Normative	2002	High	Yes	YES	YES	YES
GER68	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Länder activities in the building sector	Ongoing	Legislative/Informative, Legislative/Normative	2002	High	Yes	YES	YES	YES
GER47	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy certificates for buildings (Energieausweise für Gebäude)	Ongoing	Legislative/Informative	2008	Low	Yes	YES	No	YES
GER8	EU-related: Ecodesign Directive for Energy-using Products (Directive 2005/32/EC) - Energiebetriebene-Produkte-Gesetz - EBPG	Ongoing	Legislative/Normative	2009	High	Yes	Yes	YES	YES
GER72	EU-related: Revised Directive for Labelling of Energy-related Products (Directive 2010/30/EU) - Energy Consumption Labelling Ordinance – revised version (EnVKV - revised)	Unknown	Legislative/Informative	2011	Medium	Yes	YES	YES	YES
GER67	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Energy Savings Ordinance - revision 2012	Unknown	Legislative/Normative	2013	High	Yes	YES	YES	YES
HUN24	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Periodic inspection of household boilers	Proposed(advanced)	Legislative/Informative, Legislative/Normative		Medium	Yes	YES	No	YES
HUN14	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Energy labelling of household appliances	Ongoing	Legislative/Informative	2002	Medium	No	YES	No	No
HUN27	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy review of heat producing sets and air conditioning systems	Ongoing	Legislative/Informative, Legislative/Normative	2008	Medium	No	YES	No	YES
HUN22	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - HU71 Energy performance certificate for new dwelling	Ongoing	Legislative/Informative	2009	High	Yes	YES	No	YES
IRL23	Minimum Efficiency Standards for Boilers	Ongoing	Legislative/Normative	1995	Medium	No	Yes	No	YES
IRL15	Minimum Efficiency Standards for Appliances and Lighting	Ongoing	Legislative/Normative	1999	Medium	No	Yes	No	YES
IRL21	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Irish Response to the Energy Performance of Buildings Directive	Ongoing	Legislative/Informative	2007	High	No	YES	No	YES
IRL27	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Energy Efficient Lighting	Ongoing	Legislative/Normative	2009	High	Yes	YES	YES	YES
ITA15	EU-related: Performance of Heat Generators for Space Heating/Hot Water (Directive 92/42/EEC) - Standards and Labelling for New Boilers	Ongoing	Legislative/Normative	1997	Low	No	YES	No	YES
ITA1	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Energy labelling of household appliances - Framework Law	Ongoing	Legislative/Informative	1998	Medium	Yes	YES	YES	YES
ITA2	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Standards and Labelling for Washing and Drying Machines	Ongoing	Legislative/Informative	1998	Low	No	YES	No	YES
ITA23	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Standards and Labelling of refrigerators and freezers	Ongoing	Legislative/Informative	1998	Low	No	YES	No	YES
ITA13	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Standards and Labelling for Dishwashers	Ongoing	Legislative/Informative	1999	Low	No	YES	No	YES
ITA19	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Standards and Labelling for Air Conditioners and Electric-Fired Ovens	Ongoing	Legislative/Informative	2003	Low	No	YES	No	No
ITA24	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy Performance of Buildings	Ongoing	Legislative/Informative, Legislative/Normative	2006	High	Yes	YES	YES	YES
ITA29	EU-related: Ecodesign Directive for Energy-using Products (Directive 2005/32/EC) - Standard for efficient lighting and electrical appliances	Ongoing	Legislative/Normative	2011	Medium	Yes	Yes	No	YES
ITA32	EU-related: Revised Directive for Labelling of Energy-related Products (Directive 2010/30/EU) - Eco Design Directive. Framework Law	Ongoing	Legislative/Informative	2011	Medium	Yes	YES	YES	YES
LV20	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Minimum Thermal Insulation Standards	Ongoing	Legislative/Normative	2003	Medium	No	YES	No	YES
LV21	EU-related Performance of Heat Generators for Space Heating/Hot Water (Directive 92/42/EEC)	Ongoing	Legislative/Normative	2004	Medium	No	YES	No	YES
LV26	EU-related: Revised Directive for Labelling of Energy-related Products (Directive 2010/30/EU) - Energy Labelling of Household Appliances	Ongoing	Legislative/Informative	2004	High	No	YES	No	YES
LV27	EU-related Energy Performance of Buildings (Directive 2002/91/EC)	Ongoing	Legislative/Informative, Legislative/Normative	2009	Medium	No	YES	No	YES
LV36	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - EU-related Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC)	Ongoing	Legislative/Normative	2011	Medium	No	YES	No	YES
LV32	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Raising Minimal Energy Efficiency Requirements for Buildings	Proposed (advanced)	Legislative/Normative	2012	Medium	Yes	YES	YES	YES
LT14	EU-related: Revised Directive for Labelling of Energy-related Products (Directive 2010/30/EU) - Labelling of energy consumption-related products	Ongoing	Legislative/Informative	2004	Unknown	Yes	YES	No	YES
LT15	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Ecodesign	Unknown	Legislative/Normative	2005	Unknown	Yes	YES	No	YES
LUX11	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Ordinance of the Grand Duchy of 22 November 1995 on the thermal insulation of buildings (dwellings)	Completed	Legislative/Normative	1996	High	Yes	YES	YES	YES
LUX13	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Improvement in the overall energy efficiency of private dwellings (WD 2008) (new/old buildings)	Ongoing	Legislative/Normative	2008	High	Yes	YES	YES	YES
LUX19	EU-related: Ecodesign Directive for Energy-using Products (Directive 2005/32/EC) - Law establishing a framework for setting ecodesign requirements applicable to the EuP	Ongoing	Legislative/Normative	2009	Low	Yes	Yes	YES	YES
LUX20	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Law establishing a framework for setting ecodesign requirements for energy related products	Unknown	Legislative/Normative	2010	Unknown	No	YES	No	No
MAL4	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - EU-related Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU)	Ongoing	Legislative/Informative, Legislative/Normative	2008	Medium	Yes	YES	No	YES
NLD14	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Energy labels on appliances	Ongoing	Legislative/Informative	1996	Medium	Yes	YES	No	YES
NLD17	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Energy performance certificate for buildings	Ongoing	Legislative/Informative	2008	Low	Yes	YES	No	YES
PL11	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Certificates of energy performance for buildings	Ongoing	Legislative/Informative, Legislative/Normative	2009	Unknown	No	YES	No	YES
POR6	Energy Consumption Labelling Ordinance	Ongoing	Legislative/Informative	1994	Medium	No	Yes	No	YES
POR5	Boilers Efficiency Directive	Ongoing	Legislative/Normative	1996	High	No	Yes	No	YES
POR8	Energy labelling of buildings (2006)	Ongoing	Legislative/Informative, Legislative/Normative	2006	High	No	Yes	No	YES
RO9	EU-related: Revised Directive for Labelling of Energy-related Products (Directive 2010/30/EU) - Using promotion of performing householder appliaces	Ongoing	Legislative/Informative	2001	Medium	Yes	YES	YES	YES
RO27	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Programs for thermal rehabilitation of the multi-level residential buildings built-up 1950-1990	Ongoing	Financial	2002	Medium	Yes	YES	No	YES
RO21	EU-related: Performance of Heat Generators for Space Heating/Hot Water (Directive 92/42/EEC) - 2/42/EEC) - Minimum efficiency requirements of new hot-water boilers fired with liquid or gaseous fuels	Ongoing	Legislative/Normative	2003	Medium	No	YES	No	YES
RO31	EU-related: Performance of Heat Generators for Space Heating/Hot Water (Directive 92/42/EEC) - Energy labelling of new hot water boilers fired with liquid or gaseous fuels	Ongoing	Legislative/Informative, Legislative/Normative	2003	High	No	YES	No	YES
RO7	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Efficiency standards for household appliances	Ongoing	Legislative/Normative	2004	Medium	No	YES	No	YES
RO25	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - formance of New Buildings-building code	Ongoing	Legislative/Informative, Legislative/Normative	2007	Medium	No	YES	No	YES

RO30	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy Performance of existing Buildings-obligatory energy efficiency certificates	Ongoing	Financial, Information/Education, Legislative/Normative	2007	High	No	YES	No	YES
RO29	EU-related: Revised Directive for Labelling of Energy-related Products (Directive 2010/30/EU) - Energy efficiency improvement of heating-cooling systems on individual housing	Ongoing	Legislative/Informative	2008	Medium	Yes	YES	No	YES
SK8	Minimum efficiency standards for appliances	Ongoing	Legislative/Normative	2001	High	No	Yes	No	YES
SK1	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Domestic appliances energy consumption and labelling	Ongoing	Legislative/Informative	2002	Medium	No	YES	No	YES
SK3	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy Performance Certificates for Buildings	Ongoing	Legislative/Informative, Legislative/Normative	2006	Low	Yes	YES	No	YES
SK9	EU-related: Revised Directive for Labelling of Energy-related Products (Directive 2010/30/EU) - Act on labelling of energy related products	Ongoing	Legislative/Informative	2011	Medium	No	YES	No	No
SLO1	EU-related: Ecodesign Directive for Energy-using Products (Directive 2005/32/EC) - Energy Efficiency Requirements for Domestic Refrigeration Appliances and their combinations	Ongoing	Legislative/Normative	2002	Low	No	Yes	No	YES
SLO2	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Rules on efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels	Ongoing	Legislative/Informative, Legislative/Normative	2002	Low	No	YES	No	YES
SLO3	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Rules on minimum energy efficiency requirements for ballasts for fluorescent lighting	Ongoing	Legislative/Normative	2003	Low	No	YES	No	No
SLO15	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Rules on energy labelling of household appliance	Ongoing	Legislative/Informative	2004	Low	Yes	YES	YES	YES
SPA14	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Labelling and information on energy consumption of Domestic Use Equipment	Ongoing	Legislative/Informative	1994	Low	No	YES	No	YES
SPA13	EU-related: Performance of Heat Generators for Space Heating/Hot Water (Directive 92/42/EEC) - 2/42/EEC) - Regulation of Thermal Installations in Buildings	Completed	Legislative/Normative	1998	High	No	YES	No	YES
SPA29	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Action Plan 2005-2007: Regulatory measures for the implementation in Spanish law of Directive 2002/91/EC	Ongoing	Legislative/Informative, Legislative/Normative	2005	High	Yes	YES	YES	YES
SPA24	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Ecodesign requirements for energy-related products (recast)	Ongoing	Legislative/Normative	2007	Medium	No	YES	No	YES
SPA35	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy Certitificate for new and refurbished buildings	Ongoing	Legislative/Informative	2007	High	No	YES	No	YES
SPA36	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Technical Building Code (CTE)	Ongoing	Legislative/Normative	2007	High	No	YES	No	YES
SPA37	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Regulation of Thermal Installations in Buildings (RITE)	Ongoing	Legislative/Normative	2008	High	No	YES	No	YES
SPA39	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Action Plan 2011-2020: Construction or rehabilitation of nearly-zero energy buildings	Ongoing	Financial, Legislative/Informative, Legislative/Normative	2011	Low	Yes	YES	YES	YES
SWE25	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy efficiency certificates (Energideklarationer)	Ongoing	Legislative/Informative, Legislative/Normative	2006	Unknown	Yes	YES	No	YES
SWE19	EU-related: Energy Performance of Buildings (2002/91/EC)	Ongoing	Legislative/Informative	2008	Unknown	Yes	YES	No	No
UK13	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - UK13_Product policy and Market Transformation Programme	Ongoing	Legislative/Normative	1994	High	Yes	YES	YES	YES
UK19	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - UK19_Building Regulations 2006	Ongoing	Legislative/Normative	2006	High	Yes	YES	YES	YES
UK21	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - UK21_Energy Performance Certificates	Ongoing	Legislative/Informative	2007	Low	Yes	YES	YES	YES
UK22	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - UK22_Code for Sustainable Homes	Ongoing	Legislative/Informative, Legislative/Normative	2007	Medium	Yes	YES	No	YES
UK28	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - UK28_Building Regulations 2010	Ongoing	Legislative/Normative	2010	High	Yes	YES	YES	YES
UK32	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - UK32_Building regulations 2013	Unknown	Legislative/Normative	2013	Unknown	No	YES	No	YES
LV36	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - EU-related Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC)	Ongoing	Legislative/Normative	2011	Medium	No	YES	No	YES
LV32	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Raising Minimal Energy Efficiency Requirements for Buildings	Proposed (advanced)	Legislative/Normative	2012	Medium	Yes	YES	YES	YES
LT14	EU-related: Revised Directive for Labelling of Energy-related Products (Directive 2010/30/EU) - Labelling of energy consumption-related products	Ongoing	Legislative/Informative	2004	Unknown	Yes	YES	No	YES
LT15	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Ecodesign	Unknown	Legislative/Normative	2005	Unknown	Yes	YES	No	YES
LUX11	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Ordinance of the Grand Duchy of 22 November 1995 on the thermal insulation of buildings (dwellings)	Completed	Legislative/Normative	1996	High	Yes	YES	YES	YES
LUX13	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Improvement in the overall energy efficiency of private dwellings (WD 2008) (new/old buildings)	Ongoing	Legislative/Normative	2008	High	Yes	YES	YES	YES
LUX19	EU-related: Ecodesign Directive for Energy-using Products (Directive 2005/32/EC) - Law establishing a framework for setting ecodesign requirements applicable to the EuP	Ongoing	Legislative/Normative	2009	Low	Yes	Yes	YES	YES
LUX20	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Law establishing a framework for setting ecodesign requirements for energy related products	Unknown	Legislative/Normative	2010	Unknown	No	YES	No	No
MAL4	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - EU-related Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU)	Ongoing	Legislative/Informative, Legislative/Normative	2008	Medium	Yes	YES	No	YES
NLD14	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Energy labels on appliances	Ongoing	Legislative/Informative	1996	Medium	Yes	YES	No	YES
NLD17	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Energy performance certificate for buildings	Ongoing	Legislative/Informative	2008	Low	Yes	YES	No	YES
PL11	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Certificates of energy performance for buildings	Ongoing	Legislative/Informative, Legislative/Normative	2009	Unknown	No	YES	No	YES
POR6	Energy Consumption Labelling Ordinance	Ongoing	Legislative/Informative	1994	Medium	No	Yes	No	YES
POR5	Boilers Efficiency Directive	Ongoing	Legislative/Normative	1996	High	No	Yes	No	YES
POR8	Energy labelling of buildings (2006)	Ongoing	Legislative/Informative, Legislative/Normative	2006	High	No	Yes	No	YES
RO9	EU-related: Revised Directive for Labelling of Energy-related Products (Directive 2010/30/EU) - Using promotion of performing householder appliaces	Ongoing	Legislative/Informative	2001	Medium	Yes	YES	YES	YES
RO27	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Programs for thermal rehabilitation of the multi-level residential buildings built-up 1950-1990	Ongoing	Financial	2002	Medium	Yes	YES	No	YES
RO21	EU-related: Performance of Heat Generators for Space Heating/Hot Water (Directive 92/42/EEC) - 2/42/EEC) - Minimum efficiency requirements of new hot-water boilers fired with liquid or gaseous fuels	Ongoing	Legislative/Normative	2003	Medium	No	YES	No	YES
RO31	EU-related: Performance of Heat Generators for Space Heating/Hot Water (Directive 92/42/EEC) - Energy labelling of new hot water boilers fired with liquid or gaseous fuels	Ongoing	Legislative/Informative, Legislative/Normative	2003	High	No	YES	No	YES
RO7	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Efficiency standards for household appliances	Ongoing	Legislative/Normative	2004	Medium	No	YES	No	YES
RO25	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - formance of New Buildings-building code	Ongoing	Legislative/Informative, Legislative/Normative	2007	Medium	No	YES	No	YES
RO30	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy Performance of existing Buildings-obligatory energy efficiency certificates	Ongoing	Financial, Information/Education, Legislative/Normative	2007	High	No	YES	No	YES
RO29	EU-related: Revised Directive for Labelling of Energy-related Products (Directive 2010/30/EU) - Energy efficiency improvement of heating-cooling systems on individual housing	Ongoing	Legislative/Informative	2008	Medium	Yes	YES	No	YES
SK8	Minimum efficiency standards for appliances	Ongoing	Legislative/Normative	2001	High	No	Yes	No	YES
SK1	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Domestic appliances energy consumption and labelling	Ongoing	Legislative/Informative	2002	Medium	No	YES	No	YES

3.2. Monitoring energy efficiency trends in the EU

Publications on energy efficiency and policy monitoring are prepared periodically within the ODYSSEE-MURE project coordinated by ADEME.

The last report (Energy Efficiency Trends in the EU - Lessons from the ODYSSEE MURE project, updated in January 2013) is intended to provide an overall perspective into past developments on total energy use and energy efficiency trends for final consumers in the EU. This should help policy makers and other parties involved in energy efficiency and CO2 emission reduction to adapt current policies and to define new, effective policy measures. Although the main focus is on the improvement of energy efficiency, other drivers affecting the energy demand trend in the sector -such as the impact of economic growth, energy prices and behaviours- are also considered.

The report reviews the trends observed in terms of energy use, energy efficiency and CO2 emissions, at the level of all end-use sectors together and in each end-use sector (industry, transport and buildings). Although the analysis mainly focuses on the overall EU trends, some differences between countries are also be highlighted. The analysis covers the period 2000-2010, with a focus on the two recent years 2009, to underline the impact of the economic crisis, and 2010 as the most recent year with detailed data available.

The key messages of the document are presented below:

3.2.1. Overall trends

• Large decoupling between the primary energy consumption and the economic growth until 2008. In most countries, the high economic growth was possible with a low progression in energy consumption (less than 1%/year for 12 countries, as the EU as a whole) or even a reduction in some countries (Portugal, Germany, UK). In 2009 in most countries (18) and in the EU as a whole, the primary energy consumption decreased more than the GDP.

• Energy efficiency improved by 12% at EU level between 2000 and 2010 (1.2%/year). There has been a net slowdown in the energy efficiency progress since the economic crisis: 0.6%/year since 2007, compared to 1.5%/year between 2000 and 2007.

• The household sector has achieved the largest energy efficiency improvement, with a regular energy efficiency gain (1.6 %/year). Gains for industry and transport of goods are only registered until 2007 (1.8%/year), with even a deterioration of energy efficiency after 2007. In transport, energy efficiency progress that was regular and rapid until 2007 (1.2%/year) started to slow down because of transport of goods.

• Without energy savings, final energy consumption would have been 130 Mtoe higher in 2010. Around 38% of the savings come from households, 28% from industry, 27 % from transport and 7% from services.

• In 2010, the final energy consumption was 16 Mtoe higher than in 2000. This situation is the result of two main balancing effects: growth in the economic activity would have led alone to an increase of 85 Mtoe while energy savings contributed to 130 Mtoe; changes in lifestyle and the colder climate in 2010 both contributed to increase the consumption (by 18 and 32 Mtoe respectively), while structural changes in industry led to a decrease (-6 Mtoe).

• Almost 40% of the reduction in CO2 intensity (2.3%/year) is due to increased use of energy carriers with lower emission factors (60% linked to the reduction in energy intensity).

3.2.2. Buildings

• Buildings consume 41% of total final energy consumption in Europe in 2010. It is the largest end-use sector, followed by transport (32%), and industry (25%).

• Final energy consumption of buildings has increased by around 1%/year since 1990 and by 2.4%/year for electricity at EU level.

• At EU level residential buildings represent around 76% of the building floor area, of which 65% for single family houses.

• Annual unit consumption per m2 for buildings at EU level is around 220 kWh/m2 in 2009, with a large gap between residential (200 kWh/m2) and non-residential (around 300 kWh/m2).

3.2.3. Households

• The energy consumption trend varies among European countries; two thirds reduced their average consumption per dwelling, and in particular some new member states show a considerable decline.

• In 2009, energy consumption decreased with the global economic crisis by 1.6% (at normal climate) as a result of a decrease of income (-3%) and despite a drop in energy price (-9%).

• The fraction of energy devoted to space heating is decreasing, partly due to the relative growth in the consumption for electrical appliances. The highest fractions are not found in countries with severe winters but in countries with a moderate climate.

• Energy use for space heating per m2 is decreasing almost everywhere, except in a few countries with mild winters where winter comfort is improving.

• About 20% of energy efficiency progress for space heating has been offset by dwellings becoming larger.

• The effect of efficiency standards for new dwellings on space heating consumption is hampered by the often limited volume of new construction (below 1% of the building stock every year in most EU countries).

• The Netherlands can be regarded as a benchmark for space heating as it shows the lowest specific energy use, thanks to the large diffusion of gas condensing boilers and a comprehensive thermal retrofitting of existing dwellings.

• The amount of dwellings with solar water heaters is only a few percent. Some countries with a sunny climate, such as Cyprus and Greece, score much higher than comparable countries like Italy and Spain. Austria is the benchmark for countries with medium solar radiation.

• Electricity consumption for appliances & lighting increased in all member states except Bulgaria and Slovakia. The strongest growth is recorded for small appliances.

• The energy efficiency of large appliances has improved quite a lot over the last 20 years but most of the gains has been offset by an increase in equipment ownership.

• Most new refrigerators have label A or A+.

3.2.4. Services

• At EU level, energy consumption in the tertiary sector increased significantly in the early 2000s, and was then rather stable until 2008. In 2009, it decreased by 2.3% because of the economic downturn.

• There is no clear pattern for EU countries. Some new member states (e.g. Romania, Croatia and Bulgaria) show very high growth rates, but the same is true for some EU15 countries (e.g. Greece). Various EU-15 countries show a decrease in energy consumption (e.g. UK and Germany), but again the same is true for some new member states (e.g. Slovakia and Slovenia).

• The decrease in energy use per employee (-3% since 2000) is in strong contrast with the substantial increase in electricity consumption per employee (+16%), which is mostly due to the diffusion of cooling in summer (all southern countries) or to strong economic growth (eastern European countries) and a large diffusion of IT appliances.

• However, for countries with a sustained high level of economic welfare, the electricity consumption per employee is either stable or even decreasing. This could signal that electricity use reaches a saturation level.

3.2.5. Transport

• The global economic crisis had a significant impact on the transport sector, especially for freight transport as the traffic of goods has decreased by 12% in 2009.

• Despite deterioration in the efficiency of freight transport in 2009, the transport sector was 9% more energy efficient in 2010 than in 2000. Most of the gains come from cars, thanks to measures on new cars that have been clearly reinforced since 2007 (EU labelling for new cars and national fiscal measures).

• The energy efficiency of cars is improving on a regular basis (by 1 %/year since 2000); in 2010, cars consumed on average 0.8 litre/100 km less than in 2000 at EU level, i.e. 7.1 litre/100 km.

• The specific CO2 emission of new cars has decreased by 20% (or 2.2%/year) on average in the EU since 2000. The target of 140 g CO2/km stipulated in the agreement between the European Commission and the associations of car manufacturers were however only reached in 2010, instead of 2008.

• The annual distance travelled by cars has been steadily decreasing since 2000, which contributed to lower the energy consumption.

• Modal shift has a negative impact on energy savings as the share of public transport in passenger traffic is decreasing almost everywhere, despite policies to reverse that trend; only a few countries managed to increase the share of public transport.

• At EU level, the growth in passenger traffic between 1990 and 2010 contributed to increase the energy consumption of passenger transport by 48 Mtoe. Energy savings, have partially offset this activity effect (27 Mtoe). The decreasing share of public transport contributed to increase the consumption by 8 Mtoe, which has offset one third of the energy savings. As a result of these opposite trends, the energy consumption of passenger transport has increased by 29 Mtoe from 1990 to 2010.

• The increase in freight traffic in tonne-km was responsible for a consumption increase of 30 Mtoe between 1990 and 2010. Energy savings amounted to 10 Mtoe and have been completely offset by a modal shift from rail and water to road transport, which contributed to increase the consumption of freight transport by about 11 Mtoe at EU level between 1990 and 2010. As a result, the consumption increased by 31 Mtoe.

• In 2009, freight traffic dropped drastically (by 12%). However, because of deterioration in energy efficiency linked to the economic crisis, the energy consumption did not follow the reduction in traffic and only decreased by 5%.

• The transport sector is the only end-use sector in which CO2 emissions continue to increase: emissions in 2010 were 21% above their 1990 levels.

3.2.6. Industry

- Energy effic
2000 and 2007 in manufacturing industry (1.8%/year at EU level). Because of the economic crisis, there was no more progress after 2007 with even a reverse trend in 2009 and 2010. The average trend in energy efficiency over 2000-2010 was 1.3%/year (12%).).

- Energy efficiency improved quite unevenly across countries over the period 2000-2010: from above 4%/year in Bulgaria, Poland and Estonia and between 2 and 4%/year in 5 countries.

- A shift towards less energy-intensive branches contributed to reduce energy intensity in most countries until 2008; these structural changes explain most of the reduction (over 60%) in 11 countries over the period 2000-2008 (among which Finland, Sweden, Romania, Austria, Germany, and France). On the opposite there was a shift towards energy-intensive industry in UK, Netherlands, Lithuania and Bulgaria, which had an opposite effect and lessened the energy intensity reduction.

- The reaction of countries to the industrial recession in 2009 was quite diverse: structural changes were generally significant but not all in the same direction- they explain 40% of the large decrease in the energy intensity of industry at EU level.

- In 2010, the rebound of industrial growth resulted in an increase of the energy intensity, driven both by structural changes to more intensive branches and lower energy performance (linked to structural changes within the branches and a progressive recovery with inefficient operations in the beginning of 2010): as a result, in 2010, energy efficiency in industry is not back to its historical trend.

- A large part of the decrease in CO_2 emissions between 1990 and 2010 was achieved in 2009 (48% at EU level).

4. CONCLUSIONS AND RECOMMENDATIONS

As regards to the government structure, an interesting approach is to relay on an interministerial commission where all the departments involved in the policy design are represented (energy, environment, transport, construction, industry and, of course, the presidency of the state to lead the process). This would help ensure that all the legislation on energy efficiency and climate change is linked and consistent.

A public consultation procedure before the legislation approval is useful for several purposes. It is a key regulatory tool employed to improve transparency, efficiency and effectiveness of regulation, that should always be developed in an open and transparent fashion, with appropriate and well publicized procedures for effective and timely inputs from interested national and foreign parties, such as affected business, trade unions, wider interest groups such as consumer or environmental organisations, or other levels of government. Consultation improves the quality of rules and programmes and also improves compliance and reduces enforcement costs for both governments and citizens subject to rules.

One of the most important points when designing a policy package is to set long term targets consistent with the vision of how the system is expected to be shaped in the future. These targets should be ambitious enough for successful achievements and a whole system of clear indicators should be established to monitor the progress and success of the policies and measures implemented (the ODYSSEE-MURE project is an interesting experience in this regard). The identification of the most suitable policies and measures should be based on the knowledge of the starting situation through a complete diagnosis and a clear vision of the final target.

As an example, in the EU the Energy Efficiency Directive considers that the EU target could be better achieved at this stage by means of national energy efficiency obligation schemes for energy utilities or other alternative policy measures that achieve the same amount of energy savings. Another clear example is the Energy Performance of Buildings Directive, which addresses the great potential that the building sector has in both fields of energy efficiency and greenhouse gas emissions reduction.

A good idea is to bring the regional and local administrations into the problem because eventually the implementation of many of the policies will be their responsibility. In the EU a model that has proved to be very successful is the Covenant of Mayors, a voluntary network of local entities that make a public commitment on energy efficiency and climate change. This network enhances their knowledge through the share of experiences.

As regards to funding, the scenario of financing instruments should be very clear and understandable. It seems to be more convenient to set a general framework programme instead of several programmes with different targets that could be confusing for the applicants. This is the new approach in the EU with the Horizon 2020 programme.

The energy taxation issue is here very relevant and should be studied with detail due to its importance both for the state budget and the incentives and messages sent to the whole economic system. In the EU current taxes on energy products often do not provide a strong enough incentive for people to consume less or opt for cleaner forms of energy. In fact, sometimes taxes make it cheaper to use dirtier fuels and more polluting forms of energy. The new rules aim to restructure the way energy products are taxed to remove current imbalances and take into account both their CO_2 emissions and energy content. Existing energy taxes would be split into two components that, taken together, would determine the overall rate at which a product is taxed.

When approaching sectors more specifically, the document has focused on the building, transport and industry sectors due to their importance in the energy consumption and greenhouse gas emissions and their potential for energy efficiency and climate change mitigation.

For the building sector, if the full potential for energy savings is to be achieved there are a number of measures that can be useful:

- Set minimum technical requirements for both new and retrofitted buildings.

- Establish a system for the energy performance certification of buildings and a regular inspection of installations (heating, ventilation and air conditioning). The system of certificates (necessary for the construction, selling or renting of a building) is aimed, among other things, to reduce the split incentives by adding value to the property.

- If such a system is to be put in place, a methodology to calculate the energy performance of the building should be established and attention should be paid to increase the capacity building in the sector to understand and apply correctly the new regulations. These would help improve the trust of the market actors in the professionals and ESCOs.

- The public administration owns a great share of the built environment. If a transformation in the sector is to be achieved the administration should take the lead and assume an exemplary role in the application of the new requirements and in the use of the new funding mechanisms.

- While funding of public programmes (subsidies, grants and soft loans) can be very effective for the renovation of energy related products such as home appliances or windows, there is a clear limitation of these instruments when applied to deep renovation and long term projects. At this stage, the use of ESCOs is a good option, but always taking into consideration both the risk and the long payback time for these kind of projects. An option to overcome these problems may be for the state to subsidise the payback to a rate interesting for the energy service companies, minimizing the risks.

- The use of energy performance requirements for energy related products and the labelling is a useful tool but attention should be paid to the regular updating of the standards required.

- Eventually, the use of energy efficiency obligation schemes is an interesting option to ensure that energy distributors and retail energy sales companies achieve a cumulative end-use energy savings target, or alternatively contribute to an Energy Efficiency National Fund an amount that is equal to the investments required under the scheme.

For the transport sector, there is an obvious need of a long term transformation of the way passengers and goods move, both in the long and short distances:

- Action cannot be delayed because infrastructure takes many years to plan, build and equip (trains, planes and ships last for decades). The choices made today will determine transport in the medium and long term.

- In cities, the gradual phasing out of 'conventionally fuelled' vehicles from the urban environment should be the major contribution to significant reduction of oil dependence, greenhouse gas emissions and local air and noise pollution. But it should be complemented by the development of appropriate fuelling/charging infrastructure, one of the main barriers, and financial incentives (but having in mind that taxes from this sector are usually an important part of the state budget).

- If electric cars are to be an important element in the transformation of the transport sector, the share of renewables in the grid should be increased so that there is not just a reallocation of emissions from fossil fuelled cars to fossil fuelled power plants.

- Although necessary, more resource-efficient vehicles and cleaner fuels (through regulations or voluntary agreements) are unlikely to achieve on their own the necessary cuts in emissions.

- For long hauls, there is the need to enhance a greater use of buses and coaches, rail and air transport for passengers and, for freight, multimodal solutions relying on waterborne and rail modes.

- Behavioural change measures have proved to be very cost effective and speed management measures and eco-driving programs have produced interesting results.

- The necessary modal shift is a complicated task. In the EU the share of public transport in passenger traffic is decreasing almost everywhere, despite policies to reverse that trend.

When considering the industry sector there are several aspects worth considering:

- It is a very heterogeneous sector with big, medium and small enterprises that should be approached differently, but energy efficiency is a competitive issue for all of them.

- While bigger companies can be included in some kind of emissions trading scheme, that is more complicated for SMEs that will be in more need of public help (funding through grants, subsidies, soft loans or tax reductions), capacity building or benchmark analysis.

- Energy auditing and energy management systems are key elements to improve energy efficiency and should be encouraged, where not compulsory.

- The establishment (and regular updating) of ambitious requirements for energy related products and labelling practices have a high potential to reduce energy consumption and emissions in the sector.

Some non-sector specific issues have been discussed in the report in a cross cutting chapter due to their great potential to contribute to a more efficient use of energy and a reduction in emissions. The first one is the Energy Services Companies (ESCOs) and the second the so called General Public Procurement (GPP).

The market of the ESCOs encounters a series of barriers such as low level of awareness and trust, a high perceived risk, a lack of public rules and standards, an aversion to outsource the energy management, the current lack of finance and sometimes a surprising lack of reliable energy data.

A number of measures are needed to overcome these barriers by increasing awareness, capacity building and establishing clear public rules and support (contract models, credit lines), all of which will increase the trust of the market in the ESCOs system.

In the EU countries with a more developed ESCO market, the main success factors are very diverse but include the following: a supportive policy framework (Energy Efficiency Directive, Energy Performance of Buildings Directive, Combined Heat and Power), the steady rise in energy taxes, competitive pressures, environmental awareness, the establishment of ESCOs associations, the standardization of common core contractual provisions (such as the International Performance Measurement & Verification Protocol) and an accreditation system raise the confidence on the market, and facilitating the access to appropriate forms of financing (special purpose energy efficiency credit lines or funds).

As regards to the GPP, it is a very powerful tool because in the EU public authorities spend about 17% of EU's GDP. Hence, spending all this money with a preference on low impact products sends a clear signal to the market and becomes an important incentive for industry. It is important to have a life cycle costing approach and to develop criteria for specific and relevant areas such as office equipment or indoor and outdoor lightning.

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CAPÍTULO 2

EFICIÊNCIA ENERGÉTICA E MUDANÇA CLIMÁTICA EXPERIÊNCIA BRASILEIRA - Hamilton Pollis

CLIMATE CHANGE AND ENERGY EFFICIENCY EE AND CLIMATE CHANGES INTEGRATION ACTIONS IN BRAZIL

1. INTRODUCTION

This project has been developed under the contract of the European Commission with reference EuropeAid/130075/C/SER/BR to support the sectoral dialogues EU – Brazil.

This report intends to present an overview of Energy Efficiency and Climate Changes sectors in Brazil, the successful integration, cooperation and joint actions between these sectors, their legal framework, and barriers to overcome and indicates conclusions and recommendations to achieve common goals.

The final goal is to propose, based upon the two reports produced under the scope of this contract, considering EU experiences, actions and policies for both EE and Climate Changes sectors to accomplish common goals.

2. BRAZILIAN COMPETENT AUTHORITIES OF ENERGY EFFICIENCY AND CLIMATE CHANGE, THEIR COMPETENCES AND DEVELOPED INCENTIVES

We present the relevant Brazilian authorities respectively in the areas of EE and Climate Change, as well as describe their tasks, areas and activities.

2.1- Energy Efficiency

The Brazilian EE structure is officially leaded by the MME – Ministry of Mines and Energy, which in relation to the operation of the programs and initiatives of EE, has competence to formulate energy policies, although other players have important roles (fig 1). The Energy Planning and Development Secretariat of MME (SPDE) is in charge of formulating the politics and coordinate of all actions of EE. Subordinate to SPDE are the PROCEL and CONPET, respectively the EE programs of electrical sector and oil and gas sector, whose attributions will be described further. The Energy Development Department (DNDE) is the operational area of SPDE with the responsibility of conducting the actions.

Acting in parallel we have the ANEEL – The National Agency of Electrical Energy, which is the regulatory and supervisory agency for the electrical sector, and is in charge of running the PEE – Utilities EE program.

Likewise we have the ANP – National Oil, Natural Gas and Biofuels Agency, which is the regulatory and supervisory agency for the Oil, Natural Gas and Biofuels sector, which also has the attribution of promoting EE, but until now has not set up an area of EE.

Other important player in the EE structure is the EPE – Energy Planning Company, responsible for formulating studies and researches to support the Energy Sector planning, including as regards the EE.

A player that develops a very important supporting activity for the EE programs is INMETRO – National Institute for Metrology, Standards and Industrial Quality, which by its PBE – Brazilian Labeling Program, implemented in partnership with PROCEL and CONPET, promotes the EE labeling of many equipments and products.

Another important supporting player is The BNDES – Brazilian Bank for Economic and Social Development, which created a fund for financing ESCOs named PROESCO.

The mechanisms to promote EE can be of various formats and approaches. Currently in Brazil, may be mentioned, among others:

• Institutions of fostering: PROCEL, in the electricity sector, and CONPET, for fuel. The first runs under Eletrobras since 1985, and the second under Petrobras, from 90s. PROCEL has distinguished action in the sector, with several programs in all activity sectors - residential, public and commercial, industrial, with actions ranging from awareness in schools to direct implementation of EE measures.

• Labeling and standardization: these mechanisms exist in many countries of the world and have represented a large portion of the conservation achieved. They aim to increase the efficiency of end-use equipment and make use of two procedures: labeling, that informs the user the proven efficiency of the equipment which is acquiring and standardization, which acts generally compulsory by removing from the market less efficient equipment. The two mechanisms are not excluding, rather, their combination produces the best results. Brazil, to that effect, has been achieving excellent results, starting with labeling that allows the gathering of manufacturers, setting increasingly challenging targets for the products, and when this process is mature, enacts the law with the minimum performance required.

Associated to the labeling we have the Seals PROCEL and CONPET, which classify the best products using the results of the Brazilian Labeling Program, PBE, without relying on the tax incentive mechanisms observed in other countries.

• PEE (EE Program): This plan, which requires electricity distribution companies to implement a portion of its net operating revenue in the final use of energy, is the main provider of resources to increase the efficient use of energy. It has undergone a number of revisions.

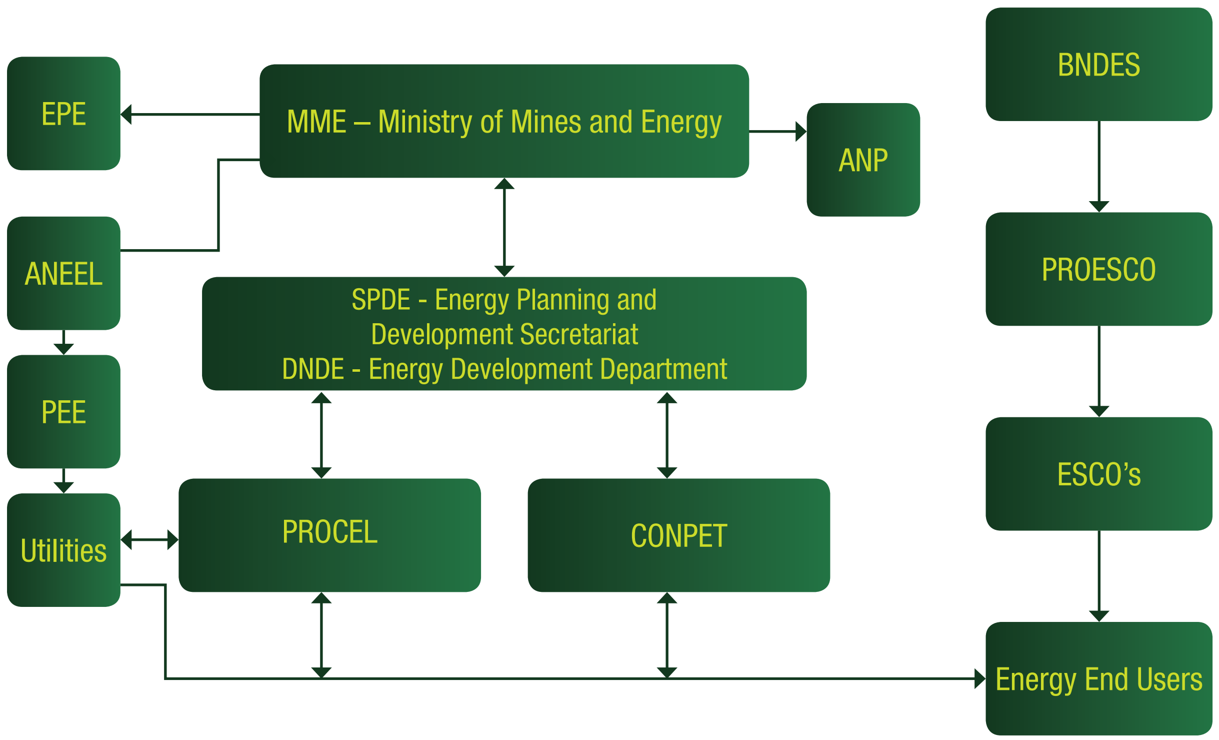
• ESCO Market: ESCOs in Brazil are created to operate in implementing EE measures, mainly through performance contracts are engineering firms, with little capital, making it difficult to obtain financing. Therefore, BNDES created PROESCO linking the borrower to secure financing, which should leverage this market.

Under these concepts, it is possible to classify the mechanisms to encourage EE in two major profiles:

• Technology: imply implementing new processes and using new equipment to reduce energy losses;

• Behavioral: is founded on changes in habits and usage patterns, reducing energy consumption without modifying equipment energy converters.

Fig. 1 EE Structure



2.1.1MME - Ministry of Mines and Energy - MME / SPDE/ DNDE

The Ministry of Mines and Energy - MME (Ministério de Minas e Energia) is the Federal Government entity responsible for the execution of energy-related policies within the country. Its paramount attributions include the formulation and the implementation of policies for the energy sector, according to the guidelines defined by the National Energy Policy Council - CNPE.

The MME is responsible for setting up the planning for the domestic energy sector, monitoring Brazilian Power Sector safety of supply, and for defining preventive actions to preserve safety of supply in case of imbalances between supply and demand of electricity.

The duties of the Secretary of Energy Planning and Development - SPDE on EE are:

• Develop long-term structural actions for the implementation of sectoral policies;

• Support and encourage the national energy capacity management;

• Advise and encourage sustainable business energy;

• Coordinate actions of energy development, particularly in the areas of renewable energy and EE.

Likewise, the Department of Energy Development - DNDE, subordinate to SPDE, is responsible for:

• Coordinate actions and strategic plans for energy conservation;

• Propose requirements and priorities for research and development of energy conservation technology to EPE and other educational and research institutions;

• Promote and coordinate national programs for the conservation and rational use of electricity, oil and oil products, natural gas and other fuels;

• To promote, coordinate and support the policies and programs for sustainable use and conservation of energy in less developed regions;

• Promote the development and testing of models of EE and rational use.

2.1.1.1 CGIEE- PNEF

The Ministry of Mines and Energy (MME) published on October 19, 2011, Ordinance No. 594 approving the "National Plan for EE - PNEf - Assumptions and Basic Guidelines". With the goal of saving 106,600 GWH in a period of 20 years, PNEf established a set of actions for a number of areas such as industries, buildings, public buildings, public lighting, sanitation, solar water heating; research and development (R & D), Measurement and Verification (M & V), international partnerships, and funding initiatives.

The document guides the actions to be implemented in order to achieve energy saving goals in the context of the National Energy Planning. Also, it will be formed a working group to detail and put into practice the guidelines established by PNEf. Therefore, the National Plan for EE - PNEf is the instrument of detailing and operating the strategies outlined in the Efficiency Policy and in PNE

The strategies and development actions contemplated in the policy should be detailed in mechanisms, infrastructure and budgets needed to ensure the planned target for the PNE in 2030.

The PNEF indicates the need to ensure sustainability of EE, as this "virtual power plant" can provide good business and profits for the market.

2.1.2 ELETROBRAS

Eletrobras - Centrais Elétricas Brasileiras SA, established in 1962, is a mixed capital company and traded under the ownership control of the Brazilian Federal Government, which operates in the areas of generation, transmission and distribution of electricity. The company leads a system composed of 12 subsidiaries, a holding company (Eletrobras Eletropar), a research center (Eletrobras Cepel) and half the capital of Itaipu Binacional.

Present throughout Brazil, Eletrobras is responsible for 37% of total generation capacity of the country. It has an installed capacity of 42,080 megawatts and 164 plants - 36 hydroelectric and 128 thermal plants, two thermonuclear plants.

It has over 58,000 kilometers of transmission lines in operation, in high and extra-high voltage, which corresponds to 57% of the national total. The company also promotes the efficient use of energy through the National Program for Energy Conservation (Procel).

2.1.2.1 PROCEL

One option to minimize the effects of the policy of low rates maintained during the 80s was the implementation of a conservation policy on the use of electricity, which resulted in the creation of PROCEL in 1985, under the coordination of ELETROBRÁS.

By the Interministerial Act No. 1877 of 30/12/85, was established as a joint initiative of the Ministry of Mines and Energy - MME and the Ministry of Industry and Trade - MIC, the Program fort Electrical Energy Waste Combat- PROCEL, subsequently renamed National Program for Electrical Energy Conservation - PROCEL.

PROCEL was the first structured initiative aimed at the efficient use of electricity, through actions aimed at rationalizing electricity, seeking, according to Ordinance No. 1877, maximizing its results and promoting new initiatives. The program aimed to combat waste in the production and use of electricity, providing the same product or service with lower consumption due to higher EE, thus ensuring an overall reduction of costs and investments in new system installations electric. On July 18, 1991, by Presidential Decree, PROCEL was transformed into a government program, expanding its scope and responsibilities, and interactions with direct repercussions on society as a whole. The program was no more restricted only to the electricity sector, articulating, now, with all sectors related to the production and use of electricity. To implement the Program were created the Coordinating Group for Energy Conservation - GCCE as coordinating body PROCEL, and the Executive Secretariat - SE GCCE, subject to ELETROBRAS, as the executive body.

2.1.2.2 PROCEL Main features

Launched in 1985 by the Ministry of Mines and Energy

Executed by Eletrobras (national utility holding company in electric energy generation, transmission and distribution)

Mission

- To promote the efficient and rational use of electricity
- To combat electric energy waste
- To reduce environmental impacts
- To generate benefits to society

Goals

- To change energy consumption habits
- To demonstrate and disseminate measures that promote cost reduction and the rational use of electricity

Guidelines

- To disseminate the concepts of rational and efficient use of electric energy
- To develop demonstration projects
- To support the technological development in this area
- To stimulate the enforcement of laws and regulations focusing on energy efficient measures
- To act through partnerships according to society needs

Annual Investments Budget

	2007 (R$ million)	2008 (R$ million)	2009 (R$ million)	2010 (R$ million)	2011 (R$ million)
ELETROBRÁS	13.62	5.49	9.02	13.91	8.52
OTHERS (RGR, etc.)	39.16	25,8	55.95	45.32	68.46
TOTAL	52.78	31,29	64.97	59.23	76.98

Source: PROCEL annual Report - 2012

Main areas of operation

Actions	Areas
• Educational and Information	
Training and Education	
Procel Info Website	Residential Sector
Market Assessment	Commercial Sector
Impacts Evaluation	Industrial Sector Public Services
• Technology	Public Lighting
Procel Seal	Public Buildings
Laboratory Financing	Water Supply and Sewage
• Marketing	
Procel Awards	
Promotion and Advertising	

2.1.2.3 PROCEL Seal

In 1993 was created the Seal PROCEL Energy Saving, aiming to guide the consumer and encourage the production and sale of more efficient products in the country. The following year were established jointly with manufacturers, consumers (represented by IDEC - Brazilian Institute of Consumer Protection) and INMETRO (National Institute of Metrology, Standardization and Industrial Quality), the criteria for awarding the Seal, its brand, and the basis for the achievement of this whole process. In 1995, already appeared in the Brazilian market the first products with the PROCEL Seal: one door refrigerators, two doors refrigerators and upright freezers. Subsequently, considering its participation in national electricity consumption were incorporated other categories: chest freezer, Domestic Air Conditioning - window type, three phase electric motors up to 10 hp (today covering up to 250 hp), flat panel solar thermal collector for water heating for bath and pools and thermal reservoirs.

The criteria currently in force for granting the PROCEL Energy Saving Seal are:

- The manufacturer / importer must agree to the terms set out in the PROCEL Seal Regulation;

- The product must primarily attend the PBE, which is coordinated by INMETRO;

- The product must undergo annual performance tests in reference laboratories indicated by PROCEL.

- The product must meet the performance criteria and safety requirements of the respective specific criteria for granting PROCEL Seal; it must be affixed on the products on display at points of sale in order to easily guide the consumer at time of purchase.

According to the classification obtained by the product in the labeling process, receive the PROCEL seal equipment level "A". After tests in laboratories, the models are classified according to EE from A to G, A being the highest efficiency level.

It is important to report that initially PROCEL Seal was designed for rewarding the most efficient among all products in a category. However it was observed that this strategy besides not pleasing manufacturers did not meet the main goal of the label which is to offer consumers options to buy efficient appliances. Attention then turned to an intermediate phase in which the three more efficient products were awarded, but this strategy also proved somewhat effective. Thus was set the current strategy of rewarding products labeled with A, adding specific criteria for obtaining the Seal.

An important evolution was the inclusion of requirements aimed at environmental protection in some of the specific criteria for the granting of PROCEL Seal, for certain equipment. In the case of washing machines criteria related to water consumption, and in case of refrigerators and freezers, elimination of CFCs in foam expansion. The trend is for gradually incorporate this type of requirements for all products according to the characteristics of each one.

Each year expanding its activities to include new categories of products, currently PROCEL Seal is awarded to various products. In 2001 we were awarded 312 models of 28 participants companies with equipment ranked in 12 categories. In 2011, the Seal PROCEL was granted to 3,784 models in 32 product categories with a total of 209 companies honored.[41]

The PROCEL results of 2011 totaled 6363 million kWh of energy saved and 2605.83 MW of peak demand withdrawn.

The management program is conducted in partnership with Inmetro within the PBE. In this sense, PROCEL acts in the qualification of independent laboratories, assists in establishing indexes of electricity consumption related to EE Law (10.295/2001), as well as provides subsidies to develop technical standards for testing EE.

41. Source: Resultados Procel 2012 ano Base 2011

2.1.2.4 PROCEL Edifica (Buildings Program)

PROCEL Edifica subprogram is responsible for promoting EE and environmental comfort in new buildings and in existing buildings in Brazil. The electricity consumption in this sector is quite significant, around 45%, if we consider the sum of residential, commercial and services. With economic stability observed in recent years and the consequent increase of income of the population, it is estimated that consumption will continue to rise. This is because more people have access to consumer goods with new technologies, which mostly consume electricity.

In 2003, PROCEL Edifica launched its Action Plan with contributions from various stakeholders of the building industry and academia, aimed at acting in various activities: training, new technologies, information dissemination, subsidies for sector regulation, housing and EE and, finally, support, marketing and financing.

With the same philosophy already adopted in other countries, the labeling of buildings was developed similarly to labeling of household appliances and equipments. Aiming to improve levels of sustainability of buildings, PROCEL Edifica topped the development of criteria for the labeling of buildings with national characteristics and thinking about electricity. To achieve this goal, was convened the National Institute of Metrology, Quality and Technology - Inmetro, which already acts as a partner in PROCEL Seal, indicating efficient household appliances and equipments in the market within the Brazilian Labeling Program (PBE).

From the partnership with Inmetro, arises the National Program for Buildings Labeling. Known as PBE Edifica, this program meets the guidelines of the MME, the National Energy Plan 2030 - PNE 2030, Decennial Plan of Energy Expansion - PDE 2007/2016 and also the National Plan for EE - PNEF.

Regarding the use of electricity, PBE Edifica defines the procedures required for Brazilian buildings incorporate sustainability concepts into the construction or renovation (by the choice of materials or efficient techniques) and also during use / operation.

The criteria for buildings labeling are described in the following documents prepared by a Technical Secretariat, consisting of experts in the field:

• Technical Regulation on Quality Level for EE of Commercial Buildings, and Public Services - RTQ-C (2009);

• Technical Regulation on Quality Level for EE of Residential Buildings - RTQ-R (2010), and

• Regulation of Conformity Assessment, of RTQ-C and RTQ-R, RAC-C and RAC-R.

In buildings labeling may be used two evaluation methods: prescriptive method with equations, tables and limit parameters or simulation method - which compares the performance of the building with other of reference.

This process is still voluntary, but PNEF already projects minimum levels of performance and efficiency in new buildings, and mandatory labeling for public buildings by 2020, commercial buildings, and buildings for residential services by 2025 and 2030. Until then it is necessary that transformation occurs over the entire chain of the construction industry and to consolidate the concept of national labeling in buildings.

The Network for EE in Buildings – R3E was created, by bringing together laboratories qualified by PROCEL since 2003 in Environmental Comfort and EE. There are 12 laboratories, 01 lab specialized in natural ventilation for buildings, 07 specialized in training, and multiplication of professionals for the Building Sector on the use and application of technical regulations. The other 04 laboratories, asked the INMETRO accreditation to become Accredited Inspection Bodies - OIA, authorized to issue labels for buildings Residential, Commercial, and Public Service. This network aims at an effective market transformation by providing greater flexibility in the process for labeling buildings in the country.

The cooperation agreement between the Energy Agency of Portugal - ADENE, Inmetro and PROCEL, signed in July 2012, has enabled the expanding the exchange of information, and relevant technical and operational data with the objective of creating an environment of international cooperation involving the themes EE and renewable energy, facilitating the development of specific activities of common interest to Brazil and Portugal.

In 2012 was launched the software Thermoenergetic Building Simulation - Domus PROCEL Edifica. This program is adapted for the regulations of the PBE Edifica and can perform analysis by prescriptive and simulation methods, with the issuance of a "virtual label," even though without legal value, since this requires the label to be issued by an OIA.

PROCEL Edifica established periodical reviews in its Action Plan, in order to discuss and rethink the progress of planned actions. Many barriers must be transposed because Brazilian society, despite worrying about the purchase of more efficient equipment and appliances, has not yet incorporated this concept to the construction sector.

In the buildings sector, it is estimated that energy savings can reach 30% in existing buildings. For new buildings, practices such as design and efficient technologies can reduce consumption by up to 50%. It is necessary to create an awareness of more sustainable buildings, with higher environmental comfort, for both the general population and to the industry representatives.

2.1.3 PETROBRAS

Petróleo Brasileiro SA or Petrobras is a simply traded company (corporation), in whose majority shareholder is the Government of Brazil (Union). It is, therefore, a state-owned mixed capital company.

Established on October 3, 1953 and headquartered in Rio de Janeiro, the leader of the oil sector in Brazil, currently operates in 28 countries, in the energy segment, in the following sectors: exploration and production, refining, marketing and transportation of oil and natural gas , petrochemical, distribution of derivatives, electrical energy, biofuels and other renewable energy sources.

2.1.3.1 CONPET

Aiming for the efficiency in the use of oil derivatives and natural gas, as well as their increasing EE in both the supply and the final uses, whether in public or private initiative, and seeking to develop a more comprehensive conservation energy to the oil and gas, was established in 1991 by Presidential Decree, the "National Program for the Rational Use of Oil and Natural Gas", CONPET.

CONPET is managed by the General Coordinator, responsibility of the Director of the DNDE, and the Executive Secretary of the Program, responsibility of a Petrobras director, which provides technical and administrative support to the program, through the Program Executive Secretariat.

The main purpose and goal of CONPET are, respectively, "develop and integrate the actions aimed at rationalizing the use of petroleum and natural gas" and "obtain an efficiency gain of 25% in energy use of petroleum and natural gas over the next 20 years, without affecting the level of activity".

The program has four main guidelines:

- Promotion and dissemination
- Permanent attitude in energy rationalization
- Increasing EE of equipment and systems
- Regionalization

The functions of CONPET should cover six areas: institutional, transportation, industrial, residential / commercial, agricultural and power generation.

Eliminate waste of diesel is cause for attention and priority by the CONPET. In the transportation sector, which accounts for over 50% of the consumption of this derivative in the country, waste is significant. It is estimated that the complete elimination of this waste would lead to very significant savings (somewhere around $ 1,000 million / year).

Partnerships between the private sector and CONPET led a project to encourage rational use of diesel and lubricating oils in companies, focusing on the proper use of the fleet of trucks and buses, in addition to the fuel storage system. CONPET began in 1994 a project to guide truckers at gas stations on highways called "SIGA BEM (GO WELL)" Its goal is to provide truckers with information on how to reduce consumption of diesel, after a diagnosis on the state of his vehicle.

The project operates through trucks checking centers at gas stations on the road, strategically located. Diagnoses are free. The driver receives technical information on how to rationalize fuel consumption, through videos and leaflets.

The ECONOMIZAR Project involves cargo and passenger transportation companies that operate their own garages where vehicles are refueled and / or which have a workshop for mechanical repairs. The goal is to guide these companies on improving the management of the use of diesel and measures of professional skill of drivers and mechanics.

This project works through mobile units that visit companies, evaluating consumption and vehicle emissions. Moreover, evaluates methods for managing the use of fuels and qualification of drivers and mechanics and care with the receipt and storage of diesel.

"SIGA BEM (GO WELL)" and "ECONOMIZAR (SAVE)" are the main CONPET projects in this sector.

The initiatives of CONPET were virtually nonexistent about encouraging the introduction of energy efficient technologies, such as the production of vehicles with lower specific consumption of gasoline, diesel or ethanol. This situation changed after 2010 with the implementation of cars labeling in partnership with Inmetro.

2.1.3.2 CONPET Seal

CONPET Seal aims to highlight to consumers, those models which achieve maximum degree of EE on the National Energy Conservation label of the Brazilian Labeling Program of INMETRO. Awarded annually by Petrobras, the Seal is a stimulus to the manufacturing of more efficient models.

CONPET Seal is in force since August 2005, and is targeted to equipments consuming oil and natural gas that achieved the lowest fuel consumption rates.

It is granted voluntarily to all products obtaining the concept "A" (most efficient) in laboratory tests conducted by the Brazilian Labeling Program (PBE). The criteria are based on data of fuel consumption, performance or EE, published by INMETRO.

Models granted with CONPET Seal:[41]

- Gas water heaters, tankless and accumulation types
- Domestic Gas Stoves and Ovens

41. Source: www.conpet.gov.br

2.1.4 INMETRO

Inmetro –National Institute of Metrology, Quality and Technology is a Federal Agency subordinated to the Ministry of Development, Industry and Foreign Trade (MDICT). Inmetro was created by law in December, 1973, to support t Brazilian enterprises, to increase their productivity and the quality of goods and services.

Its major task is to improve the quality of life of the ordinary citizen as well as to seek the competitiveness of the economy through metrology and quality.

Some highlights amid its duties are:

To implement the national policies on metrology and quality

Verify compliance with the technical and legal standards, with regard to units of measurement, measurement methods, materialized measures, measuring instruments and products pre-measured;

Keep and maintain the standards of units of measurement, as well as deploy and maintain the traceability chain of standards of measurement units in the country, so as to make them harmonious internally and consistent at international level, aiming at primary level, its universal acceptance and secondary level, their use as a support to the productive sector, regarding the quality of goods and services;

Strengthen the country's participation in international activities related to metrology and quality, and promote exchanges with foreign and international entities and agencies;

Provide technical and administrative support to the National Council of Metrology, Standardization and Industrial Quality - Conmetro, as well as its advisory committees, serving as its Executive Secretariat;

Increase the use of technical quality management in Brazilian companies;

Plan and execute the activities of accreditation of calibration and testing laboratories, proficiency testing providers, certification bodies, inspection, training and other, needed to develop the infrastructure of technological services in the country, and

Coordinate deployment of conformity assessment programs in the areas of products, processes, services and personnel, compulsory or voluntary, involving the adoption of regulations.

2.1.4.1 Brazilian Labeling Program - PBE

PBE was officially created in 1984, through a protocol signed between MDICT and the Brazilian Association of Electrical and Electronics Industry - ABINEE, with the intervention of the MME. Its goal is to provide consumers with information about the energy consumption of products so they can choose the highest EE, enabling reduction of new investment in electricity production and reducing costs for the population in general.

In 1984, Inmetro started with the society to discuss the creation of programs of conformity assessment with a focus on performance, with the aim of contributing to the rationalization of energy use in Brazil by providing information on the EE of equipment available in the domestic market.

Initially designed to the automotive industry, because of the oil crisis affecting the world in the 70's, this project was redirected, expanded and was named Brazilian Labeling Program (PBE).

Integrate PBE, conformity assessment programs that use the National Energy Conservation label to provide information about the performance of the products regarding their EE.

Its objectives are:

- Provide useful information to influence the purchasing decisions of consumers, who can take into account other attributes beyond price, when buying products.
- Fostering the competitiveness of industry through the induction process of continuous improvement promoted by the conscious choice of consumers.

PBE encourages innovation and technological evolution of products and acts as a tool for reducing energy consumption and is aligned this way, with the goals of the National Energy Plan (PNE2030) and the National Plan for EE (PNEF).

The program also contributes to the effective enforcement of Law 10 295 of 17 October 2001, known as the EE Law, which provides for a National Policy for Conservation and Rational Use of Energy:

"Art 3rd The manufacturers and importers of machinery energy consumers are obliged to take the necessary measures to be in compliance with the maximum levels of energy consumption and minimum EE (...) "

... and Decree 4059 of December 19, 2001 - Regulating the Law 10 295.

"Article 9 INMETRO is responsible for the supervision and monitoring of programs for conformity assessment of machinery and energy-consuming devices to be regulated."

Consequently PBE establishes compulsory requirements regarding product performance based on the establishment of minimum levels of EE by the Steering Committee of Indicators and Levels of EE (CGIEE).

Currently, PBE is composed of 38 Conformity Assessment Program in different stages of implementation, which come from the labeling of white goods such as stoves, refrigerators and air conditioners, up to the latest demands in the area of renewable resources (solar heating and photovoltaic systems) and other more complex and with great potential of energy savings for the country, such as buildings and vehicles.

Increasing in the number and complexity of programs is an inevitable trend, noting that the National Plan for EE (PNEF), considers the PBE strategic, to achieve the goals set in the National Energy Plan (PNE2030).

The PBE programs are developed in partnership with CONPET and PROCEL, that awards the most efficient products on the EE labeling of Inmetro with seals.

2.1.4.1.1 Labeling

Conformity assessment occurs through several mechanisms, one of which is Labeling, in order to evaluate requirements related to product performance mainly as its EE. It is a way to highlight, through the National Energy Conservation Label (ENCE), the attendance to minimum performance requirements (and in some cases, in addition, also security) established in standards and technical regulations.

The ENCE classifies equipment, vehicles and buildings by colored bands, usually from "A" (most efficient) to "E" (less efficient), and provides other relevant information, for example the fuel consumption of vehicles, and efficiency of centrifugation and water use in washing machines.

Products currently labeled:

- Accumulation Electric Heater
- Accumulators for Photovoltaic Systems
- Ceiling Fans
- Centrifugal Pumps
- Charge Controllers
- Commercial Electric Oven
- Compact Fluorescent Lamps with Integrated Reactor
- Decorative Lamps - Incandescent Line
- Domestic Air Conditioning - Window Type
- Domestic Gas Stoves and Ovens
- Electric Showers Heads
- Electromagnetic Ballasts for lamps High Intensity Discharge
- Electromagnetic Ballasts for Tubular Fluorescent Lamps
- Flat panel solar thermal collector- Bath
- Flat panel solar thermal collector for Solar Swimming Pool Heaters
- Freezers
- Gas water heaters, tankless and accumulation types
- Heat Pumps
- High Pressure Sodium Lamp
- Hybrid Electric Accumulation Heater
- Inverter DC / AC
- Lamps for domestic use - Incandescent Line
- Microwave Ovens
- Passenger and Commercial Light Vehicles
- Photovoltaic Module
- Plumbing, Electrical
- Point-of-use electric water heaters
- Refrigerators
- Residential, Commercial and Public Services Buildings
- Solar heater panels with integrated storage tank
- Split Type Air Conditioner
- Systems for Wind Energy
- Table Fans
- Tanks Solar Thermal
- Televisions (Stand-by)
- Three Phase Electric Motors - High Performance Type
- Transformers for Distribution Network
- Washing Machines
- Whirlpool Bathtubs
- Whirlpool Electric Heaters

Not listed products under study or in initial phase of labeling[41]

41. Source: www.inmetro.gov.br

2.1.5 Energy Research Company – EPE

Created by Law 10.847/04 and established by Decree 5.184/04, the Energy Research Company - EPE (Empresa de Pesquisa Energética) is a company attached to the MME with the purpose to carry out studies and research in order to provide background information to Brazilian energy sector planning activities.

Its paramount attributions include the provision of studies and projections regarding the Brazilian energy mix, the execution of surveys to support integrated planning of energy resources, the development of studies to support generation and transmission expansion short-, medium- and long-term planning efforts, the performance of power generating plants feasibility studies which include both technical-economic and social-environmental aspects, as well as the coordination of efforts to obtain pre-construction environmental licenses for hydro power plants and transmission lines.

Should be highlighted among its duties:

- Conduct studies and projections of the Brazilian energy matrix and,
- Preparing and publishing the National Energy Balance - BEN.

Specifically regarding EE, EPE is incumbent upon:

- Promoting research and produce information to support plans and programs of environmentally sustainable energy development, including EE;
- Promoting plans geared targets for the rational use and conservation of energy, being permitted to establish collaborative partnerships to this end.

2.1.5.1 National Energy Plan 2030 – PNE 2030

The National Energy Plan - PNE 2030 aims at long-term planning of the energy sector of the country, marking out trends and alternatives for expansion of this segment over the coming decades.

The PNE is composed of a series of studies that seek to provide inputs to formulate energy policies according to an integrated view of available resources.

According to the PNE 2030, National EE Policy will be built in aiming at guiding:

- A set of priority and consistent projects, to be conducted under the guidance of MME, in coordination with the other agents of the Government.
- The inclusion of EE in the energy sector planning, consistent with the National Energy Matrix - MEN, the National Energy Plan - PNE and the Ten Year Plan for Electricity - PDEE.
- Strategic planning and priority actions of PROCEL and CONPET and other programs that may be defined for specific areas.
- The formulation of effective regulatory mechanisms and instruments for inspection by regulatory agencies in the energy sector - ANEEL and ANP.
- The provision of funding by official financial agents in accordance with guidelines and lines of action established.
- The policy on R & D in the area of EE through coordination of resources and institutions involved.
- The design and implementation of EE projects in the utilities, in compliance with the regulations established by regulatory agencies.
- The establishment of an operational structure able to manage implementing this Policy, endowed with human and budgetary resources consistent with the importance of this mission.

One of the most important issues identified in long-term studies of the expansion of electricity supply, certainly is the anticipation of a transition from a predominantly hydraulic expansion, for an expansion with a relevant thermal participation.

The choice of which sources will be part of the new matrix of expansion of electricity generation is based on technical studies, but should be regarded as a strategic decision of government. The social and environmental concerns are a factor present in these studies, which supports the inclusion of clean sources.

The strategic choice to invest in EE is the option that less harms the environment, creating jobs and a growing expectation of increasing its competitiveness compared to other options for expanding the supply of energy.

2.1.6 ANEEL

The National Electric Power Agency - ANEEL (Agência Nacional de Energia Elétrica) was created by Law 9.247/96 and established by Decree 2.335/97. Its responsibilities are to regulate and inspect production, transmission, distribution and commercialization of electricity so that quality of provided services and universal access to electricity are assured. ANEEL is also responsible for the establishment of tariffs for end consumers, in a way that the economic and financial feasibility of power sector Agents and of the Industry as a whole is preserved. The changes brought about in 2004 by the new model made ANEEL responsible for promoting, directly or indirectly, auctions for the Distribution Agents to purchase electricity through long term contracts within the National Interconnected System (Sistema Interligado Nacional), SIN.

The duties of ANEEL on EE are:

- Approve procedures and methodologies for optimizing the operation of the interconnected and isolated systems, for access to the transmission systems and distribution and trading of electricity;

- Encourage combating energy waste with respect to all forms of production, transmission, distribution, trading and use of electricity;

- Encourage and participate in the research and development necessary for the electricity sector;

- Encourage and participate in environmental actions aimed at the benefit of society as well as interact with the National Environmental System in accordance with the law and acting in harmony with the National Environmental Policy.

In accordance with Laws nº 9.991 of 07/24/2000, nº 11.465 of 03/28/2007 and nº 12.212 of 01/20/2010, ANEEL is responsible for the EE Program – PEE management.

2.1.6.1 The EE Program – PEE

Since 1995, the federal government decided to ensure that utilities of electricity distribution newly privatized, invested in EE, including clauses in contracts for this purpose. Later, in July 2000, was created the law nº 9991. This law provides for the investment of 1% of utilities net sales in research and development programs and EE. Until the present time many changes have occurred changing the guidelines for the use of these resources, including the period during the electricity rationing in 2001. Over US$ 2,000 million were already invested so far.

From the first cycle (1998/1999) PEE has undergone significant changes. None of the parties involved, companies and ANEEL, knew early on how to conduct such projects and therefore the program has undergone many changes over time.

In 2005, ANEEL determined that at least 50% of the funds were aimed for the low-income residential consumers (adequacy of residential electrical installations and equipment donation as efficient CFLs and refrigerators).

In recent years the ANEEL Manual for Development of EE Program, limited programs to projects developed in commercial and services buildings, industrial and residential installations, rural installations, utilities (water, sewage, gas distribution, collection and treatment of waste), government services, solar heating to replace electric shower and serving low-income communities.

Many electricity utilities had been using the proposed projects to develop performance contracts. ANEEL regulated this procedure by limiting the maximum amount to be invested in projects with contract performance in 50% of the total PEE. Other measures were adopted to regulate this procedure, and the most controversial is requiring the utility to reverse the gains from performance contracts in new financing EE projects, also through performance contracts, in later cycles.

Conduct measurement and verification campaigns (M & V) of project results is another important development in order to verify the actual savings achieved.

In 2010 the government approved Law No. 12.212 that established the application of at least 60% of the resources in the PEE programs for the efficient use of energy by low-income residential consumers benefited by social tariff. The same law established new distribution in resource allocation for R & D and EE. So, until December 31, 2015 resources will be 0.5% for both R & D and for EE. From 01.01.2016 the percentage for EE will come down to 0.25%.

From 2008 to 2012, ANEEL has recorded 926 EE projects submitted by electricity distribution companies (dealers and licensees), with investments of R $ 2.5 billion. These projects involve initiatives related to solar heating, for municipal energy management, cogeneration, and educational projects aimed at changing consumer habits, among others. Altogether, there was an energy saving of approximately 2.5 million megawatt hours / year (MWh/year).

Considering the average consumption of 150 kWh / month per consumer unit, was obtained a demand reduction during peak hours (between 18h and 21h) of 790 thousand kilowatts (kW).

In the same period, were also performed replacements or installation of equipments to combat energy waste. Among the actual and projected values we highlight the exchange of almost 630 thousand refrigerators, in addition to distributing 16.8 million CFLs.

2.1.7 National Agency of Petroleum, Natural Gas and Biofuels - ANP

The National Agency of Petroleum, Natural Gas and Biofuels (ANP), established in 1998, by Decree No. 2455, is the regulatory body for the activities within the industry of oil and natural gas and biofuels in Brazil.

Federal agency under the MME, the ANP is responsible for implementing the national policy for the energy sector of oil, natural gas and biofuels, according to the Petroleum Law (Law 9.478/1997).

The ANP rules through ordinances, resolutions and normative instructions; promotes bids and conclude contracts on behalf of the Union with dealers for exploration, development and production of oil and natural gas, and surveys the activities of regulated industries, directly or through agreements with other public agencies, among other duties.

The ANP also participates in the Program of Air Pollution Control by Motor Vehicles (PROCONVE), developing standards with locations and deadlines for the adoption by the Brazilian fleet of buses and trucks, types of diesel less polluting. The Agency also participates in the government working group that draws up the first national inventory of emissions for heavy vehicles, light vehicles and motorcycles, established by the Ministry of Environment.

2.1.8 BNDES

The Brazilian National Economic and Social Development Bank (BNDES) is the main financing agent for development in Brazil. Since its foundation, in 1952, the BNDES has played a fundamental role in stimulating the expansion of industry and infrastructure in the country. Over the course of the Bank's history, its operations have evolved in accordance with the Brazilian socio-economic challenges, and now they include support for exports, technological innovation, sustainable socio-environmental development and the modernization of public administration.

The Bank offers several financial support mechanisms to Brazilian companies of all sizes as well as public administration entities, enabling investments in all economic sectors. In any supported undertaking, from the analysis phase up to the monitoring, the BNDES emphasizes three factors it considers strategic: innovation, local development and socio-environmental development.

Considering the attention given to the environment and the social problems vital to development, the BNDES offers especially elaborated support for projects in the social and environmental development areas.

Through financing with specific conditions, non-refundable resources or subscription of securities, the Bank enables efforts that reflect in social environmental development and better living conditions for people.

2.1.8.1 PROESCO and ProCopa Tourism

The evolution of the EE sector in Brazil showed the need to have mechanisms that ensure the financing of projects and performance contracts drafted by ESCOs.

Thus, aimed at projects that contribute to EE, PROESCO was created by BNDES - National Bank of Economic and Social Development, and the MME - Ministry of Mines and Energy.

With the same philosophy of environmental protection projects, PROESCO offers a credit line of R $ 100 million for ESCOs use in their contracts and projects, endorsing 80% of its total funding.

PROESCO was designed to overcome a major barrier to the development of the EE market, estimated at R $ 200 million per year and creates opportunities for the whole market, creating new business opportunities for utilities, efficient equipment manufacturers, energy user companies and especially for ESCOs.

The end uses and processes that contribute most to the energy savings are the focus of PROESCO: lighting, motors, process optimization, compressed air, pumping, air-conditioning and ventilation, refrigeration and cooling, production and distribution of steam, heating, automation and control, power distribution and energy management.

Another line of credit is the BNDES Program of Tourism for the World Cup 2014 - BNDES ProCopa Tourism Sustainable Hotel. Its goal is to finance the construction, renovation, expansion and modernization of hotels that obtain certification in the Sustainability Management System for Hosting, acknowledged by an accreditation entity accredited within the Brazilian System of Conformity Assessment, in order to increase hosting capacity and quality, according to the 2014 World Cup.

Another line of credit focused on 2014 World Cup is the BNDES ProCopa Tourism - Hotel EE, aiming to finance the construction, renovation, expansion and modernization of hotels that obtain EE certification at level "A" by the Program for EE in Buildings - PROCEL Edifica.

2.1.9 MMA

Considering the growing importance of the issue in national and international policy the federal government is developing a number of specific actions focused on mitigation and adaptation to climate change. Thus, the Ministry of Environment, through the Department of Climate Change and Environmental Quality, is also working with the Reducing Emissions from Deforestation and Forest Degradation (REDD), a concept that emerged in the United Nations Framework Convention (UNFCCC) held in 2003. After COP-13, the concept was expanded passing to be designated as REDD +, including the task of forest conservation, sustainable management and enhancement of carbon stocks. About the adaptation to climate change, actions are being conducted for federative articulation, in order to harmonize the Climate Policy and for the insertion of adaptation guidelines for major events such as the World Cup 2014. With regard to the protection of the ozone layer to maintain the climatic balance, the Department of Climate Change and Environmental Quality has also contributed for a strict management of equipment and products with CFCs and its substitutes, seeking compliance with the requirements and goals of the Montreal Protocol.

2.1.10 – Considerations about national experience in EE

2.1.10.1 Evolution of EE mechanisms in Brazil

In the 70s, with the oil crisis many countries have changed their energy policies, noting the importance of EE. However, with the relative stability of oil prices in the 80s, investments in EE were relegated to a second plan. Concern about climate change and environmental risks at the end of the twentieth century, renewed the importance of EE in governmental energy policies. In Brazil programs such as National Alcohol Program - PROÁLCOOL, PROCEL and CONPET Programs and important institutional actions as the contractual obligation of electricity distribution companies to invest a percentage of its revenue in EE Programs (PEE) and the EE Law, work as support mechanisms for EE.

It deserves to be highlighted establishing voluntary or compulsory standards and / or EE labels for the equipments. The Brazilian Labeling Program (PBE) began to be implemented from 1985.

A first effort institutional of energy conservation, with clearly defined goals in the area of liquid fuels, the Protocol was signed in 1979 between the Ministry of Industry and Trade and ANFAVEA, claiming 20% reduction in fuel consumption by ethanol powered automobiles. PROÁLCOOL was the first effective program implemented in Brazil in the area of liquid fuels. Its first step was ethanol added to gasoline, and the second stage, after 1979, was addressed to hydrated ethanol powered engines (not just by the addition of ethanol to gasoline). It was therefore the introduction of new technology and not just the improvement of existing ones.

Another important theme was the issue of fuel oil consumed in industries. Since 1980, the National Petroleum Council (CNP) raised prices, and ordered cuts from 10% to 5%, in supplying fuel oil and diesel for industry and implemented fuel quotas until 1983. To mitigate the negative reaction among entrepreneurs, the federal government created in 1981, the CONSERVE program, with the aim of encouraging conservation and substitution of fuel oil consumed in the industry, being the first major action of energy conservation in

Brazil. Protocols were developed which took effect on EE of sectors such as cement, steel and paper / pulp. However, occurred actually more actions of energy replacement than of energy conservation. There was also an underutilization of resources allocated to the program, due to the bureaucracy, the recession of 1981-85 periods and the lack of a clear signaling by the government regarding the path of economic and energy policies. Conservation initiatives ended up losing importance.

Except PROÁLCOOL, most of these programs were discontinued with the fall in oil prices in the second half of the 80s, making it difficult to justify conservation programs in an environment of falling prices and plenty of oil.

Another instrument of policy used was encouraging the substitution of fuel oil for electricity, of hydraulic origin, for thermal uses. With the increasing use of electricity for thermal purposes in industry, promoted in part by CONSERVE, and in part by the electrothermal program, happened in fact a transfer of the responsibility about the conservation of energy to the electricity sector, as increased demand by electric power to thermal purposes in industry limited the supply capacity of the sector, plunged into financial crisis because of the tariffs containment policy to try to curb hyperinflation of that period.

So it was decided to a policy of energy conservation, with the creation of PROCEL in 1985, which was the first systematic initiative to promote the efficient use of electricity in Brazil.

Following the model adopted by PROCEL, was decided to create a similar program for the oil and natural gas, was thereby established CONPET in 1991. With activities basically of articulation, the performance of CONPET in the past was limited mainly to the conception of conservation and to establish partnerships with final consumers of fuel and with the other bodies of PETROBRAS.

Besides engaging in different energy sources, in the past, there was no coordination between the PROCEL and CONPET, in order to establish an integrated policy for EE, allowing make the most of the efforts and investments undertaken separately. With PNEf the time is right to initiate this integration. Today there is more recognition that EE is intrinsically linked to increased productivity and environmental benefits.

2.1.10.2 National Experience in EE

After the Montreal and Kyoto Protocols, EE has become one of the preferred instruments for mitigating effects due to emissions for greenhouse gases and depletion of the Ozone Layer, and environmental pollutants. It was concluded that increasing efficiency is one of the most economical and environmentally friendly answer for part of the energy needs. Long time Brazil develops EE programs recognized internationally: PROCEL, CONPET and PBE.

The PEEs of the distribution utilities of electricity, regulated by ANEEL, ensure a regular flow of resources to efficiency projects. Completing this structure EE Law No. 10.295/01 allows the federal government to establish minimum levels of efficiency - or maximum consumption - to equipment manufactured or sold in Brazil.

Comparing the current situation with the scenario of 28 years ago when PROCEL was established, it turns out that the situation has changed and that several barriers were removed. In fact, today the market offers many efficient technologies at affordable prices. For this a fundamental role was played by the labeling and the awards, which helped disseminate efficient alternatives. Moreover, the control of inflation and the readjustments of energy tariffs and fuels have made attractive the options for technological modernization. The laboratory network, today strengthened and more capable, provides the necessary services to ensure product quality and consumer safety, recognized by labels and seals with the credibility of the brands INMETRO, CONPET and PROCEL.

Currently, Brazilian consumers, still relatively mobilized by residual memory of the 2001 energy crisis, remain sensitive to energy costs and the threat of shortages.

Summarizing, according to PNEf, national policy for EE will be built in order to guide:

- A set of priority projects and consistent, to be conducted under the guidance of MME, in coordination with the other agents of the Government.
- The inclusion of EE in the energy sector planning, in accordance with the National Energy Matrix - MEN, the National Energy Plan - PNE and the Ten Year Plan for Electricity - PDEE.
- Strategic planning and identifying priority actions of National Programs for Energy Conservation - PROCEL and CONPET and others that may be defined for specific areas.
- The formulation of effective regulatory mechanisms and instruments for inspection by regulatory agencies in the energy sector - ANEEL and ANP.
- The provision of funding by financial agents in accordance with official guidelines and action lines established.
- The policy on R & D for the area of EE through articulation of resources and institutions involved.
- The design and implementation of EE projects by utilities, in compliance with regulations established by regulatory agencies.
- The establishment of an operational structure able to manage the implementation of this Policy, endowed with human and budgetary resources consistent with the importance of this mission.

The consistency of its national programs, the approach combining voluntary accessions with compulsory legislation, and the foundation provided by the funds arising of the utilities revenues make Brazil an international reference regarding the EE programs.

The Brazilian government decided to use its state-owned companies - Petrobras and Eletrobras - to run the two national programs for energy conservation and ANEEL to supervise the EE Program (EEP), run by the distribution utilities of electricity. Labeling of equipments constitutes another powerful tool that Brazil used to promote EE.

According to PROCEL, over 95% of energy savings estimated for 2011, was attributed to labeling of electrical equipment within the PBE and Seal PROCEL, which confirmed the rightness of EE Law, which establishes mandatory minimum efficiency levels for equipment and buildings.

Initially CONPET's activities have been concentrated mainly on personnel training, information dissemination and performing diagnostics on cargo vehicles and passenger cars. Later in partnership with PBE started labeling and launching of CONPET Seal for gas furnaces, stoves and water heaters. Further steps in all major consuming sectors, involving the labeling of light vehicles, pilot programs for energy optimization in small and medium industries, combating heat losses and promoting the use of natural gas in industrial cogeneration, are currently being developed.

In the case of PEE, most investments in the initial stages were to reduce technical losses in distribution networks, installation of energy efficient light bulbs in street lighting and performing energy diagnoses in industrial, commercial and services facilities. In the most recent cycles, it was observed an increase of actions to optimize energy management, often involving partnerships with ESCOs, industries and commercial establishments and service facilities.

Another important development is the requirement for campaigns of monitoring and verification (M & V), of the projects results.

2.2. Environment- Climate Change

The National Policy on Climate Change (PNMC) was established in 2009, through Law No. 12.187/2009. The PNMC has the objective of promoting the reduction of emissions of greenhouse gases in Brazil associated with the promotion of sustainable development based on the use of clean technologies, new production practices and the development and dissemination of knowledge.

The National Policy on Climate Change formalizes the voluntary commitment of Brazil to UN Framework Convention on Climate Change to reduce emissions of greenhouse gases between 36.1% and 38.9% of projected emissions by 2020.

The PNMC administration is up to the Interministerial Committee on Climate Change (CIM) and its Executive Group (GEx), established by Decree No. 6.263/2007. The instruments for their implementation are, among others: the National Plan on Climate Change, the National Fund on Climate Change and the Communication of Brazil to the UN Framework on Climate Change.

2.2.a Competent Authorities of the National Policy on Climate Change

The Brazilian government has developed a system of institutional administration to conduct its National Policy on Climate Change, based on four boards of articulation.

Implementation of the National Policy on Climate Change occurs in the following Institutional Forums.

Fig. 2.1
Institutional instruments of the National Policy on Climate Change – Law nº 12187/2009

2.2.1 Civil House

According to the structure of the Brazilian government between the missions of the Civil House of the Presidency of the Republic shall:

I - assist directly and immediately to the President in the performance of their duties, in particular:

a) coordination and integration of government actions;

b) the prior verification of the constitutionality and legality of presidential actions;

c) the analysis of the merits of the appropriateness and compatibility of the proposals, including the matters in the National Congress, with government guidelines;

d) in the evaluation and monitoring of government action and the management of agencies and entities of the federal public administration;

II - to promote the publication and preservation of official acts.

Hence and considering the item Ia above, it is up to the Civil to coordinate the Interministerial Committee on Climate Change.

2.2.1.1 Interministerial Committee on Climate Change (CIM), a deliberative body coordinated by Civil House;

The Interministerial Committee on Climate Change (CIM) was established by Decree No. 6.263/2007 with the assignment to guide the development, implementation, monitoring and evaluation of the National Policy on Climate Change and the National Plan on Climate Change (PNMC).

Permanent, the committee consists of 16 ministries and the Brazilian Forum on Climate Change, coordinated by the Civil House and the principal representatives of each ministry should hold the position of Secretary or equivalent. The decisions of the CIM are institutionalized through resolutions.

The federal agencies that comprise it are: Ministry of Agriculture, Livestock and Supply, Ministry of Science and Technology, Ministry of Defence, Ministry of Education, Ministry of Finance, Ministry of National Integration, Ministry of Health, Ministry of Cities, Ministry of Foreign Affairs, Ministry of Mines and Energy, Ministry of Agrarian Development, Ministry of Development, Industry and Foreign Trade, Ministry of Environment, Ministry of Planning, Budget and Management, Ministry of Transportation, and the Secretariat of Strategic Affairs of the Presidency.

The responsibility for the preparation, implementation, monitoring and evaluation of the National Plan on Climate Change was in charge of the Executive Group on Climate Change (GEx) within the CIM, which is coordinated by the Ministry of Environment, and composed of six other ministries, and the Brazilian Forum on Climate Change and Civil House.

2.2.2 MCTI

The Ministry of Science, Technology and Innovation (MCTI) was created on 15 March 1985. The MCTI has as competencies, the following subjects: the national policy for science, technology and innovation; planning, coordinating, supervising and controlling the activities of science and technology; policy on development of information technology and automation; national policy on biosafety, space policy, nuclear policy and control the exporting sensitive goods and services.

By incorporating the two major fostering agencies in the country - the Financier of Studies and Projects (FINEP) and the National Council for Scientific and Technological Development (CNPq) and its research units - the Ministry of Science and Technology now coordinates the work implementation of programs and actions that consolidate the National Policy on Science, Technology and Innovation.

We must highlight the role of the MCTI, which serves as the Executive Secretariat of the Interministerial Commission on Global Climate Change, responsible for CDM projects and the General Coordination of Climate General Changes (Department of Policies and Theme Programs - DEPPT / SEPED - Secretariat of Policies and of Research and Development Programs) responsible for Emissions Inventory and Communications under the Convention on Climate Change.

The Secretariat of Policies and Programs for Research and Development - SEPED aims to deploy and manage policies and programs aimed at developing scientific and technological innovation in the country: in the areas of Exact Sciences, of Engineering, Earth and Life in especially in Biotechnology and Health, Nanotechnology and the areas of strategic interest for the collection and the sustainable use of national assets, particularly in Biodiversity, Ecosystems, Meteorology, Climatology and Hydrology, Ocean Sciences, Antarctic and Global Climate Changes.

2.2.2.1 Interministerial Commission on Global Climate Change - CIMGC and its competences

The purpose of the Interministerial Commission on Global Climate Change, created by Decree of July 7, 1999, is to articulate actions at government level to implement the United Nations Framework Convention on Climate Change and its subsidiary instruments in which Brazil takes part.

The Commission shall be composed of representatives from the following bodies:
a) Ministry of External Relations;
b) Ministry of Agriculture and Supply;
c) Ministry of Transports;
d) Ministry of Mines and Energy;
e) Ministry of Planning, Budgeting and Management;
f) Ministry of Environment;
g) Ministry of Science and Technology;
h) Ministry of Development, Industry and External Commerce;
i) Civil Office of the Presidency of the Republic;

First paragraph. The State Minister of Science and Technology shall be the president of the Commission.

Second paragraph. The State Minister of Environment shall be the vice-president of the Commission, performing the president's duties during the president's absence.

Third paragraph. The office holders of the bodies composing the commission shall indicate their representatives and alternate representatives, which will be designated by the State Minister of Science and Technology.

The Ministry of Science and Technology shall serve as the Executive Secretariat of the Interministerial Commission and shall provide technical and administrative support to the work of the Commission.

The attributions of the Interministerial Commission are:

I - to provide statements, whenever requested, on proposals for sectoral policies, legal instruments and norms that contain a relevant component for the mitigation of global climate change and the country's adaptation to its impacts;

II - to provide inputs on the government's positions in the negotiations under the United Nations Framework Convention on Climate Change and its subsidiary instruments in which Brazil takes part;

III - to define eligibility criteria additional to those considered by the bodies of the Convention in charge of the Clean Development Mechanism (CDM), as provided for in Article 12 of the Kyoto Protocol to the United Nations Framework Convention on Climate Change, pursuant to national sustainable development strategies;

IV - to analyze statements on projects that result in emission reductions and that are considered eligible to the Clean Development Mechanism (CDM), as provided for in Article 12 of the Kyoto Protocol to the United Nations Framework Convention on Climate Change, and approve them, when appropriate;

V - to cooperate with entities of the civil society to promote actions by governmental and private bodies in the implementation of the United Nations Framework Convention on Climate Change and its subsidiary instruments in which Brazil takes part;

2.2.2.2 National Emissions Inventory

Brazil presented in October 2010 the second National Emissions Inventory of Greenhouse Gases, covering the period 1990-2005.

Emissions of greenhouse gases have increased by about 60% between 1990 and 2005, from 1.4 gigatons to 2.192 gigatons of carbon dioxide equivalent - and CO_2e (as it considers all greenhouse gases), according to the document.

In this period, deforestation has been primarily responsible for the emissions of greenhouse gases. About 61% of total emissions in the period was caused by the sector of changes in land use and forests. Agriculture appeared then with 19% of national emissions and the energy sector with 15%. The inventory also considered emissions from industry and waste treatment, accounted for 3% and 2% of the national total, respectively.

The expectation, is that the numbers decrease in the next inventory, which should cover the period after 2005, when Brazil started to show decreasing rates of deforestation, mainly in the Amazon.

In 2009, deforestation in the Amazon was seven thousand square kilometers approximately. A number much lower than the nearly 20 000 recorded in 2005 and 25,000 in 2004. The trend is that Brazil registers a reduction to five thousand km ² in the rate of 2010, ie a fall estimated to 25-30%.

2.2.2.3 Brazilian Network for Climate Change Research – Rede CLIMA

The Brazilian Research Network on Global Climate Change (Rede CLIMA) was established by MCTI in 2007 and is supervised by a Board and managed by an Executive Secretariat exercised by the National Institute for Space Research (INPE) and advised by a Scientific Committee. Its objectives are:

- generate and disseminate knowledge and technologies for Brazil to be able to meet the challenges represented by the causes and effects of global climate change;
- produce data and information necessary for the support of Brazilian diplomacy in the negotiations on the international regime on climate change;
- carry out studies on the impacts of global and regional climate change in Brazil, with emphasis on the country's vulnerabilities to climate change;
- assess alternatives for adaptation of social, economic and natural resources systems of Brazil to climate change;
- investigate the effects of changes in land use and on social, economic and natural resources systems in Brazilian emissions of gases that contribute to global climate change, and
- contribute to the formulation and monitoring of public policies on global climate change within the Brazilian territory.

The Board is responsible, among other things, to define the Network research agenda, advised by the Scientific Committee; promote the management of REDE-CLIMA, making all the decisions necessary for its proper functioning and articulate the integration of Rede programs and public policies in the area of global climate change.

The Scientific Committee of Rede CLIMA is composed of representatives of the sub-thematic networks and by scientists from outside the Rede. It will advise the Board on issues of research and evaluation of scientific results, in addition to drafting calling invitations to research.

2.2.3 Ministry of Environment – MMA

The Ministry of Environment (MMA), created in November 1992, aims to promote the adoption of principles and strategies for the knowledge, protection and recovery of the environment, the sustainable use of natural resources, the valuation of environmental services and insertion of sustainable development in the formulation and implementation of public policies, acting by transversely and shared, participatory and democratic ways at all levels and instances of government and society.

Law No. 10,683, of May 28, 2003, which provides for the organization of the Presidency and ministries, constituted as an area of competence of the Ministry of Environment the following subjects:

I - national policy for the environment and water resources;

II - policy of preserving, conserving and the sustainable use of ecosystems and biodiversity and forests;

III - propose strategies, mechanisms, and economic and social instruments to improve environmental quality and the sustainable use of natural resources;

IV - policies for the integration of environment and production;

V - environmental policies and programs for the Legal Amazon, and

VI - ecological-economic zoning.

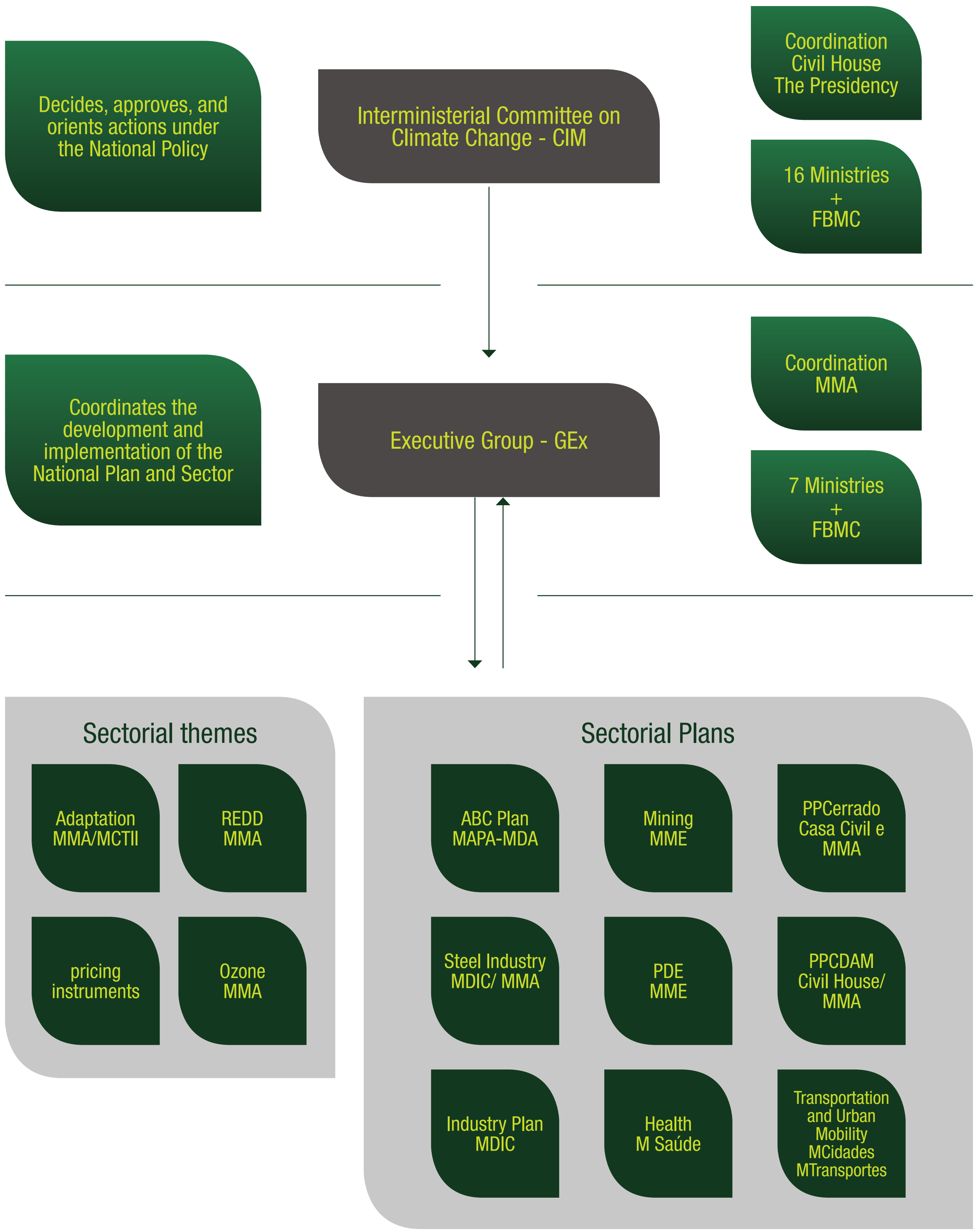
2.2.3.1 Executive Group on Climate Change (GEx)

Coordinated by the Ministry of Environment, meeting monthly to discuss issues related to National Policy.The Executive Group on Climate Change (GEx), subordinated to the CIM, has competence to design, implement, monitor and evaluate the PNMC. It consists of eight ministries and the Brazilian Forum of Climate Change (FBMC) and is coordinated by the Ministry of Environment (MMA).

In the context of the GEx may be created working groups to discuss specific topics of the National Policy on Climate Change.

Its role in the elaboration and implementation of the PNMC is described below:

Fig. 2.2
Governance of the National Plan on Climate Change



2.2.3.2 CLIMATE FUND (FUNDO CLIMA)

The National Fund on Climate Change (Fundo Clima) was created by Law No. 12.114/2009 and regulated by Decree No. 7.343/2010. The Fund is an instrument of the National Policy on Climate Change (NPCC) instituted by Law n ° 12.187/2009. It is intended to fund projects, studies and enterprises aimed at mitigating climate change and adapting to its effects.

The Climate Fund is attached to the Ministry of Environment (MMA) and provides resources in two modalities, namely reimbursable and non-reimbursable. The reimbursable resources are administered by the National Bank for Economic and Social Development (BNDES). The non-reimbursable funds are operated by MMA. A percentage of 2% of the annual budget is reserved for the payment of the financial agent and settlement of expenses related to administration and management.

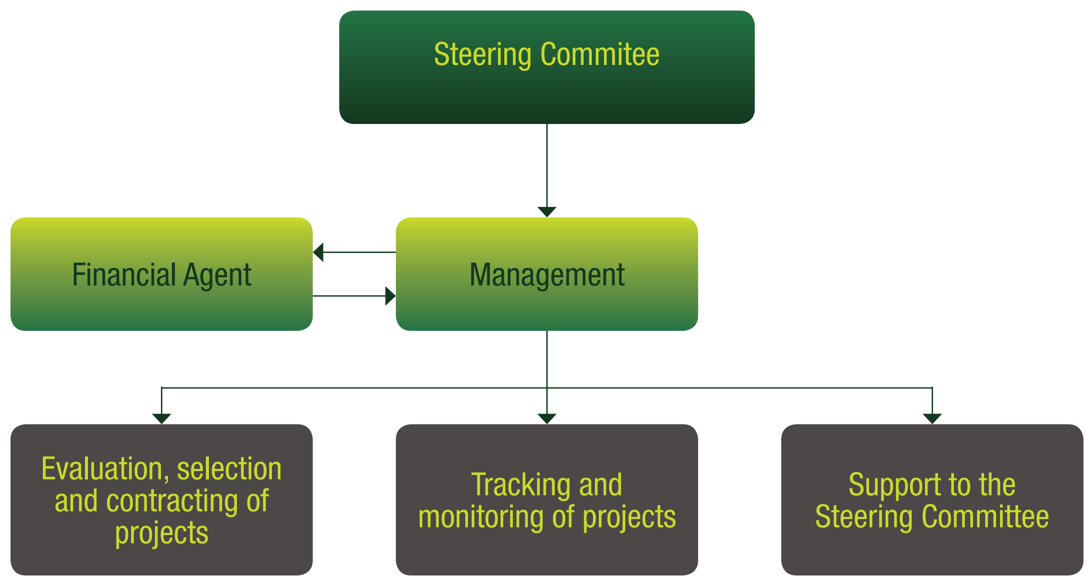
Funding sources of Fundo Clima are:
- Up to 60% of the special participation that fits the Ministry of Environment in the resources from the oil production, according to clause II § 2 of art. 50 of Law No. 9478 of August 6, 1997;
- Appropriations contained in the Annual Budget Law (LOA) of the Union;
- Donations of national and international entities, whether public or private;
- Other arrangements set in the law of creation.

The Fund is managed by a Steering Committee chaired by the Executive Secretary of the MMA. The Committee must approve the proposed budget and Annual Plan of Resource Investment of the Fund, the PAAR. At the end of each year, must report on the application of funds.

The collegial body also has the authority to establish, every two years, guidelines and investment priorities. Finally, the Steering Committee has the task of authorizing projects financing and recommend the contracting of studies.

The current organization is outlined in the following figure:

Fig. 2.3



2.2.3.2.1 Steering Committee – Management of Fundo Clima

The Steering Committee, composed of representatives of government and civil society, is bound to MMA, which coordinates, and has the assignments to approve the proposed budget and the Application Resources Annual Plan - PAAR, establish biennial guidelines and priorities in applying resources, approving plans and annual reports of activities and performance of the financial agent and of coordination of the Fund.

The Executive Secretary of the Fundo Clima is a management linked to the Department of Climate Change - DEMC of the Secretariat of Climate Change and Environmental Quality - SMCQ, with the assignment to perform the function of administrative and operational support to carry out the instruction, celebration and other procedures which have as their object the execution of projects supported by the Fund.

Fundo Clima management is organized to meet the three priority themes, namely: the feasibility of projects contracting, the necessary monitoring of project implementation and its monitoring results, and support the activities of the Steering Committee. In its first year, activities focused on the viability of projects and supporting the Steering Committee, it was not possible, given the reported conditions, to deepen and build the system for monitoring and tracking.

The Financial Agent of the Fund is the National Bank for Economic and Social Development - BNDES, as expressed in the law that created the fund.

From the standpoint of budget and finance resources, totals shown at the beginning of the year for 2011 were R$ 238,927,463.00 distributed as follows:

a) R $ 5,200,000.00 as reopening special credit from the 2010 budget, but with commitment and limit for moving (released at the end of the year).

b) R$ 233,727,463.00 Annual Budget Law (LOA) from 2011, of which:

i) R $ 204,000,000.00 in reimbursable resources for project financing and R $ 4,200,000.00 to be transferred to the operating agent Fund, as administrative costs related to the management of which were effectively transferred R$ 4,000,000.00.

ii) R$ 29,167,463.00 in grant resources.

iii) R$ 560,000.00 for management and administration of the Program, to be administered by the Fund to carry out its activities.

However, the total amount available during the period was R $ 238,727,463.00, from the opening of a new limit at the end of the year.

Beyond the budget for 2011quoted above, it is expected for 2012 approximately R$389,100,000.00, to which must be added to the years of the PPA 2012-2015, the estimated amount of R$1,275,544,166.00.

From the preliminary structuring of Fundo Clima, was opened the process of execution of the resources available for 2011. Such resources were divided into non-reimbursable under the direct responsibility of MMA, and reimbursable under the management of BNDES. From the point of view of reimbursable resources for BNDES start operating, there was a need for structuring Fundo Clima, both in MMA, as the BNDES. In this process, the MMA had to perform the procedures for transfer of funds from the budget to the BNDES, financially executing the budget available. A similar process had to be done for non-reimbursable resources, organized in stages and phases.

2.2.3.3 National Plan on Climate Change

The National Action Plan on Climate Change was introduced on the 1st of December 2008 and aims to encourage the development and improvement of mitigation actions in Brazil, collaborating with the global effort to reduce emissions of greenhouse gases, as well as aims the creation of internal conditions to deal with the impacts of global climate change (adaptation).

The Plan is divided into four areas: mitigation opportunities; impacts; vulnerabilities and adaptation; research and development; and education, training and communication. Its main objectives are:

1) As a primary and main objective to identify, plan and coordinate actions to mitigate emissions of greenhouse gases generated in Brazil, as well as those necessary to adapt society to the impacts occurring due to climate change; and,

2) Encourage efficiency gains on the performance of economic sectors in the constant pursuit of the reach of best practices;

3) Maintain the high share of renewable energy in the electricity matrix, preserving the outstanding position Brazil has always occupied in the international scene;

4) Encourage the sustainable increase of the participation of biofuels in the national transportation matrix, and also act aimed at structuring to an international market of sustainable biofuels;

5) seek the sustained reduction of deforestation rates in its four-year average in all biomes, until it reaches zero illegal deforestation;

6) eliminate the net loss of forest cover area in Brazil by 2015;

7) Strengthen intersectoral actions aimed at reducing vulnerability of populations;

8) Seek to identify the environmental impacts of climate change and promote the development of scientific research in order to be able to develop a strategy that minimizes costs socioeconomic of adaptation of the Country;

The National Plan on Climate Change also presents some goals to reduce emissions of greenhouse gases, and to promote other socioeconomic benefits and environmental gains. Some of these goals are related to EE:

- Replace 1 million old refrigerators per year, in 10 years;
- Increasing the supply of electricity from cogeneration, mainly sugar cane bagasse, to 11.4% of the total electricity supply in the country in 2030;
- Reduction of non-technical losses in the distribution of electrical energy at the rate of 1,000 GWh per year for the next 10 years.

2.2.3.3.1- Sectorial Plans - Mitigation and Adaptation Sector Plans

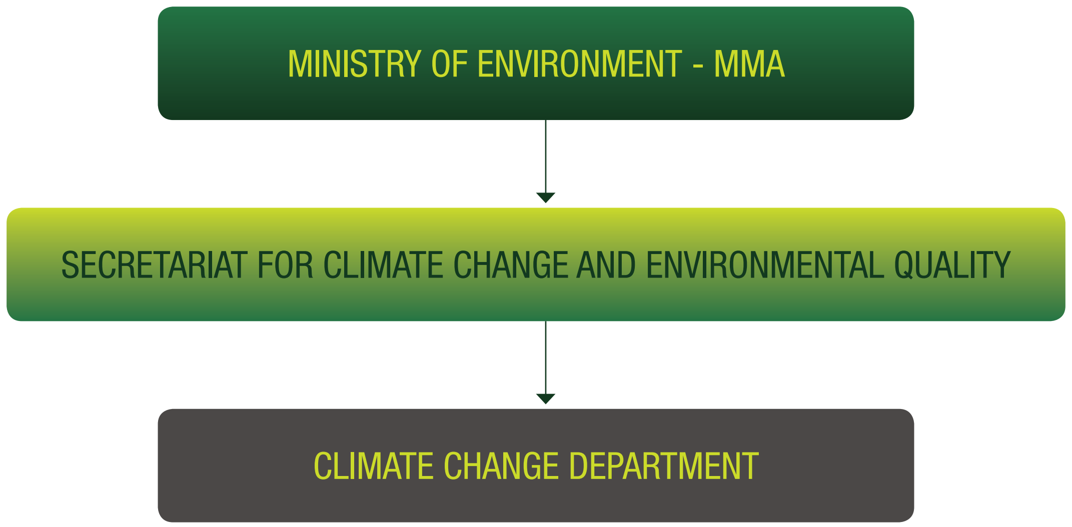
To meet the voluntary commitment, Decree No. 7390/2010 provides for the elaboration of Sector Plans, including actions, indicators and specific targets to reduce emissions and mechanisms to verify its fulfillment.

It is noteworthy that besides containing a mitigation strategy, the Sector Plans should also include adaptation actions, defined by Law No. 12.187/2009 as initiatives and measures to reduce the vulnerability of natural and human systems face of the effects of current and expected climate change.

The formulation of Sector Plans forms the basis for the revision of the National Plan on Climate Change in 2012, one of the tools for the implementation of Law No. 12.187/2009. The Ten Year Energy Plan is one of Mitigation and Adaptation Sector Plans already completed and currently under revision.

2.2.3.4 MMA operational structure for the climate change sector

The operational structure of MMA Climate Change Sector is as follows



Competencies in each area:

The Secretariat of Climate Change and Environmental Quality is responsible for:

I - propose policies and regulations, and to define strategies on issues related to:

a) Strategic environmental assessment;

b) The various forms of pollution, environmental degradation and environmental risks;

c) Waste harmful to health and to environment;

d) The environmental impact assessment and environmental permits;

e) Monitoring the quality of the environment;

f) The development of new instruments for environmental management and

g) The development of environmentally sound energy matrix;

II - to propose, coordinate and implement programs and projects in its area of competence;

III - technically monitor and evaluate the implementation of projects in its area of competence;

IV - formulate, propose and implement prevention policies and environmental emergency assistance;

V - coordinate the actions of the Ministry related to climate change;

VI - to propose policies and economic instruments to regulate the carbon market (CDM);

VII - coordinating the Brazilian participation in activities related to the Intergovernmental Forum on Chemical Safety;

VIII - promote technical and scientific cooperation with national and international bodies in the area of its competence;

IX - coordinate and implement public policies arising from international agreements and conventions ratified by Brazil in the area of its competence;

X - Develop studies and projects related to environmental preservation and reclamation of environmental damage caused by activities of the oil industry, and

XI - perform other activities as assigned in the area of its operations.

The Department of Climate Change is responsible for:

I - support and advise the various units of the Ministry and related entities on issues related to global climate change;

II - coordinating meetings intended to define the position of the Ministry related to global climate change;

III - monitor and support technically the Interministerial Commission on Global Climate Change;

IV - subsidize, assist and participate, in conjunction with the Office of International Affairs, in international negotiations and events related to global climate change;

V - Develop studies for the protection of global climate system and the ozone layer;

VI - develop policies and strategies for mitigation and adaptation to the consequences of global climate change;

VII - to support an expanded use of environmentally sound energy alternatives;

VIII - conduct studies for the formulation of policies and definition of economic instruments to regulate the carbon market (CDM);

IX - to coordinate and articulate, within the Ministry, the implementation of public policies arising from international agreements and conventions ratified by Brazil in their area of expertise, and

X - Perform other activities as assigned in the area of its operations.

Also competes to these areas of MMA, in relation to the theme Energy:

Formulating and proposing policies and standards and developing strategies related to environmental repercussions associated with the Brazilian energy matrix. In this sense, subsidizes the area and advises the various units of MMA and related areas, in matters related to energy theme in national and international level; subsidizes the MMA in their decision making regarding the Brazilian energy matrix; promotes coordination with different governmental and non-governmental organizations for the promotion of a clean energy matrix; develops studies and projects and supports initiatives aimed at expanding the use of alternative energy sources environmentally sound and socially just.

2.2.4 Brazilian Panel on Climate Change - national scientific body

On April 17th 2009 the Brazilian government established the Brazilian Panel on Climate Change. The initiative brings together 300 leading scientists and researchers from various institutions and universities. This forum, along the lines of the UN Intergovernmental Panel on climate, gathers 300 renowned scientists and researchers from various institutions such as Brazilian space agency, Embrapa, Coppe, university centers, among others, to update the data on climate change in the country.

The government makes use of the Brazilian Research Network on Global Climate Change (Rede Clima), established in 2007. With a interdisciplinary composition, including representatives of government and academia, the Network produces and promotes knowledge and technology on climate change, contributing to the formulation and monitoring of public policies in Brazil, focusing on the following areas: Cities, Coastal Zones, Economics of Climate Change, Water Resources, Regional Development, Renewable Energy, Agriculture, Health and Models.

Researchers from public and private institutions in Brazil are encouraged to organize and expand the scientific production on the impacts of climate change in the country.

Besides analyzing the scientific, technical and socioeconomic production on Climate Changes in all its aspects, the Panel has the task of placing this knowledge, organized as reports, available to the United Nations Framework Convention on Climate Change (UNFCCC), and to governments and all institutions and persons interested in the subject.

Facing the interference of human actions on the environment - which reached a global scale and unprecedented magnitude, affecting the natural functioning of the climate system - the public policy makers and society in general need objective information about the causes of climate change, its environmental and socioeconomic impacts, and possible solutions.

Based on this, the Brazilian Panel on Climate Change (PBMC) was established, in the molds of Intergovernmental Panel on Climate Change (IPCC). The role of PBMC is to gather, synthesize and evaluate scientific information on relevant aspects of climate change in Brazil.

The PBMC will provide technical and scientific information on Climate Changes from integrated assessment of technical and scientific knowledge produced in Brazil or abroad, on the causes, effects and projections related to climate change and its impacts, of importance for the country.

Information will be disseminated through the elaboration and periodic publication of National Assessment Reports, Technical Reports, Summaries for Policymakers on Climate Changes and Special Reports on specific topics.

The PBMC may support international cooperation among developing countries, for the promotion of national experience, share methods, results and knowledge in order to help countries strengthen their national capabilities for responses to climate change.

The panel consists of the following structure: Plenary Assembly, the Board, Scientific Committee, Executive Secretariat, Working Groups (Working Group 1, 2 and 3), Task Force on Methodologies for Emissions Inventories of Greenhouse Gases and Units Technical Support.

2.2.5 Brazilian Forum on Climate Change

To bring the topic of Climate Change at the heart of society was created the Brazilian Forum on Climate Change (FBMC) by Decree No. 3515 of June 20, 2000, aiming to "raise awareness and mobilize society for discussion and decision making "about the impacts of greenhouse gas emissions by human activities, which enhance the greenhouse effect.

The FBMC is chaired by the Brazilian President, and has as members State Ministers, Presidents of Regulatory Agencies, State Secretaries of Environment, representatives of the Corporate Sector, Civil Society, the Academy, and Non-Governmental Organizations. The Forum has an Executive Secretary appointed by the President with the assignment of organizing the agenda and attend meetings and to adopt measures for the execution of the works and activities.

In April 2007, the President of the Republic, at the suggestion of the Ministry of Environment (MMA) and the Secretariat of the Brazilian Forum on Climate Change (FBMC), placed on the agenda of government activities to draw up a plan. This plan was initially called "National Action Plan to Combat Climate Change - PNMC ", oriented to structure and coordinate government actions concerning to the impact of global warming arising from anthropogenic activities.

In order to meet this demand, the FBMC promoted several meetings which culminated in the drafting of a reference document entitled "FBMC Proposal for the National Action Plan to Combat Climate Change", being delivered to the President.

In the process of drafting the PNMC, the discussion regarding the plan was extended for the different sectors of society, as a way to contemplate the specific demands these stakeholders. Therefore, it became imperative to promote an agenda seeking to promote discussion and encourage participation of society through their representative bodies.

To attain these goals, the Executive Secretariat of FBMC, held Sector Dialogues in order to collect contributions for the construction of the PNMC. These dialogues consisted of a series of meetings with representatives from various sectors, whose objective was the mapping of actions already implemented, as well as the actions necessary to future implementation, regarding the structural axes composing the PNMC.

In sectoral dialogues and public consultations conducted, have been heard various sectors of society, such as industry, forestry, finance, agriculture, forest and land use changing, the municipalist movement, besides civil society and NGOs. Once the process of creating the Plan includes periodic reviews, dialogues with society should adopt a dynamic for consultation that allows this continuous dialogue with public administrators responsible for updating the plan. In this context, the role of FBMC has significant importance as in its institutional prerogatives fits to act as a promoter of dialogue between the government and society.

The Sector Dialogues raised a set of propositions presented in documents created and approved by the various entities constituting the consulted sector. These contributions after systematized by the Executive Secretariat of FBMC, were forwarded to the Executive Group of the Inter-Ministerial Committee on Climate Change (GEx), who considered for improving the Plan.

3. BRAZILIAN LEGISLATION ON ENERGY EFFICIENCY AND CLIMATE CHANGE. MUTUAL INTERACTIONS AND INCENTIVES

3.1 PPA Multi-annual Plan 2012-2015 – Law 12593/2012

The Multiyear Plan (PPA) 2012 – 2015, stated by Lau 12593/2012, defines all the policies and actions of the federal government, thus expressing the commitments of a presidential term. It sets out the projects and programs of long-term government, defining goals and objectives of public action for a period of four years. It is the primary planning tool of the Federal Government which aims, among others, to promote efficient use of government resources.

The Multiyear Plan (PPA 2012-2015) is a planning tool of government action provided for by Article 165 of the Constitution. The importance of the Plan can be verified by the significant contribution of planned resources: R$ 2.4 trillion in 2004-2007 to R$ 5.5 trillion in the current Plan More Brazil (PPA 2012-2015). The plan has 65 thematic programs that articulate 492 goals and 2417 targets.

The tracking performance can be measured annually to the Annual Report Assessment of the PPA 2012-2015, as established by Decree No. 7.866/2012. For each of the 65 programs of the PPA, will be published the identification of updated index of indicators, the situational analysis of the objectives and targets and financial implementation of the initiatives, as well as evaluating the macroeconomic scenario.

Specifically, with respect to Climate Change was established the Thematic Program for Climate Change and Environmental Reparation, aimed at building a cohesive and consistent national policy able to prepare the country for the challenges arising from climate change.

3.1.1 Program 2050: Climate Change

According to the Multiyear Plan (PPA) 2012-2015, the program that covers the topic of Climate Change is the Program 2050, which covers six goals and their targets and initiatives, under the responsibility of the Ministry of Science, Technology and Innovation and the Ministry of Environment.

The program 2050 has a total budget of R$ 2,020,860, allocated between 2 goals under the responsibility of MMA, and 4 of MCTI responsibility. Among the objectives under the responsibility of MMA is the Goal 0698: "Develop and implement tools for mitigation and adaptation to climate change considering sustainable development and regional diversity."

Among the various initiatives under Objective 0698 stands out on the Elaboration of opportunities and challenges diagnosis about unconventional sources of energy consumption and efficient consumption.

For better understanding we detail below the Program 2050's objectives:

Objective 0698:

"Develop and implement tools for mitigation and adaptation to climate change considering sustainable development and regional diversity."

Targets:

- Approve legal framework of the mechanism for reducing emissions from deforestation and forest degradation (REDD).
- Update the National Plan on Climate Change.
- Fostering the implementation of 40 projects and 20 enterprises that promote adaptation and mitigation to climate change.
- Implement the National Plan for Sustainable Production and Consumption.
- Monitor sectoral emissions of greenhouse gases.

Initiatives:

• Creating the legal and institutional mechanism for Reducing Emissions from Deforestation and Forest Degradation (REDD).

• Preparation of National Communication of Brazil to the Convention on Climate Change.

• Making a diagnosis on opportunities and challenges of unconventional sources of energy and efficient consumption.

• Support studies, projects and ventures aimed at mitigating and adapting to climate change.

• Implementation of the National Plan for Sustainable Production and Consumption (PPCS).

• Implementation of the National Plan on Climate Change.

• Implementation of the Brazilian Program for the Elimination Hydro chlorofluorocarbons (HCFCs).

• Continuous Monitoring Sectorial Emissions of Greenhouse Gases in Brazil.

• Operationalization of the Clean Development Mechanism (CDM).

Objective 0707:

Reduce risks and vulnerabilities environmental, economic and social, arising from climate change, desertification processes and land degradation, to minimize material losses, ecosystem impacts and promote socioenvironmental improvement through adaptation measures.

Targets:

• Update the National Action Plan to Combat Desertification and Mitigate the Effects of Drought.

• Develop the National Program for Climate Change Adaptation.

Initiatives:

• Ecological and socioenvironmental adequacy of instruments for the use, sustainable production and consumption in areas susceptible to desertification.

• Elaboration the National Program for Climate Change Adaptation.

• Identification, diagnosis and combating the desertification.

• Mapping, data interpretation, and reclaim of environmentally degraded areas undergoing desertification.

Still within the 2050 Program the following objectives will be undertaken under MCTI:

Objective 0536

Generate environmental scenarios, including regional particularities, by the construction of the Brazilian Model of the Global Climate System, for the formulation of public policies for mitigation, adaptation and vulnerability reduction.

Objective 0540:

Generate and disseminate knowledge and technologies for mitigation and adaptation to the effects of climate change through a network formed by public and privately funded research and teaching institutions (REDE CLIMA).

Objective 0734:

Assess the impacts of climate change on Brazilian natural systems, through the monitoring of emissions and observation of climate signs.

Objective 0990:

Expand the weather, air quality and climate forecast on regional and global scales.

3.1.2 PPA 2012-2015 programs regarding EE

According to the Multiyear Plan (PPA) 2012-2015, the Programs that covers the topics of Energy Efficiency are Program 2022 – Fuels and Program 2033 - Electric Energy, both mostly under the responsibility of the Ministry of Mines and Energy.

For better understanding we detail below the 2022 and 2033 Programs' objectives related to EE:

PROGRAM 2022 – FUELS

OBJECTIVE 0604:

Stimulate energy efficiency measures in the use of derivatives of the Petroleum, Natural Gas and Biofuels that contribute to the rational use of these inputs.

Goals:

Raise the percentage of car models labeled by Brazilian Vehicle Labeling Program (PBE Vehicular) to 50%.

Avoid consumption of 650 million liters of diesel oil through energy efficiency measures.

Initiatives:

Promote awareness on the efficient use of oil derivatives and natural gas.

Promote studies and projects aimed at the regulation of Law No. 10.295, of 10/17/01, adding new equipment to the list of Indicators and Minimum Levels of Energy Efficiency and promoting improvements to existing ones, with regard to equipment that consumes derivatives of oil and natural gas.

Conduct studies and projects to stimulate energy efficiency measures in the use of oil, natural gas and biofuels.

PROGRAM 2033: ELECTRIC ENERGY

OBJECTIVE 0048:

Stimulate energy efficiency measures, which contribute to the optimization of the transmission, distribution and consumption of electrical energy.

Goals:

Save 20,000 GWh of electric energy consumption that would occur without conservation measures.

Initiatives:

Strengthen the activities of measurement and verification, in order to incorporate the results in studies of electric sector planning.

Encourage Replacement and Disposal of Obsolete Equipment.

Promoting Awareness About the Efficient Use of Electric Energy.

Promote synergy between the existing energy efficiency programs in the country.

Promote studies for the regulation of the Law n. º 10.295/2001, adding new equipment to the list of indicators and minimum levels of energy efficiency and promoting improvements to existing ones.

3.2. PPA Multi-annual Plan 2012-2015 – Law 12593/2012

A seguir apresentamos um panorama resumido da evolução e estado atual do arcabouço legal que dá sustentação jurídica aos planos, programas e ações governamentais, respectivamente nas áreas de EE e de Mudanças Climáticas.

3.2.1 Legislation on EE

• In 1981, through Ordinance MIC/GM46, CONSERVE Program was created in order to promote energy conservation in industry, to develop products and processes more energy efficient, and to stimulate substitution of imported energy sources by native alternatives. CONSERVE aimed to encourage the conservation and substitution of fuel oil consumed in industry, especially in steel, pulp and paper, and cement industries. The incentive was given to seize the surplus capacity of hydro electric generation for heat generation in industries (electrothermal).

• On April 2, 1982, Decree 87 079 approved guidelines for the Energy Mobilization Program - PME, a set of actions aimed at energy conservation and substitution of petroleum. PME was established with the aim of rationalizing the use of energy by getting the decrease in consumption of energy inputs and progressively replacing oil products by domestic alternative fuels. Energy conservation was a priority for the program.

• In 1984, Inmetro, implemented the Program for Energy Conservation in Electrical Appliances, aiming to promote the reduction of energy consumption in equipments such as refrigerators, freezers, and residential air conditioners. In 1992, this program was renamed, and from then on called Brazilian Labeling Program, having preserved its initial assignments, to which were added safety requirements and establishment of minimum levels of EE.

• In December 1985, through the Interministerial ordinance nº1877, of the Ministries of Mines and Energy (MME), and Industry and Trade (MIC), was created PROCEL - National Program for Energy Conservation, with the aim of integrating the actions for conservation of electricity, with a comprehensive and coordinated sight.

• In 1990, by Decree 99656, the federal government creates the Internal Commission for Energy Conservation - CICE, determining the installation of a CICE in all property belonging directly or indirectly to an agency or entity of the Federal Government, foundations, public and semi-public companies, that have an annual electricity consumption exceeding 600,000 kWh or an annual fuel consumption of more than 15 Toe (tons of oil equivalent), indicating an attempt to reduce energy waste in the Public Sector. CICE is up to the development, implementation and monitoring of Program for Energy Conservation's goals, and dissemination of its results at each facility.

• On July 18, 1991, by Federal Decree was created CONPET - National Program for the Rational Use of Oil and Natural Gas. In this same document PROCEL assignments were revised. Both programs are intended to develop and integrate actions for the rational use of energy. It was established that actions of the program shall be supervised by the Coordinator Group of CONPET - GCC, comprising representatives from various ministries and federations of industry and commerce, and the actions of PROCEL shall be supervised by the Coordinator Group of Energy Conservation - GCCE, with composition similar to the GCC. By Decree, it was up to Petrobras to provide technical, administrative and financial support to the Program.

• On December 8, 1993, by Federal Decree was established the National Award for Conservation and Rational Use of Energy, for recognition of contributions for the conservation and rational use of energy. The Decree established that the award is conferred annually in the following categories: agencies and companies of public administration, energy sector companies, industries, commercial and services companies, micro and small enterprises, buildings, transportation and press. On the same date, another decree has created the EE Green Seal, with the goal of identifying the equipment presenting optimal levels of efficiency in energy consumption.

• On December 26, 1996, Law 9427 created the National Electricity Law, which was defined by Decree No. 2335 of 6 October 1997. The Decree established the guidelines of ANEEL, its basic structure and functions.

• On August 6, 1997 is enacted Law No. 9.478/1997 (Petroleum Law), which addresses the National Energy Policy and creates the ANP. This Law determines that one of the principles and objectives of the National Energy Policy is the national policy for the rational utilization of energy sources, aiming among others the objective of protecting the environment and promoting energy conservation. This law also states that it is up to ANP to enforce good practices of conservation and rational use of oil and natural gas and environmental protection.

• On July 24, 2000, is enacted Law No. 9991, which governs the investments in research and development on EE by the utilities, licensees and authorized companies of the electricity sector.

• On 17 October 2001, is enacted Law No. 10295, also known as the EE Law and corresponds to the principal regulatory matter in Brazil providing on a national policy for the conservation and rational use of energy, aimed at the efficient use of energy resources and the preservation of the environment. The federal government should establish maximum levels of specific energy consumption or minimum levels of EE of machines and energy-consuming devices, manufactured or sold in Brazil, based on relevant technical indicators that consider the equipment life. It also states that, one year after the publication of the levels of EE, a program will be established with targets for its progressive evolution, and requires manufacturers and importers of equipment to take the necessary steps to be in compliance with the maximum levels of energy consumption and minimum levels of EE, contained

in the regulations set for each type of machine or device. Importers must also prove compliance to the levels established during the process of importing. The federal government is also up to develop mechanisms for promoting EE in buildings constructed in Brazil.

• Decree No. 4059 of 19 December 2001 regulates the EE Law by determining procedures for the establishment of indicators and levels of EE. The Decree created the Steering Committee of Indicators and Levels of EE - CGIEE, composed of representatives of the following organizations and entities:

• Ministry of Energy and Mines (MME) (who heads the Committee);

• Ministry of Science and Technology (MCTI);

• Ministry of Development, Industry and Foreign Trade (MDICT);

• National Electric Energy Agency - ANEEL;

• National Agency of Petroleum, Natural Gas and Biofuels - ANP;

• A representative from a Brazilian university expert on energy;

• A Brazilian citizen expert on energy.

The representatives are chosen for two-year terms that may be renewed for a similar period.

According to the Decree No. 4059, Article 3, it is up to CGIEE:

• Develop a work plan and a schedule to implement the application of EE Law;

• Prepare specific regulations for each device and machine consuming energy;

• Establish a program of targets stating the evolution of levels to be achieved for each regulated product;

• Establish Technical Committees to analyze and opine on specific issues under the guidance of CGIEE, including the participation of civil society representatives;

• Monitor and evaluate systematically the regulatory process and propose monitoring plan, and

• To deliberate on the propositions of the Technical Group for EE in Buildings.

ANEEL, ANP and INMETRO and the Executive Secretaries of PROCEL and CONPET provide technical support to CGIEE and to constituted Technical Committees.

3.2.2 Legislation on Climate Change

There are two laws directly related to climate change in force in the country: Law No. 12.187, of December 29, 2009, establishing the National Policy on Climate Change, and Law No. 12.114, of December 9, 2009, which creates the National Fund on Climate Change (FNMC). Law 12.187/2009 institutes the National Policy on Climate Change and establishes its principles, objectives, guidelines and instruments. The Policy and the consequent actions will observe the principles of precaution, prevention, of citizen participation and sustainable development.

The National Policy on Climate Change has, among others, the following objectives:

- Compatibility of economic and social development with the protection of the climate system;

- Reducing emissions and strengthening of anthropogenic removals by sinks of greenhouse gases in the country;

- Implementation of measures to promote adaptation to climate change;

- Conservation of environmental resources, with particular attention to major natural biomes taken as National Heritage;

- Consolidation and expansion of legally protected areas and encouraging reforestation and restoration of vegetation cover in degraded areas.

Among the instruments of the National Policy on Climate Change, appearing the National Plan on Climate Change already prepared by the Federal Government, the National Fund on Climate Change, created by Law 12,114 / 2009, Plans of Action for the Prevention and Control Deforestation in the biomes, as well as economic and financial mechanisms related to climate change mitigation and adaptation to the effects of climate change.

It is worth noting, though, contained in the Law 12.187/2009, the voluntary commitment of Brazil, made in Copenhagen to reduce its emissions of greenhouse gases by 36.1% and 38.9% compared to projected emissions by 2020.

To carry this commitment, several actions are planned, among which stands out the reduction of deforestation, accounting for about 75% of total carbon dioxide emitted by Brazil. The country already has important mechanisms to support efforts to control deforestation, such as the National Fund on Climate Change (FNMC) and the Amazon Fund.

The first, as already mentioned, was created through Law 12.114/2009, in order to ensure funds to support projects or studies and finance projects aimed at climate change mitigation and adaptation to climate change and its effects. Among the resources allocated to FNMC includes up to 60% of the resources of the special participation, in case of large volumes of oil production and high profitability of this production, intended for the Ministry of Environment.

The use of funds may be allocated to, among others, the following activities:

- Projects to reduce carbon emissions from deforestation and forest degradation, with priority to natural areas threatened by destruction and relevant to biodiversity conservation strategies;
- Research and development of systems and design methodologies and inventories that contribute to the reduction of net emissions of greenhouse gases and to reduce emissions from deforestation and land use change;
- Developing products and services that contribute to the dynamics of environmental conservation and stabilization of the concentration of greenhouse gases;
- Support for sustainable production chains;
- Payments for environmental services to communities and individuals whose activities demonstrably contribute to carbon storage, linked to other environmental services;
- Agroforestry systems that contribute to reducing deforestation and carbon absorption by sinks, and for income generation;
- land reclamation and forest restoration, prioritizing areas of Legal Reserve and Permanent Preservation Areas and priority areas for the generation and quality assurance of environmental services.

The financial agent of FNMC will be Banco Nacional de Desenvolvimento Economico e Social (BNDES), which will enable the Bank of Brazil, Caixa Economica Federal and other public financial agents to act in financing transactions with funds from FNMC.

The Amazon Fund, created by Decree No. 6,527, of August 1, 2008, consists of a specific account within the BNDES, for allocation of donations in kind to carry non-refundable applications in preventive, monitoring and combating deforestation actions and to promote conservation and sustainable use of the Amazon biome, covering the following areas:

I - Management of public forests and protected areas;

II - control, environmental monitoring and inspection;

III - sustainable forestry management;

IV - economic activities developed from the sustainable use of forests;

V - ecological and economic zoning, land use planning and land tenure regularization;

VI - conservation and sustainable use of biodiversity;

VII - recovery of deforested areas. I - Management of public forests and protected areas;

II - control, environmental monitoring and inspection;

III - sustainable forestry management;

IV - economic activities developed from the sustainable use of forests;

V - ecological and economic zoning, land use planning and land tenure regularization;

VI - conservation and sustainable use of biodiversity;

VII - recovery of deforested areas.

The activities listed above must comply with the guidelines of the Sustainable Amazon Plan (PAS) and the Plan for Prevention and Control of Deforestation in the Legal Amazon (PPCDAM). Up to twenty percent of the Amazon Fund resources may be used in the development of systems for monitoring and control of deforestation in other Brazilian biomes and in other tropical countries.

To complete the legal framework to fully endorse the mitigation of climate change, lack even the standards that should govern in the national sphere, the next period of international commitments under the United Nations Framework Convention on Climate Change. Even with the failure of COP 15 in Copenhagen, the Brazilian Parliament is aware of the issues, particularly with regard to the mechanism for Reducing Emissions from Deforestation and Degradation (REDD), of special interest to Brazil.

In this regard, it should be mentioned the bill (PL) No. 5586 of 2009, which “establishes the Certified Emission Reductions from Deforestation and Degradation (RCEDD) and makes other provisions”, subject of extensive discussion with technicians from the area and representatives of Government and civil society, embodied in Substitutive approved by the Environment and Sustainable Development Commitee of the House of Representatives.

As the project was shelved at the end of the legislature and could not be reinstated, Mrs. Rebecca Garcia, who was the rapporteur on the previous Commission for the Environment and Sustainable Development (CMADS) at the House of Representatives, presented as the Substitute new bill: PL 195/2011. This restatement aims to continue the process of discussion and construction conducted during the year 2010, which involved several governmental and non-governmental sectors. The new project has the same content of the final version voted of the bill 5586 and started legal procedures initially passing by the Commission for the Environment and Sustainable Development (CMADS), in which was approved on June 8, 2011.

Besides the discussion occurs in the House of Representatives, Federal Senator Eduardo Braga also presented Senate Bill 212/2011. The content of the bill is the same text initially presented by Mrs. Rebecca Garcia in the House and is being debated in the Senate.

3.2.2.1 Comments on the Climate Change Legislation

Brazil has become one of the main references regarding the achievement of appropriate solutions, with strong and positive action in international forums since Rio 92. One of the landmarks of Brazilian action was the creation in 2009 of the law known as the National Policy on Climate Change.

This legislation also paved the way to implement the National Action Plan on Climate Change, which includes other integrated initiatives to reduce these emissions, ranging from the increased use of ethanol to doubling the planted forest area in Brazil, through improvement in efficiency in the productive sectors economy with more sustainable practices, and developing research to identify current environmental impacts.

Countries have different historical responsibilities in relation to the volume of emissions. Unlike developed nations (like the United States and European countries), the emissions of greenhouse gases in Brazil stems in large part from changing land use - the technical name for deforestation - mainly the Amazon and Cerrado biomes.

To contain the spread of this kind of devastation and, consequently, reduce CO2 emissions, the federal government launched in 2004 the Action Plan for Prevention and Control of Deforestation in the Legal Amazon (PPCDAm). The combination of more coordinated actions, satellite monitoring and support to more sustainable productive activities allowed the area of deforestation in the Amazon drop from 27,000 km ² (in 2004) to 6000 km ² (2011).

Is worth noting that from 2020 onwards, according to a new commitment agreed at COP 17, all nations need to take actions to mitigate the emission of greenhouse gases, whether or not considered developed countries. This will require negotiating, financing, training and knowledge exchange.

The PPCDAm is just one of the tools created by the Brazilian government to contain the advance of climate change. Beyond it are the ongoing Action Plan for Prevention and Control of Deforestation and Burning of the Cerrado (PPCerrado), the Ten-Year Plan for Energy Expansion (PDE) and the Plan of Low Carbon Agriculture (ABC Plan).

3.3 Regulations, laws and resolutions

The Brazilian legal framework on EE is vast and establishes responsibilities for key government agencies, defines stable sources of funds and determines mandatory and voluntary measures. However some key aspects still need improvement.

At present there is an interesting context, both by the dynamics of the energy sector, as the institutional changes, setting up a range of opportunities for the rational use of energy to be pursued in an integrated and complementary manner - from primary resources, up to its conversion by the final consumer. Thus, shall be established coordinated and integrated activities of various institutions and organizations that are related to EE considering that:

• Law 9478 of 06/08/97, in Article 1, section IV, states that one of the principles and objectives of the

National Energy Policy is to “protect the environment and promote energy conservation”;

• should the National Energy Policy Council (CNPE), according to the same law, “promote the rational use of energy resources in the country, in accordance with applicable law”, with the technical support of regulatory bodies of energy sector;

• It is up to the National Petroleum Agency (ANP), according to the same law, “promoting the regulation, contracting and supervision of the economic activities of the oil and natural gas industries” and “enforce good practices of conservation and rational use of oil, derivatives and natural gas and preservation of the environment “;

• Law 9427 of 26/12/96, in its Article 3 establishes that the National Agency of Electric Energy (ANEEL) has as its mission, among others, as prescribed in Law 8987 of 2/13/95, in Article 29, item X, “stimulate the increase of quality, productivity, environmental preservation and conservation”

• Annex I to Decree 2335 of 06/10/97, in Article 4, paragraphs IX, XX and XXIII, defines as ANEEL competencies, respectively, “encourage combating waste of energy with respect of all forms of production, transmission, distribution, trading and use of electricity “,” articulate with other regulators in the energy sector and the federal government on matters of common interest “and” encourage and participate in research and technological development necessary for electricity industry”.

3.3.1 EE Law

Important milestone for EE in Brazil was the approval of Law No. 10,295 about the National Policy for Conservation and Rational Use of Energy on October 17, 2001. The law, in its Article 2, provides that the government shall determine “maximum levels of specific energy consumption or minimum EE levels of machines and energy-consuming devices, manufactured and sold in the country.” Decree No. 4059 of 19 December 2001, established the Steering Committee of Indicators and Levels of EE - CGIEE with assignments, among others, the development of specific regulations for each appliance energy consumer and the establishment of the Program targets showing the evolution of the levels to be achieved by each regulated equipment.

Technological innovations in the production of more energy efficient equipment can bring benefits that go beyond the energy sector, also reaching other sectors of the economy and society. Thus, by reducing energy consumption in a washing machine, it may result as consequence lower water consumption. These technological innovations also generate benefits for the environment, such as the manufacture of refrigerators efficient CFC-free.

The EE Law determines that the government should establish maximum levels of specific energy consumption or minimum EE levels for machines and energy-consuming devices, manufactured or sold in the country, based on relevant technical indicators. For long term purposes the Law is planned to establish a Target Program to establish the progressive evolution of these levels of efficiency. The effective implementation of this law was enforced by Decree 4.059/01, creating the CGIEE, coordinated by the Ministry of Mines and Energy. Also participate of CGIEE representatives of MCTI, MDICT; ANEEL and ANP, as well as representatives of the Brazilian society and universities.

The CGIEE should prepare work plan and schedule, as well as the specific regulations and plan goals for each machine or appliance energy consumer. Technical Committees are created to instruct their decisions and monitor their rulemaking process. The law created several instances to interact with stakeholders: manufacturers, consumers and civil society organizations, with the convening of public hearings and consultations with the technical support of INMETRO, PROCEL and CONPET. The goal is to ensure transparency in the setting of EE indicators.

Law No. 10.295/01 also predicts that the maximum levels of specific energy consumption or minimum EE of machines and energy-consuming devices, should be established based on values technically and economically feasible, considering the life cycle of the machines and energy-consuming devices

CGIEE began its works in July 2002 and so far has developed the following core products:

• Work Plan for Implementation of the Law;
• Specific Rules of Three Phase Electric Motors;
• Specific Rules of Compact Fluorescent Lamps;
• Consultation and Public Hearings for Specific Regulations of the following equipment: refrigerators, freezers, air conditioners, stoves and ovens;
• Draft for Specific Regulations for Gas Water Heaters;
• Regulation for Voluntary Labeling of EE Level of Commercial and Public Buildings.

The implementation of the EE will result in:

• Remove less efficient equipment from the market, in the medium and long term;
• Get progressive energy savings over time;
• Promote technological development;
• Promoting increased industrial competitiveness of the country;
• Reduce consumer spending;
• Contribute to the reduction of social and environmental impacts through the use of equipment that consume less energy and are environmentally friendly.

3.4 National Policy on Climate Change – Law 12187/2009 and decree 7390/2010

In 2009 was established the National Policy on Climate Change (PNMC), through Law No. 12.187/2009. The PNMC has the objective of promoting the reduction of emissions of greenhouse gases in Brazil associated with the promotion of sustainable development based on the use of clean technologies, new production practices and the development and dissemination of knowledge.

The National Policy on Climate Change formalizes the voluntary commitment of Brazil to UN Framework Convention on Climate Change to reduce emissions of greenhouse gases between 36.1% and 38.9% of projected emissions by 2020.

According to Decree No. 7.390/2010, which regulates the National Policy on Climate Change, the baseline emissions of greenhouse gases for 2020 was estimated at 3.236 Gt CO2-eq. Thus, the corresponding absolute reduction was established between 1.168 Gt CO2-eq and 1.259 Gt CO2-eq, 36.1% and 38.9% reduction in emissions, respectively.

The PNMC administration is up to the Interministerial Committee on Climate Change (CIM) and its Executive Group (GEx), established by Decree No. 6.263/2007. The instruments for their implementation are, among others: the National Plan on Climate Change, the National Fund on Climate Change and the Communication of Brazil to the UN Framework on Climate Change.

4. FUNDING SOURCES AND FINANCING FOR EE

The current funding of EE programs in Brazil comes from several sources: budget funds from Petrobras and Eletrobras, Global Reversion Reserve (RGR), resources of international funds such as the Global Environmental Facility (GEF), 0.25% of operating revenue income (net sales) of utility companies electric power distributors, Program PEE, bank loans to ESCOs (BNDES, Caixa Economica Federal), and consumers own capital. As noted, most of the funds come from the public sector via compulsory market mechanisms (minimum percentage of investment). There is a market for EE, yet underutilized, coming from the Clean Development Mechanism (CDM).

4.1 Global Reversion Reserve - RGR

The Global Reversion Reserve (RGR) was established in 1957, corresponding to a percentage of assets of concessionaires of public service of electricity, collected for administration by Eletrobras, for system expansion and improvement of service quality. In 1993, through Law No. 8631, was expanded in order to finance EE projects and rural electrification.

In 2002, Law No. 10,438 RGR is intended for use in the program for universal access to electric energy (Luz para Todos) and for developing projects with alternative energy sources (Wind, Solar and Biomass) and Small Hydropower Plants (PCHs), and for thermoelectric plants and thermonuclear plants.

In 2003, Law No. 10,762 allows the use of RGR in the form of economic subsidy in implementing the program for universal access to electric energy.

In 2004, Law No. 10,848, RGR is intended for use in the program for universal access to electric energy for developing projects with alternative energy sources (Wind, Solar and Biomass) and Small Hydropower Plants (PCHs) as well as thermoelectric plants and thermonuclear power generation.

In 2010, Provisional Measure 517 extended the term of RGR up to the end of 2035.

The average annual revenue of RGR in recent years is in the range of R $ 1,000.00 million. The RGR is an important duty which is funding the expansion of the electricity sector since the 70s, when it became managed by Eletrobras.

However, with the publication of Law No. 12,783, of January 11, 2013 (Conversion of Provisional Measure No. 579 of 2012) which deals with the extension of concessions of electricity generation, in order to obtain a reduction in electricity rates through this extension and reducing or eliminating some tariff charges levied on electricity bills, it created great uncertainty about the future of RGR resources for EE.

This law determines that:

Article 21. Are not bound, as of January 1, 2013, the payment of annual dues of RGR:

I - the concessionaires and licensees of public service of electricity distribution;

II - the public utilities of electricity transmission auctioned from September 12, 2012, and

III - the public utilities of transmission of and electric power generation extended or tendered under this Act.

Article 22. The RGR funds can be transferred to the CDE.

Article 23. Law No 10,438, dated April 26, 2002, becomes effective with the following changes:

I - promoting the universalization of electricity service throughout the national territory; ...

VI - to promote the competitiveness of energy produced from the following sources: wind power, thermo solar, photovoltaic, small hydroelectric plants, biomass, other renewable and natural gas.

This leaves uncertain the future of these resources until authorities of the Federal Government publish new guidelines.

4.2 Law No. 9991 of 24/07/2000.

This Law determines the application of amounts of 0.5% up to 2015 and 0.25% as of 2016, of net operating income - net sales - of the electricity distribution utilities in EE projects aimed at final use. This law also establishes the minimum percentage for investment in research and development of the electric sector (including EE) by the utilities generation, transmission and distribution. These funds are invested in programs directly by the companies themselves or through the National Fund for Scientific and Technological Development - FNDCT, plus the portion allocated to MME studies and research for planning the expansion of energy system, as well as studies of inventory and feasibility necessary for exploitation of hydroelectric potential.

- The aim is to demonstrate the importance and viability of actions to combat the waste of electricity, and improve EE of equipment, processes and end uses of energy, stimulating the transformation of the electricity market, and the development of new technologies and creating habits of rational use of electricity.

- On January 20, 2010, Law No. 12,212 was amended, stating that up to December 31, 2015, the minimum percentage is 0.50% for both research and development and for EE programs in supply and end-use energy.

- Law No. 12.212/2010 also determined that the concessionaires and licensees of distribution of electricity should apply at least 60% (sixty percent) of its resources in efficiency programs for consumer units benefited by the Social Tariff.

4.3 Sectorial Funds

- On July 31, 1969, by Decree-Law no. “719, was created the National Fund for Scientific and Technological Development - FNDCT to give financial support to priority programs and projects for scientific and technological development. Its constitution was designed in a flexible manner and can receive budget funds, from tax incentives, loans from financial institutions or other entities, contributions and donations from public and private entities and funds from other sources. The Financier of Studies and Projects - FINEP, established in 1967, is the Executive Secretary of FNDCT.

- Other sectorial funds have been created since 1998, with the purpose of funding research projects, development and innovation in Brazil and to contribute to national growth in science, technology and innovation.

- Some of these are relevant Funds for the Energy Sector. Among the existing Sectorial Funds, those most directly related to the topic are the Energy Sector Fund (CT-Energ), the Water Resources Fund (CT Hidro), the Mineral Fund (Mineral-CT) and the Petroleum and Natural Gas Fund (Petro CT). This mechanism aims to attend to the development of their respective industries, and can be used to promote the development of technologies to improve EE, such as, for example, the CT-Energ.

- Created by Law No. 9991 of June 24, 2000 and regulated by Decree 3867 of July 16, 2001, the CT-Energ has as its fundamental objective to finance scientific research and technological development in electricity sector as well as projects that seek to increase the efficiency in energy end-use.

4.4 PROESCO

On May 19, 2006, BNDES approved PROESCO; program intended to finance EE projects. The program aims to support the implementation of projects that contribute to energy savings, with action focuses on lighting, motors, process optimization, compressed air, pumping, air-conditioning and ventilation, refrigeration and cooling, steam production and distribution, heating, automation and control, power distribution and energy management. The funding also includes end users of energy, interested in financing the purchase of efficient equipment. Performed in the same patterns and in line with environmental protection projects, PROESCO opens a credit line of R $ 100 million to fund up to 80% of the total value of the projects. PROESCO funds: studies and projects, works and installations, machinery and equipment, specialized technical services, information systems, monitoring, controlling and surveillance.

It is worth mentioning lines of credit that can be offered to consumers of energy such as the BNDES FINAME, and BNDES FINEM. The BNDES FINAME is a line of credit for financing production and acquisition of new machinery and equipment made in Brazil. The BNDES FINEM is a line of credit for financing the projects worth more than $ 10 million, held by BNDES directly or through Accredited Financial Institutions002E

4.4.1 ESCOs market

The Brazilian market for ESCOs has evolved very slowly mainly due to some market failure that are summarized below. The market is organized around ABESCO - Enterprises Association of Energy Conservation Services was founded in 1997 and aims to officially represent the energy efficiency companies segment, encouraging and promoting activities and projects for the growth of the energy market. ABESCO currently has 84 members within a market estimated at about 100 companies. Most ESCOs are businesses created from owners' capital and are relatively young, up to 10 years of foundation. Most of these companies operate nationwide

Most ESCOs are dedicated to projects in the following areas:

Electricity
Rates Revision
Thermal Energy
Solar Energy
Wind Energy
Water and effluent treatment

Most of these companies are dedicated to EE projects in electricity as the main area. Within this field we can relate the following activities:

Lighting
Compressed air
Diagnostics
Demand Management
Power Factor Correction
Tariff Review
Substitution of Equipment
Demand Control
Motors and drive systems
Sectoral Measurements by type of process
Correction of electrical installations
Power Quality
Replacing equipment

The major problems faced by ESCOs in the Brazilian market are lack of funding, mostly related to the lack of performance contract, and the ignorance and / or entrepreneurial demotivation regarding EE.

Most customers of ESCOs belong to the industrial or service sectors, and there is also a significant market share corresponding to the commercial sector. Very few ESCOs operate or have customers in the areas of oil and gas.

In Brazil there are virtually no ESCOs working with strict or "pure" concept of Performance Contract, ie, that in which ESCO offers customers a full energy efficiency service, which includes the financial resources needed to implement the technology solution verified and remunerates along time depending on the results achieved. Abroad this type of solution is more common and ESCO receives part of the total energy saved through M & V methodology and under conditions stated in the contract, without any initial disbursement client. There are often partnerships between investors and ESCOs in "Pure" Performance Contracts. Abroad the great bulk of ESCOs works are linked to the public sector.

In Brazil, ESCOs work with their own resources or clients resources. There is a funding source from BNDES - Proesco, which was created in order to encourage energy efficiency projects performed by ESCOs. However, the conditions, primarily demand for guarantees, and bureaucracy inherent to the process, represent barriers to operations. Another point that inhibits the action of ESCOs in Brazil is the fact that they have immense difficulties to work in the public sector through contract performance, since in the budget of public institutions, energy expenditure is linked to current expenditures, while contracting ESCOs (or contracting in general), as well as deployments of technology solutions are linked to investment. Thus, the reduction of energy costs cannot be used to pay for the investments made according to a cash flow project. Some PPP models have been implemented as a means to minimize barriers within the public sector, but without a standard to be followed. Finally, the PEE of ANEEL also has no effective mechanism to support ESCOs, although they participate in the program.

In this context, the aspects listed above constitute the main constraints to ESCO service in Brazil.

4.5 National Fund on Climate Change - FUNDO CLIMA

The National Fund on Climate Change, created through Law 12.114/2009, aims to provide the financial resources to implement the Policy and Plan on Climate Change. This Fund provides that a portion of the funds from exploration and production of oil should be used in order to avoid or minimize environmental damage caused by these activities, especially those associated with the use of this natural resource as an energy source that contributes to the generation of greenhouse gases and consequent global warming.

This phenomenon has on burning fossil fuels the main source of global emissions of greenhouse gases. Although Brazil presents a differentiated scenario, with emissions from burning fossil fuels contributing with a smaller portion compared with the change in land use and forests, one must recognize its relevance to the total national emissions.

Thus, part of the resources needed for the effective implementation of the Policy and Plan will come from the profits arising from the exploration and production of oil. It is important to emphasize once again the uniqueness of this Brazilian action in an attempt to avoid or minimize climate change.

The funds may be used in different ways: repayable loan granting, through the financial agent, or non-reimbursable projects or studies focusing on mitigation of climate change and adapting to climate change and its effects chosen according to the guidelines issued by the Management Committee of FNMC.

The source of funds will be from different sources: up to 60% of the resources referred to in Part II of § 2 of art. 50 of Law 9478 of August 6, 1997; appropriations contained in Union Annual Budget Law and additional credits; resources form agreements, adjustments, contracts and covenants concluded with entities of the federal, state, district or municipal public administration, donations made by national and international, public or private entities, loans from national and international financial institutions, diverse resources provided by law; reversal of the annual balances not applied; funds from interest rates and amortization of financing.

The Fund aims to support projects or studies and finance projects aimed at climate change mitigation and adaptation to climate change and its effects. It is aimed, preferably to the development of environmental management activities related to the oil production chain.

We highlight the following points of the law that created the National Fund on Climate Change (Law 12.114, December 9, 2009):

Purpose (article 2): "Ensure resources to support projects or studies and finance projects aimed at climate change mitigation and adaptation to climate change and its effects".

Priorities:
Not Reimbursable resources:
• Activities for mitigation and adaptation, especially to meeting the most vulnerable sectors of society.

Reimbursable resources:
• Mitigation actions related primarily to sectoral plans.
• Actions of adaptation that have potential financial returns and public sector investments.

Applications of funds
1. Resources Not Reimbursable Direct operation by MMA
1st Year: application of R$ 30 million
2. Reimbursable Resources Operated via BNDES (contract with MMA)

Budget 2011: R$ 200 million
Additional Resources => contributed annually
2012 => budget: + 360 million
Applications Reimbursable BNDES:
In 2011 => 6 lines of action (Annual Plan Application Resources) subprograms:
1. Modals Transportation Efficient
2. Efficient Machinery and Equipment
3. Renewable Energy
4. Harnessing Energy from Waste
5. Vegetable Charcoal
6. To Combat Desertification

Expected Results:
Have encouraged significant investment for the country to:
1. Achieving the targets of emission reductions of greenhouse gases - set out in the National Policy on Climate Change;
2. Reduce vulnerability to the adverse effects of climate change, and
3. Prepare to compete in an economy of low carbon.

Perspectives:
- The limit for raising the Climate Fund, only because of the special participation, is now approximately R$ 750 million per year.

4.5.1 Fundo Clima Management

The Executive Secretary of the Climate Fund is a management linked to the Department of Climate Change - DEMC of the Secretariat of Climate Change and Environmental Quality - SMCQ, with the assignment to perform the function of administrative and operational support to carry out the instruction, celebration and other procedures that have as their object the execution of projects supported by the Fund.

The Management Climate Fund is organized to meet the three priority themes, namely: the feasibility of contracting projects, the necessary monitoring of the implementation of the projects and their associated monitoring results and support the activities of the Steering Committee.

The Fund is managed by a Steering Committee chaired by the Executive Secretary of the MMA. The Committee must approve the proposed budget and Annual Plan for Resource Investment of the Fund, the PAAR. At the end of each year, must report on the application of funds. The joint committee also has the authority to establish policies and investment priorities for periods of two years. Finally, the Steering Committee has the task of authorizing the financing of projects and to recommend the contracting of studies.

5. EE AND CLIMATE CHANGE INTEGRATION, COOPERATION AND JOINT ACTIONS

Despite all the indications and mutual references written into their legislation, plans and programs of the sectors of EE and climate change, there is no formal joint action of the two sectors formalized between the sectors.

However, several initiatives have occurred in an isolated manner. Such initiatives not only really show the affinity between the two sectors, but also indicate a great potential for mutual cooperation. They also show that the sectors think globally, and always with a mutual concern.

It is worth mentioning here some of these actions.

5.1 Labeling sector

PBE in partnership with PROCEL, develops labeling programs in the area of renewable energy with the aim of encouraging the use of these sources. Labeling a product of this area not only indicates its efficiency but also shows to the market of this type of product a clear indication that it is a reliable product. This has prevented low quality products to the consumer to pass a negative image of this technology.

A case that has shown excellent results is the sector of solar water heating. After the beginning of labeling occurred a total transformation of the market with market exit of companies that were not complying with new standards and have been clearly put away by consumers and with remarkable efficiency gains among manufacturers remaining in the market.

Two other examples are the labeling of photovoltaic systems and small wind turbines. Both products were not labeled classically, but considering that the market for these products was in serious danger due to the presence of very low quality products, it was decided for its labeling with very encouraging results. These

actions meet one of the goals of the National Plan on Climate Change which is: "Maintain the high share of renewable energy in the electricity matrix, preserving the outstanding position Brazil has always occupied in the international scene".

Another example of global vision, demonstrating environmental concern is the labeling of washing machines. The label rates this product according to 4 criteria: energy consumption, washing performance, efficiency centrifugation (extraction of water), and water consumption. This allows the consumer to consider in his decision of purchase, beyond EE, a factor of great importance in an environmental standpoint that is water consumption.

To get PROCEL Seal the washing machine must be rated A in the first 3 requirements and have low water consumption.

The most significant action PROCEL focused on environment is the labeling of refrigerators. PROCEL imposed to refrigerators, as a condition for receiving the Seal, that they should employ in their expanded foam used in thermal insulation, non-aggressive gases to the environment, i.e., they do not attack the ozone layer or contribute to warming global of the planet.

Below we reproduce the criteria contained in the document Criteria for Granting the PROCEL Seal for Energy Saving to refrigerators and similar products - (supplementary document to the Rules for Granting the PROCEL Seal for Energy Saving) - 25/08/2010:

"The manufacturer / importer who wish to make use of PROCEL Seal on model of its manufacturing line (or on an imported model) shall demonstrate, through tests prescribed in" RAC Refrigerators and Similar ", in force, that the model meets:

- Electrical safety requirements;
- At the minimal of efficiency level corresponding to the range classification "A" of the respective ENCE, and
- If the product use expanded foam to provide its thermal insulation, the expander gas used must meet

the following characteristics:

- present-ODP (Ozone Depletion Potential) equal to 0.
- present-GWP (Global Warming Potential) equal to or less than 300.

Note: The values of ODP and GWP will be effective from 01/01/2012. "

To establish these parameters of ODP and GWP was performed a joint action of PROCEL with the Coordination of Protection of the Ozone Layer of the Secretariat of Environmental Quality and Climate Change of MMA. This action allowed PROCEL to be properly advised and guided in determining the appropriate parameters and was able to dialogue with manufacturers with complete mastery of the topic.

5.2 PEE programs

Another action of EE sector with great concern for their environmental impacts was the various programs implemented under the PEE by utilities for the exchange of refrigerators of low-income consumers. It was established as a condition the reverse logistic, in which to carry out these programs the old refrigerators received in exchange for new ones are dismantled by specialized companies seeking the perfect collection of compressors gases and insulating foams so that there is no leakage to the environment. Compressor oils should also be carefully collected. Such determination prevented the improper disposal of polluting materials of thousands of dismantled refrigerators. According to ANEEL from 2008 to 2012 have been exchanged 630,000 refrigerators. [41]

5.3 Buildings Labeling

An important action of EE sector also establishing environmental criteria is the labeling of buildings. Besides all the classic considerations relating to EE, the Technical Regulations on Quality Level for EE of PBE - Edifica also adopts criteria for use of renewable energies, such as use of solar water heating, power generation by wind systems and/or photovoltaic systems, natural ventilation and lighting. It also adopts criteria for environmental preservation as the rational use of water, individual metering of water consumption, rainwater harvesting and greywater reuse.

5.4 Transport

The transport sector is the 2nd largest energy consumer in the country with about 30% of the total final consumption in 2011. Consumption is basically concentrated in petroleum and ethanol. These two sources together account for 98.4% of total energy consumption in the transportation sector.

The diesel stands out as the largest energy consumption reaching 48.6% of total consumption in 2011 (35,929 toe). Of this total, 96.3% is allocated to road transport.

We list a table with a summary of the major energy consumption in the transportation sector in 2011:

41. Source: www.aneel.gov.br

Table 5.4
Consumption of main sources in the transport sector in 2011 (10^3 toe) [41]

Source (10^3 toe)	TOTAL		Highways		Railroads		Airways		Waterways	
	%	10^3 toe	%	10^3 toe	%	10^3 toe	%	10^3 toe	%	10^3 toe
Diesel	48.6	35,929	50.9	34,588	87.3	1,002	-	-	25.6	339
Gasoline automiles	28.2	20,838	30.7	20,838	-	-	-	-	-	-
Gasoline aerial	0.07	54	-	-	-	-	1.5	54	-	-
Electricity	0.002	146	-	-	12.7	146	-	-	-	-
Ethanol	14.5	10,735	15.8	10.734	-	-	-	-	-	-
Kerosene	4.8	3,569	-	-	-	-	98.5	3,569	-	-
Natural gas	2.34	1,735	2.6	1,735	-	-	-	-	-	-
Fuel oil	1.3	983	-	-	-	-	-	-	74.4	983
Others	0.02	-	-	-	-	-	-	-	-	-
Total	100	73,989	100	67,896	100	1,148	100	3,623	100	1,323

41. Source: National Energetic Balance 2011- BEN, EPE

The transportation sector is divided in cargo transportation and passenger transportation. Each one having specific needs and critical issues that directly affect its energy efficiency.

The passenger transportation sector is characterized by a extremely low efficiency. In urban areas, despite the large urban concentrations, there are few mass transportation systems in operation, with a predominance of buses and minibuses.

In the sector of intercity transport of medium and long distances also dominates the road transportation followed by air transportation. The first is saturated and dependent on a road network saturated and often in precarious conditions. The second finds also serious infrastructure problems that cannot meet a demand with high growth rates.

This scenario can stimulate the emergence of new opportunities. Projects are under studies for subways and rapid transit corridors in several cities. Are also under study, or in bidding phase, high-speed rail connections between major cities. However, many of these initiatives become frustrated due to uncertainties regarding the demand associated with a higher level of prices and the lack of regulatory framework for long-term return enterprises.

In the cargo transport sector the country has a matrix with a strong predominance of road transport accounting for about 60% of the total.[41]

Few initiatives for EE are really concrete in the transportation sector. As we saw earlier the CONPET keeps some assistance programs for truckers and fleets and also programs in education. As we will see, the program with the greatest impact is the labeling of vehicles, but that still does not cover all vehicles, especially cargo.

According to PNEf, efficiency from road transport compared to other transport systems is very low. The fuel consumption for transporting 1,000 tons of cargo per km is 5 liters in waterways, railways in 10 liters, 96 liters and on highways. And compared to U.S. indexes these figures would be even lower in the event reaching the on road transportation 15 liters.

Furthermore, the average age of the fleet is very high, with 44% of the trucks with more than 20 years and 20% over 30 years of use.

41. Fonte: PNEf

Also according to the PNEf, to achieve satisfactory levels of EE the transport sector needs to face the following challenges:

- Overcoming limitations of transport infrastructure;
- Expand the geographic coverage of transport infrastructure;
- Ensure that the transport infrastructure is inducing factor and catalyst for development;
- Reduce the predominance of road transport in the transport matrix, through the intensive and adequate use of the modalities railway and waterway, taking advantage of its greater productivity and energy/environmental efficiency.

This of course will require a multidisciplinary effort involving various ministries and government agencies.

The PNEf, proposes diverse lines of action to achieve these goals. The most relevant are:

- Support the National Transport Policy, based on the National Plan for Logistics and Transportation - PNLT, which proposes to change the matrix of cargo transport, with priority for rail and water transport;
- Supporting the National Policy for Transportation and activities for the implementation and retrofitting projects for mass transportation in major cities, renewing the fleet of trucks and buses vehicle inspection programs, improvement of fuel quality, research on biofuels of 2nd and 3rd generations , driver training for economical driving;
- Broaden the scope of the vehicles labeling program for the greatest number of types and models of light vehicles, developing methodologies for the labeling of heavy vehicles;
- Promoting technological development to improve vehicle engines, including options for hybrid and electric engines;
- Reduction of taxes on vehicles more energy efficient and / or with lower emission levels of pollutants;
- Promoting EE through policies encouraging waterway, rail and pipelines transport and promote actions for EE in these sectors;
- Promoting the use of electric vehicles, with tax cuts and subsidies, and also evaluate the issue concerning the regulation in the electric sector;
- Encourage drivers education aimed at economic driving through driving techniques aimed at reducing fuel consumption.

5.4.1 Vehicles Labeling

In the field of vehicular labeling a technical approximation is being discussed between INMETRO and PROCONVE. PROCONVE (cars) and PROMOT (motorcycles), Programs of Control of Air Pollution by Motor Vehicles was created in 1986 by the National Environment Council - CONAMA. Its objectives are to reduce and control air pollution by mobile sources (motor vehicles), setting time limits, maximum emission limits and establishing technological requirements for domestic and imported automobiles. Compliance with these requirements is assessed through standardized testing in dynamometer and with “reference fuels”.

This rapprochement between the two programs aims to unify efforts. This unification considers that the test methodologies are very similar and use the same laboratory for their tests. As result will be initially informed a unique value of CO_2 emissions and in the next step all the information about the tests of PROCONVE will be indicated on the label.

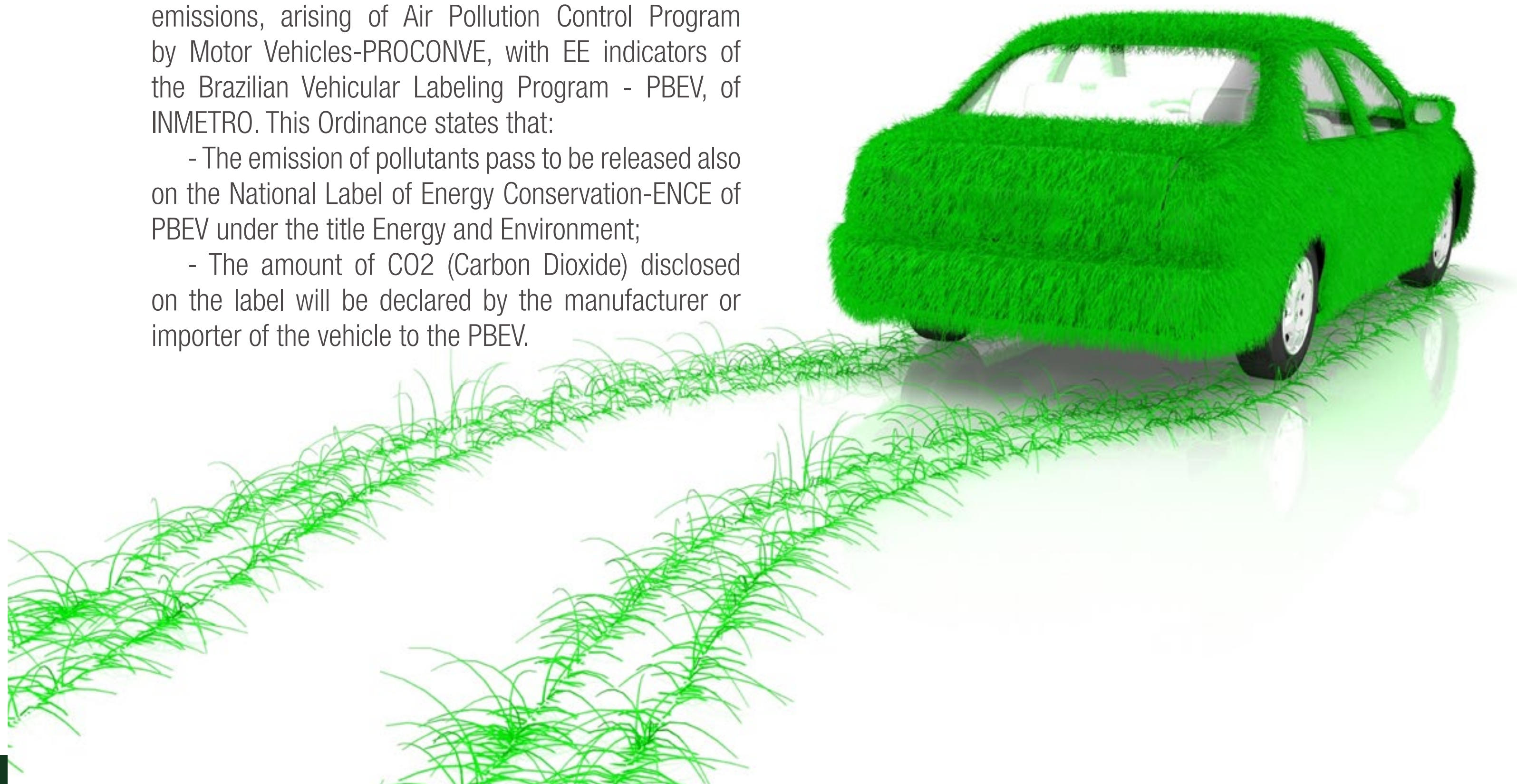
For this purpose was published Joint Ordinance IBAMA / INMETRO No. 2, December 16, 2010, establishing the unique classification resulting from the union of environmental indicators that compose the Green Note of the Brazilian Institute of Environment and Renewable Natural Resources-IBAMA , methodology for classification of vehicles in relation to levels of emissions, arising of Air Pollution Control Program by Motor Vehicles-PROCONVE, with EE indicators of the Brazilian Vehicular Labeling Program - PBEV, of INMETRO. This Ordinance states that:

- The emission of pollutants pass to be released also on the National Label of Energy Conservation-ENCE of PBEV under the title Energy and Environment;

- The amount of CO_2 (Carbon Dioxide) disclosed on the label will be declared by the manufacturer or importer of the vehicle to the PBEV.

5.4.2 Future trends in transports emissions

The future level of carbon dioxide emissions in the transportation sector will largely depend of whether users will continue to increase the weight and power of the vehicles they drive, as well as the distances they travel. Work is required between the government together with automotive companies to develop a new generation of vehicles that are more efficient than the current, without any loss of security, comfort, and cost. Furthermore, it is important to develop engines and advanced fuels, cleaner and more efficient, which can be used both in trucks and in the utilities, which are becoming increasingly popular.



5.5 Solar Strategic Plan

The Solar Strategic Plan is an initiative of the Solar Energy Technical Group, coordinated by MMA and with the participation of various entities. The plan establishes priority lines of action to achieve a goal of 15 million m2 of collectors for solar heating systems (SHS) installed in the country by 2015.

This Plan meets one of the objectives of the PNMC that is "Maintain the high share of renewable energy in the electricity matrix, preserving the outstanding position Brazil has always occupied in the international scene". Its general purpose is to organize the actions of different entities, aiming at increasing the participation of solar thermal energy source. It was divided into five lines of action:

1 - Public Policy;

1 a) Program My House My Life (Minha Casa Minha Vida) : for the construction of residences for low-income families, in this case the Plan seeks to insert the SHS program. For single-family houses SHS will be mandatory, and in the others constructions, viability should be analyzed. It is estimated up to 260 thousand homes equipped with SHS.

1 b) promotion of legal instruments (Solar Cities). Aims to work with local governments to create laws favoring the installation of SHS, disseminate successful cases, and include the SHS in public works.

1 c) propose new lines of funding and financing for residential, commercial and small businesses, including market mechanisms aimed at reducing greenhouse gases.

2 - Training;

2 a) Awareness rising of decision-makers, such as: financial agents, architects and designers, managers and technicians of the construction industry, to disseminate SHS sustainably.

2 b) Green Jobs: intends to develop a training program for formation of skilled manpower.

2 c) Training of end users: so that they know the operation and maintenance of SHS. It will be produced educational material to disseminate information on the subject.

2 d) Training SHS: aimed at educating future architects and engineers through the inclusion of the subject in their respective courses.

2 e) Educational materials for capacity building and training programs will be developed, including standards and legislation, best practice design and installation of SHS, and also considering regional characteristics.

3 - Innovation and technological development;

3 a) Life Cycle SHS: The aim is to create a database on the main materials, costs, performance and manufacturing process, to make the analysis of its life cycle.

3 b) Creation of industrial poles: for the production of materials and equipment.

3 c) New materials, technologies and processes for production of SHS: to promote the design and manufacture of new solar collectors for different applications with compatible costs.

3 d) SHS in the industrial and commercial uses: there will be a study of industrial processes for low and medium temperatures, to encourage the use of solar technology.

4 - Management of information and marketing;

4 a) Information Campaign and Marketing: Plan will create the National Marketing on the use of solar thermal energy in order to adopt an adequate language to meet the whole society.

4 b) Site for Knowledge and Technology Management: to manage information through communication tools and collaborative work.

5 - Creation of the Brazilian Platform for Solar Thermal Energy: This network aims to follow up the Plan and its results, proposing corrective actions when necessary.

6. CONCLUDING REMARKS

Brazil is currently facing a scenario extremely favorable for strengthening the EE market with great potential to be explored. But in practice, this market and this potential does not seem to be materializing. Considering the achievements and the achievements of the national EE programs, the existence of a policy and the implementation of PNEf will provide advances in the mobilization and in the actions of several agents to overcome the existing barriers. The detailing of the National Policy of EE and the planning of the actions and of the operational structure will consolidate the policy established by PNEf.

To increase EE programs results depends on the consolidation of operational strategies that are producing good results and the creation of new strategies so that these programs can be considered as alternatives to options for expanding the supply of energy in planning expansion of the energy sector.

The design of EE projects as options to expand the supply of energy will only be feasible with the adoption of reliable procedures for monitoring and verification (M & V) of the results of these projects. As a result of a number of EE strategies, a virtual power plant can replace the implementation of a generation enterprise.

So the major challenge of the moment is to make the market and business activities of EE sustainable. This sustainability is an essential condition so that actions of EE may also be considered in the planning of other sectors such as Climate Change.

From the standpoint of actions, joint or integrated with the sector of Climate Change some points of EE policies should be approached with special attention, as discussed below.

6.1 Improve the legal framework in order to stimulate the market of EE

Brazil has currently a vast legal and regulatory framework, whose scope covers the PBE, PROCEL, CONPET, PEE, and EE Act, among others. New operational strategies will require the expansion of this legal basis. New operational strategies will require the expansion of this legal basis. As examples, we can mention: changes in tariff regulation of the distribution utilities of electricity and gas, allowing making profits with EE programs, and regular and more intensive use of tax incentives for more efficient equipments and processes.

6.2 To institutionalize and to intensify the adoption of criteria of environmental protection for PROCEL Seal and CONPET Seal

Considering the good results presented by the actions already carried out under the PROCEL Seal, as seen previously, it is clear that these actions must take an institutional character with a formal participation of MMA's Climate Change Sector in the Seal Program. There are many opportunities to include not only new criteria for the equipment already encompassed as well as for new equipment. We may mention as examples, among other actions:

- Limit mercury content in CFLs and sodium vapor lamps, which are already part of the Seal and all other discharge lamps that might receive the Seal.
- Impose limits for ODP and GWP, also for refrigerant gases in refrigerators, freezers and air conditioners and insulating materials of thermal reservoirs of solar water heating.
- Require manufacturers to have programs of reverse logistics for all products.

Likewise Seal CONPET might adopt similar measures for products of its coverage area, especially with regard to the labeling of vehicles.

6.3 Facilitate accessing permanent funding sources

After the publication of Law No. 12,783, of January 11, 2013 (Conversion of Provisional Measure No. 579 of 2012), which created great uncertainty about the future of RGR resources for EE, it is very important to create new financing sources for EE or to redirect some existing sources. As PROCEL and CONPET are coordinated and supported by Eletrobras and Petrobras, this law may also affect those programs. Considering the Federal Government policy of reducing energy costs and also the fact that those companies are now aimed to provide profits to its private shareholders, they are under threat of suffering cuts to their budgets and their staff.

On the other hand there is a market worldwide, yet underutilized, for EE, coming from CDM. Currently, there are very few projects directly specified as being for EE. This option can be an alternative for financing EE projects. However it is necessary that interested parties can rely on a advisory services so that they can properly fit the project requirements to obtain these funds. Many entrepreneurs, especially the smaller, give up obtaining these resources when faced with these requirements.

It would be important to facilitate access by EE programs to some funds from the environmental sector. This will depend on the nature of the funds and also the rules for resources application.

6.4 Tax breaks and tax reduction Policies

Tax incentives, easy credit, and reducing taxes and fees for the purchase of efficient vehicles and equipment has been another tool utilized in many countries, but still not widely used in Brazil. The government has sporadically employed tax cuts for efficient products as a result of actions to increase sales of industry in time of crisis or in situations of shortage of power supply, as in 2001. These actions are not seen as permanent and institutionalized instruments. This mechanism needs to be further worked together with the various government sectors. It is important that these sectors become aware that these benefits shall revert in gains for society and for the economy, due to increased sales and consequent increases in the number of jobs and tax revenues, and thus not a mere tax waiver applied in times of crisis.

6.5 Industrial Policy

EEE plays an important role in the issue of quality and productivity of industries in general. Energy conservation programs can also substantially improve the competitiveness of energy-intensive industries in the global market. In this case the reduction of energy consumption may generate not only financial gain, but also considerable gains on reducing the environmental impacts of these industries. The inclusion of EE as a basic principle of government industrial policy formulation should be worked out jointly with other government actors.

The Climate Change Sector may eventually contribute to actions in this direction.

6.6 Final Comments

In conclusion, the importance of joining efforts between sectors of EE and Climate Change is clear. The successes of joint actions already performed presented in this report, clearly show the total affinity between the two sectors and the potential gains to be shared by both. It is important to create mechanisms and formal channels for joint action with fixed partners and patterns of work planned together.

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8. ABBREVIATIONS AND ACRONYMS

ABINEE - Brazilian Association of Electrical and Electronics Industry
ADENE - Energy Agency of Portugal
ANEEL - National Agency of Electrical Energy
ANFAVEA – National Association of Motor Vehicles Manufacturers
ANP - National Agency of Petroleum, Natural Gas and Biofuels
BEN - National Energy Balance
BNDES - National Bank for Economic and Social Development
CDE - Energy Development Account
CDM - Clean Development Mechanism
CFC - Chlorofluorocarbons
CFL –Compact fluorescent lamp
CGIEE - Steering Committee of Indicators and Levels of Energy Efficiency
CICE - Internal Commission for Energy Conservation
CIM - Interministerial Committee on Climate Change
CIMGC - Interministerial Commission on Global Climate Change
CMADS - Commission for the Environment and Sustainable Development, at the House of Representatives
CNP - National Petroleum Council
CNPE - National Energy Policy Council
CNPq - National Council for Scientific and Technological Development
CONAMA - National Environment Council
CONPET - National Program for the Rational Use of Oil and Natural Gas
CONPET Seal - CONPET Energy Saving Seal
Coppe - Coordination of Post Graduation Courses of Engineering
CT Hidro - Water Resources Fund
CT-Energ - Energy Sector Fund
DEMC - Department of Climate Change
DEPPT - Department of Policies and Theme Programs
DNDE - Department of Energy Development
EE - Energy Efficiency
Eletrobras – Centrais Elétricas Brasileiras S.A.
Embrapa – Brazilian Company of Agricultural Research
ENCE - National Energy Conservation Label
EPE - Energy Research Company
ESCO - Energy Saving Company
FBMC - Brazilian Forum of Climate Change
FINEP - Financier of Studies and Projects
FNDCT - National Fund for Scientific and Technological Development
FNMC - National Fund on Climate Change
FUNDO CLIMA - National Fund on Climate Change
GEF - Global Environmental Facility
GEx - Executive Group on Climate Change
GWP - Global Warming Potential
HCFCs - Hydro chlorofluorocarbons
IBAMA - Brazilian Institute of Environment and Renewable Natural Resources
IDEC - Brazilian Institute of Consumer Protection
INMETRO - National Institute for Metrology, Standards and Industrial Quality
INPE - National Institute for Space Research
IPCC - Intergovernmental Panel on Climate Change
LOA - Annual Budget Law
M & V - Measurement and Verification
MCTI - Ministry of Science, Technology and Innovation
MDICT - Ministry of Development, Industry and Foreign Trade
MEN - National Energy Matrix
MIC - Ministry of Industry and Trade
Mineral-CT - Mineral Fund
Minha Casa Minha Vida - Program My House My Life
MMA - Ministry of Environment
MME - Ministry of Mines and Energy
ODP - Ozone Depletion Potential
OIA - Accredited Inspection Bodies
PAAR - Application Resources Annual Plan
PAS - Sustainable Amazon Plan
PBE - Brazilian Labeling Program
PBE Edifica - National Labeling Program for Buildings
PBEV - Brazilian Vehicular Labeling Program
PBMC - Brazilian Panel on Climate Change
PDE - Ten-Year Plan for Energy Expansion
PDE 2007/2016 - Decennial Plan of Energy Expansion
PDEE - Ten Year Plan for Electricity
PEE - Energy Efficiency Program
Petro CT - Petroleum and Natural Gas Fund
Petrobrás - Petróleo Brasileiro S.A.
Plano ABC - Plan of Low Carbon Agriculture
PME - Energy Mobilization Program
PNE 2030 - National Energy Plan 2030
PNEf - National Plan for Energy Efficiency
PNLT - National Plan for Logistics and Transportation
PNMC - National Plan on Climate Change
PPA 2012-2015 - Multiyear Plan
PPCDAM - Plan for Prevention and Control of Deforestation in the Legal Amazon
PPCerrado - Action Plan for Prevention and Control of Deforestation and Burning of the Cerrado
PPCS - National Plan for Sustainable Production and Consumption
PPP - Private Public Partnership
PROALCOOL - National Alcohol Program
PROCEL - National Program for Electrical Energy Conservation
PROCEL Edifica (Buildings Program)
PROCEL Seal - PROCEL Energy Saving Seal
PROCONVE - Program of Air Pollution Control by Motor Vehicles
ProCopa Tourism - BNDES Program of Hotel Energy Efficiency for the World Cup 2014
ProCopa Tourism Sustainable Hotel - BNDES Program of Tourism for the World Cup 2014
PROMOT - Programs of Control of Air Pollution by Motor Vehicles (motorcycles)
R & D - Research and Development
R3E - Network for Energy Efficiency in Buildings
RAC - Regulation of Conformity Assessment
REDD - Reducing Emissions from Deforestation and Forest Degradation
Rede CLIMA - Brazilian Network for Climate Change Research
RGR - Global Reversion Reserve
RTQ - Technical Regulation on Quality Level for Energy Efficiency
SEPED - Secretariat of Policies and of Research and Development Programs
SHS - Solar Heating Systems
SIN - National Interconnected System
SMCQ - Secretariat of Climate Change and Environmental Quality
SPDE - Energy Planning and Development Secretary
UNFCCC - United Nations Framework Convention on Climate Change

CAPÍTULO 3

ENERGIA EÓLICA NA EUROPA - BARREIRAS E BOAS PRÁTICAS PARA O DESENVOLVIMENTO SUSTENTÁVEL - Juan Ramón Martínez

EUROPEAN WIND POWER - BARRIERS & BEST PRACTICES FOR ITS SUSTAINABLE DEVELOPMENT - Juan Ramón Martínez

ABOUT IDAE

The Institute for Diversification and Saving of Energy (IDAE in its Spanish acronym) is a public business entity reporting to the Spanish Ministry of Industry, Energy and Tourism, through the State Secretariat for Energy.

It promotes energy efficiency and the rational use of energy in Spain, as well as the diversification of energy sources and the increasing use of renewable energies. It fosters these activities by carrying out technical consultancy missions, by financing and implementing innovative and replicable projects using low-carbon technologies, by developing specific renewable energy and energy efficiency programs and plans, etc. It also has a strong focus on international activities.

IDAE was born in 1974 as an Energy Study Centre and took its present name in 1984.

www.idae.es

PREFACE

The Sector Dialogues are a new form of cooperation dynamics between the European Union (EU) and emerging countries. The EU-Brazil Sector Dialogues Support Facility has been created with the objective, among others, of fostering greater exchanges of technical know-how between Brazil and the European Union.

On the other hand, the Brazilian Ministry of Environment in coordination with the Brazilian Ministry of Mines and Energy, as part of its lines of action, develops policy and planning and implements activities towards the achievement of a national low carbon energy mix.

Within the framework of the EU-Brazil Sector Dialogues the Brazilian Ministry of Environment has commissioned this report.

The main objective of the report is to summarise the most important barriers large-scale deployment of wind power has faced and is currently facing in Europe and the best practices or lessons learned in attempting to partially or totally overcome those barriers. The methodology employed is the review of a vast amount of existing literature, its analysis, synthesis, combination and, in some cases, the literal extraction of carefully selected segments of material. The information has been modified, organised and linked together following the author's personal criteria and experience, seeking to provide, by educational and clear lines of reasoning, general grounds on which potentially draw the basis for future good practices on wind energy deployment to be implemented for a different energy context[41]. The entire literature reviewed is listed in the section "References".

This work starts by an overview or description of some noteworthy aspects of the European wind energy sector that lay the foundations for relevant subjects subsequently examined in the report. Then, barriers and best practices are explored, followed by a glance over the European renewable energy and, in particular wind energy objectives up to 2020. Finally, practices from some EU Member States have been selected with the objective of constituting a source of instructive, diverse and, generally, exemplary actions as far as successful achievement of wind energy deployment is concerned[42].

Hopefully, this report will effectively deliver some of the European experiences and knowledge as regards the development of its wind energy sector. This know-how will have to be placed under the particular Brazilian context and its implementation adapted to its specific barriers and needs in order to produce the expected results.

41. Other than European
42. The country profiles have been extracted from an outstanding publication produced by IRENA in collaboration with the Global Wind Energy Council (GWEC) (see reference [39]).

EXECUTIVE SUMMARY

By the end of 2012 the cumulative global installed capacity of wind energy added up to 282 GW. The figure below shows the cumulative worldwide installed wind power from 1996 to 2012.

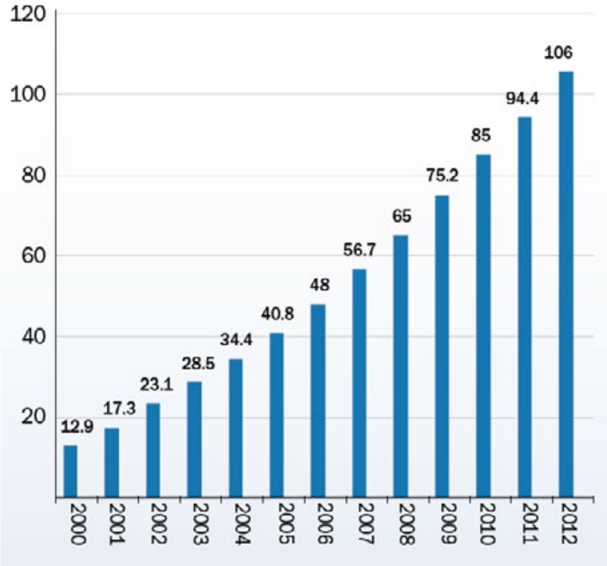
Global cumulative installed wind capacity 1996-2012 (MW)

Source: GWEC, 2013

China, USA, Germany and India accounted for almost 70% of the global wind market in 2012. European wind power represented more than 28% of the overall installed capacity that year.

As far as Europe is concerned, annual installations of wind power have increased steadily over the last 12 years, from 3.2 GW in 2000 to 11.9 GW in 2012, a compound annual growth rate of over 11.6%. A total of 106 GW is now installed in the European Union (see figure below). Germany remains the EU country with the largest installed capacity followed by Spain, the UK and Italy. The wind power capacity installed by the end of 2012 would, in a normal wind year, produce 231 TWh of electricity, enough to cover 7% of the EU's electricity consumption. Denmark remains the country with the highest penetration of wind power in electricity consumption (almost 27.1%), followed by Portugal (16.8%), Spain (16.3%), Ireland (12.7%) and Germany (10.8%).

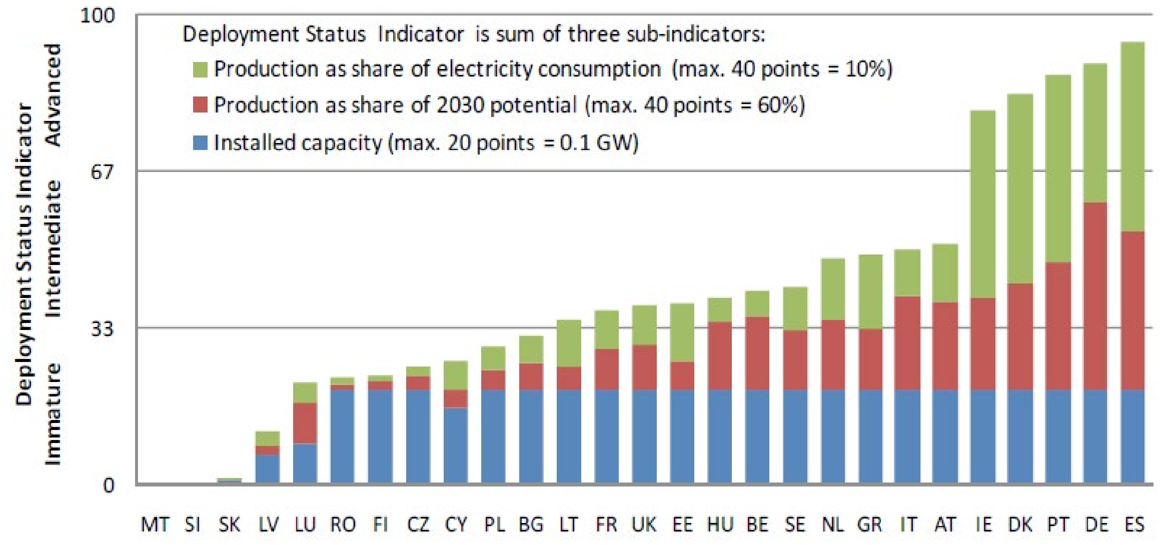
Cumulative wind capacity in the EU 2000-2012 (GW)



Source: EWEA, 2013

16 out of 27 European Member States show a medium or high degree of maturity of their national electricity markets concerning market development for wind energy; high market maturity being characterised by a high number of actors involved, high level of achievement of national wind energy potential, high share of wind energy into the electricity mix and high absolute wind power installed capacity. The figure below shows the aggregation of these features quantifying the overall result (Spain, Germany, Portugal, Denmark and Ireland markets are ranked, respectively, in the top positions):

Deployment status indicator for wind onshore - 2010



Source: RE-Shaping project. Mario Ragwitz, et al., 2012

However, in order to continue increasing wind energy penetration in the EU, overcoming the barriers to its deployment is of foremost importance:

There are some technical and technological improvements of wind power plants that would help (a) reduce the cost of energy (COE) from wind power; (b) achieve the 2020 EU objectives; (c) increase wind power competitiveness against conventional electricity production; (d) improve its efficiency of energy capture, its reliability, its integration into the grid and its adaptation to new harsh environments (e.g., offshore).

Some of the immediate needs so as to achieve the above mentioned goals include the development of large scale turbines (10-20 MW) intended for offshore applications; the improvement of wind turbine components' reliability through the use of new materials and designs; decreasing the cost of turbine parts; implementing advanced rotor designs and control and monitoring systems; applying further automation and optimisation of manufacturing processes; developing innovative logistics for offshore wind energy, including transport and construction techniques, in particular in remote, weather-hostile sites; finding replicable and standardised substructures for large-scale offshore turbines such as tripods, quadropods, jackets and gravity-based structures; increasing the contribution of wind turbines to grid stability as far as grid codes' compliance is concerned; etc.

The latter is one of the mainstays on which large-scale integration of wind power in the electricity grid relies upon, and it gains all the more importance as wind energy and variable energy sources penetration levels exceed 20-25% share of the mix. Therefore, apart from the full compliance of the grid's technical requirements for power plant operation, other important areas whose development and optimisation would enable successful wind power integration involve (a) short-term balancing by TSOs, among other things by improving wind forecasting methods, applying demand-side measures and developing flexible energy storage solutions, such as pumped hydropower; (b) reinforcing, technological upgrading and extending national network infrastructures and international interconnections with neighbouring countries; (c) and defining the necessary power market rules paving the way for intra-day markets to flourish.

Other non-technical barriers to wind energy deployment stem from the administrative and grid connection processes. The EU average administrative lead time for an onshore wind power project is 42 months (18 months for offshore wind); while the grid connection lead time of an onshore project is 25.8 months (14 months for offshore). The combination of these two lead times account for the overall lengthy process of obtaining a grid access and building permit for a wind farm in the EU, approaching 55 months for an onshore project and 32 months for offshore wind power plants. This long delay entails high administrative costs; temporarily blocks and, on occasions definitely stops projects and; as a consequence greatly detracts potential wind energy investors. This barrier only adds to others, such as the frequent high uncertainty associated with wind energy ventures rooted in the incorrect internalisation of the external benefits returned by this energy source; and the instability, inefficiency and lack of effectiveness of the public support mechanism(s) employed.

Finally, as with other industrial activities the construction, operation and dismantling of wind power technologies can potentially have damaging consequences on the environment and on human activities and well-being. As for the environmental impacts, negative interaction with birds, bats and marine mammals are those giving rise to higher concerns. On the other hand, net lifecycle GHG emissions, collateral GHG emissions from conventional power plants and climate change interplay effects have been proved or considered by relevant stakeholders to be insignificant or partly negligible when compared to fossil fuel generation displacement by wind power penetration. Effects on human activities and well-being involve land and marine usage; visual impacts; turbines noise, flicker, health and safety risks; and property value impacts. However, despite these possible impacts described above, surveys of public attitudes across Europe and in specific countries generally show consistent and strong support for wind power.

Next, there are a number of best practices applied in the EU aimed at overcoming the barriers to wind energy deployment examined in the previous paragraphs:

The technological component of wind farms is being tackled by the European RD&D structure whose main engine is the European Wind Initiative (EWI). The EWI was launched in June 2010, and is composed of EU institutions, Member States, the EERA (association whose members are European leading research institutes and organisations) and the wind industry private sector. Its budget for the 2010-2020 period is EUR 6 billion (USD 7.8 billion), shared between private and public funding. The main four R&D areas on which the EWI focuses include new turbines and components; offshore structures; resource assessment and spatial planning; and grid integration.

As regards wind turbine technology and grid integration, the current and most advanced wind turbine configuration featuring variable speed, direct drive, full-scale power converter, and either electromagnet or permanent magnet electricity generator allows easy compliance with the most demanding grid "fault ride-through" capabilities required by recent grid codes from wind turbines.

Other practices, external to pure wind turbine technology, include (a) control centres for renewable energies, which manage and control in real time and with frequently updated data from all wind farms, the latter's corresponding wind energy output by anticipating sudden losses in their power generation; (b) planning of new pump hydro accumulation storage (PAC) facilities; (c) dynamic line rating with temperature monitoring; (d) rewiring with high temperature conductors; (e) installing power flow control devices (FACTS, etc.); (f) legislation such as the 3rd Energy Package intending to assist in new electrical infrastructure planning processes. In addition, the ongoing market integration across Europe, notably the implementation of regional markets, is an important building block for a future power system characterised by flexible and dynamic electricity markets, based on "implicit auctioning" or "market couplings" rather than on cumbersome explicit auctions. In order to promote these fluid interactions between neighbouring systems and electricity markets, ENTSO-E (European Network of Transmission System Operators for Electricity) was created. ENTSO-E represents all electric TSOs in the EU and others connected to their networks, for all regions, and for all their technical and market issues.

At European level, the main global drivers for mandatory national ongoing implementation of measures seeking to improve the efficiency and effectiveness of the administrative and grid connection procedures for renewable energy projects are, respectively, articles 13 and 16 of Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

With respect to public support instruments for wind power, although they have not succeeded in every country that has enacted them, price-driven policies, such as feed-in tariffs (FIT) or feed-in premiums (FIP) have resulted in rapid renewable electric capacity growth and strong domestic industries in several countries, most notably Germany and Spain. In addition, the IEA argues that the key for countries like Germany, Spain and Denmark has been high investment security, which has been partly produced by the higher certainty provided by long-term guaranteed fixed prices. Some best practice design elements include: utility purchase obligation; priority access and dispatch; different tariffs based on the generation costs, differentiated by technology, project size and wind yield; short-term automatic payment level adjustments; tariffs' guarantee for a sufficiently long time period thus ensuring adequate rates of return; etc.

To conclude the European best practices, four pieces of European legislation are essential in eliminating or mitigating the environmental and social impacts of wind farm projects, namely, Directive 2009/147/EC on the conservation of wild birds (Birds Directive); Directive 94/43/EEC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive); Directive 2001/42/EC on the evaluation of the effects of certain plans and programmes on the environment ("SEA" Directive); and Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment ("EIA" Directive).

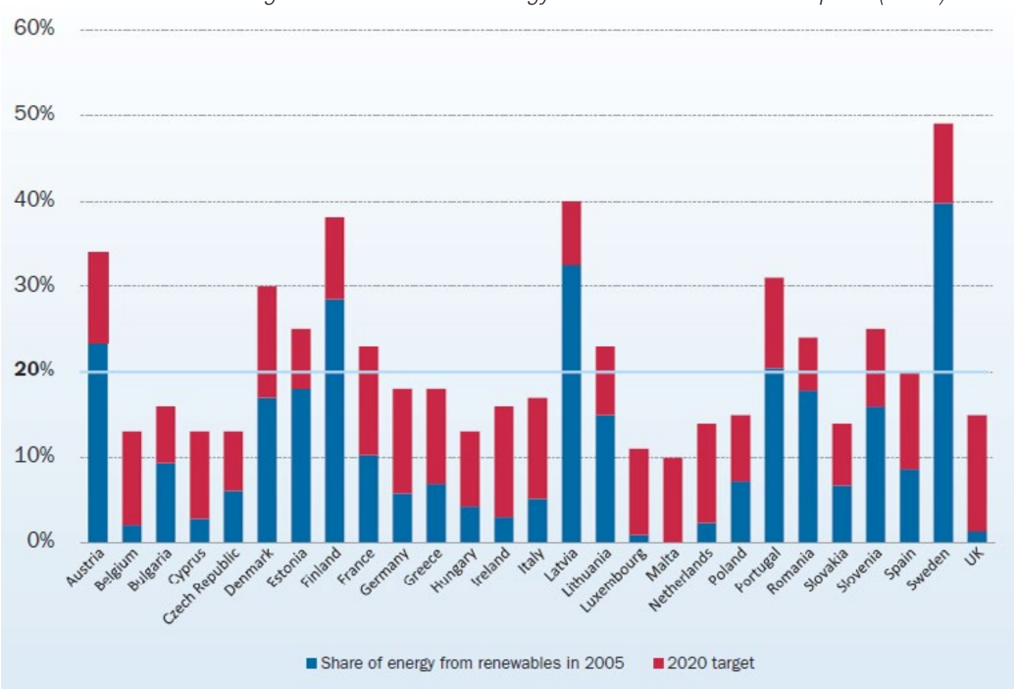
As regards GHG emissions, by improving short-term balancing operation takes place a reduction of the necessary short-term balancing reserves, number of start-ups and shut-downs and periods of part-load operation of conventional generation power plants, hence increasing their efficiency and thereby diminishing their unit exhaust gas emissions. Also, an important tool is the EU Emissions Trading Scheme (ETS) which handles 45% of the EU total emissions, covering more than 11,000 power stations and manufacturing plants around Europe.

Finally, even though the generalised positive attitude in Europe towards wind energy, further experience suggests that local ownership of wind power plants and other benefit-sharing mechanisms can improve even more public attitudes towards wind energy development.

PLANNING BY 2020

Looking into the future, Directive 2009/28/EC sets binding national targets for the share of renewable energy in each of the 27 EU Member States in 2020 (see figure below).

National overall targets for the share of energy from RES in final consumption (2020)



Source: EWEA, European Commission directive 2009/28/EC

As regards the electricity sector, according to NREAP technology projections by 2020 wind would become the most important renewable energy source providing 40% of all renewable electricity compared to 25% in 2010.

At present, the 106 GW of total installed wind power capacity is 1.6 GW (1.5%) below the installed capacity outlined in the 27 National Renewable Energy Action Plans (NREAPs) of 107.6 GW. Onshore there are 101 GW of installed capacity instead of 101.7 GW foreseen by the NREAPs (-1%). Offshore there are 4,993 MW of installed capacity instead of 5,829 foreseen by the NREAPs (-14%).

COUNTRY PROFILES

This section extracts the summary of enabling conditions from wind energy for each of the selected countries.

Denmark

Effective rule of law; and transparency in administrative and permitting processes	A coherent and long-term policy framework has been in place since 1979. However, the wind sector experienced stagnation on the period 2001-2008, due to limited political support for the technology. There has been a strong revival of political support for wind energy post-2009.
A clear and effective pricing structure	Electricity production from renewable sources is supported through price premiums added to the market price, capped at a maximum amount, and tenders for offshore wind power. These instruments are drawn up and managed by the Danish Energy Agency. The combination of market price and premium ensures stable revenue to the producer. All subsidy costs are passed on to consumers as an equal Public Service Obligation.
Provisions for access to the grid (incentives & penalties for grid operators)	Priority access is guaranteed to renewable energy producers.
An industrial development strategy	Four energy plans – the outcome of which was that Denmark became a net exporter of energy.
A functioning finance sector	The investment for wind farms initially came from individuals through cooperatives. However, turbines became larger, the size of the projects increased, requiring private sector investment. Small individual developers have difficulties in investing in large projects (onshore), due to the amount of investment required. Offshore projects are mostly financed by utilities.
Expression of political commitment from government (e.g. targets)	The country aims to generate 50% of its electricity consumption from wind power by 2020, aiming at a full independence from coal, oil and gas by 2050.
A government and/or industry led strategy for public and community buy-in.	Stakeholder engagement and consumer awareness have played an important role in shaping the Danish energy sector. The country has a large number of cooperatives. The 1996 Energy Plan aimed at creating an energy sector rooted in a "democratic, consumer-oriented structure".
An employment development strategy	Subsidies have been available to the wind sector for R&D, and the government supported the initial phase of exports.
NOTE	Continuous government support has been in place since the 1980s, including support to long-term R&D, premium tariffs and the setting of ambitious national targets. All of these have helped the domestic wind industry to expand internationally.

Source: IRENA and GWEC, 2012

Germany

Effective rule of law; and transparency in administrative and permitting processes	The legislation is clearly defined and has been enforced in a timely and targeted manner. Clear guidance is provided through the building codes, while siting and permitting laws are available for all landscapes.
A clear and effective pricing structure	A feed-in tariff has been available since 1991. Its subsequent revisions have allowed long-term certainty in the stability of the national market for both the local wind industry and its investors.
Provisions for access to the grid (incentives & penalties for grid operators)	Clear guidance is available to utilities, electricity generators and consumers on the role and duties of the grid operators. However, cooperation of regional grid companies in expanding the inland grid capacity and the offshore connections is not optimal. Issues related to grid integration are causing delays and adding risk to future projects.
An industrial development strategy	Focused and early support for R&D programmes was available for wind energy, as well as early support for demonstration projects both onshore and offshore. However the offshore development has run into delays.
A functioning finance sector	Wind projects have received long-term support from the National Development Bank (KfW) and the regional finance sector. Europe's current economic conditions and the impact of Basel 3 regulations62 could influence the ability of German lenders to finance large projects (especially offshore) in the short- to medium-term.
Expression of political commitment from government (e.g. targets)	According to the National Renewable Energy Action Plan, the percentage of energy from renewable sources in the gross final energy consumption will rise from 6.5% in 2005 to 18% in 2020, and could even be surpassed to reach an aspirational target of 19.6%. Targets up to 2030 would be welcome, in order to provide long-term certainty for both the offshore and onshore developments.
A government and/or industry led strategy for public and community buy-in.	As a result of the national commitment to renewable energy, the country has seen a tremendous increase in renewable energy production since the 1980s as well as job creation and industrial development.
An employment development strategy	At an early stage, the regional governments provided regulatory and financial support for small- and mediumsized enterprises to build and operate wind turbines and farms. By 2011, Germany had created more than 100 000 jobs in the wind industry.
NOTE	In Germany most of the early jobs created by the wind energy sector were in small- and medium-sized enterprises, often in rural or less developed regions. This helped create a positive view of the technology and highlighted its socio-economic benefits.

Source: IRENA and GWEC, 2012

Ireland

Effective rule of law; and transparency in administrative and permitting processes	Continuous support and a long-term policy framework were available from 1993 to 2010. The Sustainable Energy Authority of Ireland completed a series of surveys to assess the public attitude towards wind farms and future energy policy. The public is generally positively disposed to the introduction of wind farms. Detailed local planning guidelines and environmental guidelines are available.
A clear and effective pricing structure	The tariffs were first determined through auctioning under the AER programme, followed by a feed-in tariff system. A regulatory review after the financial crisis has had an adverse effect on the growth of, and confidence in, the wind industry. The sector now expects a review of the feed-in tariffs (REFIT 2).
Provisions for access to the grid (incentives & penalties for grid operators)	Electricity produced by renewable sources has priority over other energy production facilities. The national grid development strategy, Grid25, plans for the grid expansion until 2025. The share of electricity from renewable sources should reach 40% by 2020. At present planning regulations are not in phase with grid connection timelines. The standard planning permission granted to a wind farm development typically expires after five years, but it can take up to six years to process a grid connection application (Staudt, 2000).
An industrial development strategy	Regulatory and policy support were made available for the growth of a domestic wind industry.
A functioning finance sector	After the 2009 financial crisis, commercial lending was difficult to obtain, in particular for developers with limited track records.
Expression of political commitment from government (e.g. targets)	There is a long-term renewable energy target of 16% by 2020 under the 2009 European Renewable Energy Directive. However, regulatory support and secondary legislations are not in place, which causes significant delays to projects.
A government and/or industry led strategy for public and community buy-in.	EirGrid organises public engagement through public education efforts and outreach for specific transmission projects.
An employment development strategy	Not Applicable
NOTE	Despite a difficult economic atmosphere, the development of a green economy is set to be a key driver of the economic recovery and future growth of Ireland.

Source: IRENA and GWEC, 2012

Italy

Effective rule of law; and transparency in administrative and permitting processes	A continuous and long-term policy framework has been in place since 1988. There is scope for improving regional permitting procedures to facilitate project development.
A clear and effective pricing structure	The tradable green certificates system under the quota obligations was an effective mechanism. The proposed shift to a feed-in system is likely to provide dependable support for wind power development.
Provisions for access to the grid (incentives & penalties for grid operators)	Electricity produced from renewable sources has priority for dispatch by the distribution companies and favourable connection procedures.
An industrial development strategy	The main driver developing renewable energy sources has been to promote energy security and reduce import dependency. No national industrial development strategy is in place. Some of the regions provide capital subsidies.
A functioning finance sector	Financing for wind projects has been available through the private sector.
Expression of political commitment from government (e.g. targets)	Long-term renewable energy target of 17% by 2020. Italy plans to produce 98 TWh from renewable sources by 2020, up from 27.5 TWh in 2010.
A government and/or industry led strategy for public and community buy-in.	Stakeholder engagement and consumer awareness have not been a specific activity undertaken by the government or industry.
An employment development strategy	Not Applicable
NOTE	Italy's national policy for renewables operates through a complex set of incentives which range from indirect regulatory support measures, such as feed-in tariffs and fiscal incentives, to marketbased mechanisms, such as quota obligations and tradable green certificates. According to a recent European study, Italy has the highest average expenditure for supporting wind power and small hydropower.

Source: IRENA and GWEC, 2012

Portugal

Effective rule of law; and transparency in administrative and permitting processes	Historically the regulatory framework has been stable. However, since 2010, there has been limited clarity on the future of the tariff and support schemes for renewables, due to the need for structural adjustments in the Portuguese economy. The short-term actions now being deployed to meet budgetary obligations may affect long-term investment priorities. According to the European Wind Energy Association, the average lead-time for project developments could now reach 58 months, when the EU average was 24 months in 2010.
A clear and effective pricing structure	Feed-in tariffs were available for almost all renewable energy producers. The tariff system is combined with tendering schemes, and has proven to be effective. The tariff system has led to a very steep growth of both installed capacity and electricity production over the last five to six years. Both the scheme and the tariffs have been continuously monitored against the level of market prices.
Provisions for access to the grid (incentives & penalties for grid operators)	Renewable energy projects have priority on access to the grid, as stated in the National Energy Strategy Plan. Sites for new wind and forestry biomass power plants are tendered and located where the grid can be efficiently and consistently developed.
An industrial development strategy	The government supported the development of industrial clusters, thus creating a local supply chain. Long-term targets for wind energy and a large pipeline of projects provided the necessary long-term visibility on market conditions to allow a local supply chain to be built.
A functioning finance sector	The stability of the support scheme, and of other fiscal incentives through the last decade, allowed for predictable returns on investments. Project financing was easily available until the economic crisis.
Expression of political commitment from government (e.g. targets)	Portugal intends to supply 60% of its electricity from renewable resources by 2020, in order to satisfy 31% of its final energy consumption.
A government and/or industry led strategy for public and community buy-in.	The 2.5% (of gross income from wind projects) taxbased contribution to municipalities helped to improve public acceptance and cooperation between project developers, power producers and the municipalities.
An employment development strategy	Small- and medium-size enterprises were supported to develop capacity and manpower for building and operating renewable energy projects and manufacturing equipment.
NOTE	Portugal has one of the most stable policy and regulatory regimes for wind. However, the ongoing financial and economic crisis will greatly affect the future of the sector.

Source: IRENA and GWEC, 2012

Spain

Effective rule of law; and transparency in administrative and permitting processes	A contiguous and long-term policy framework has been in place since 1985. Administrative and permitting processes are primarily the responsibility of regional governments. Detailed guidance is available to the industry.
A clear and effective pricing structure	Until 2009, there was strong support for renewable energy. Since 2010, revised legislation has slowed the growth of the wind sector. The revised legislation followed constraints on public expenditures caused by the financial crisis.
Provisions for access to the grid (incentives & penalties for grid operators)	Electricity produced from renewable energy sources has priority access. All electricity produced is purchased.
An industrial development strategy	The industry's growth has been largely due to the initial public support for wind turbine manufacturing. Two of the largest wind manufacturers are based in Navarre. The Navarran Hydroelectric Energy Company or EHN (presently called Acciona Energy) was created in 1989 under a public-private partnership. In 1994 GamesaEólica was created to manufacture wind turbines as a joint venture between the government of Navarre, GamesaEnergía and Vestas (with a 40% stake) .
A functioning finance sector	Spanish wind energy companies are among the largest in the global market. Financing was not a problem till 2010.
Expression of political commitment from government (e.g. targets)	There is a long-term renewable energy target of 20.8% by 2020.
A government and/or industry led strategy for public and community buy-in.	Early benefit-sharing among local populations (via rent for land use for wind farms, job creation, economic development in the community, etc.) has helped create positive support for the wind industry.
An employment development strategy	This was largely driven by the governments of the autonomous regions who provided additional support to both foreign and domestic investors in the 1990s to set up manufacturing units in Spain.
NOTE	Through the 1990s and early 2000s, the rapid development of renewable energy was the result of Spain's national industrial and energy policy. Since 2008, the legislation has been influenced by the implementation of the European Directives.

Source: IRENA and GWEC, 2012

UK

Effective rule of law; and transparency in administrative and permitting processes	A long-term energy policy framework has been in place since 2010 although it was not specifically designed for promoting renewable energy sources. The UK is developing a large renewable energy capacity, but current projects do not generate high local benefits. Since the country is densely populated, there has been opposition to wind farms in many rural areas.
A clear and effective pricing structure	The auction system was not favourable to small, local investors. The RO created uncertainty for investors, since future ROC prices could collapse if excess renewable generation were built. Due to this risk element, the cost of capital was increased, which favoured large companies able to finance the developments on their balance sheet. Before the banding process, the ROCs were awarded per MWh regardless of the method of generation. This system favoured mature, lower-cost generation technologies, such as landfill gas, over less mature technologies like offshore wind and wave power.
Provisions for access to the grid (incentives & penalties for grid operators)	Until recently renewable energy did not have priority access to the grid, making the UK among the most difficult markets to secure a grid connection for wind projects.
An industrial development strategy	The UK did not create a domestic industrial base for onshore wind. However, this is changing with the upcoming development of the offshore wind market, especially in Scotland.
A functioning finance sector	Since the 2009 financial crisis, commercial lending has been difficult to access, and the finance sector is yet to recover completely, as of 2012.
Expression of political commitment from government (e.g. targets)	The 2008 Climate Change Act committed the UK to reducing its emissions by 80% by 2050. This required a rapid advance in the rate of growth of renewable energy. The Act further specified a reduction in emissions of at least 34% by 2020, on a 1990 baseline.
A government and/or industry led strategy for public and community buy-in.	The UK wind industry started working closely with other stakeholders to address the issue of local communities' hostility to onshore wind projects in the late 1990s. Today the UK has the most developed processes for public consultation and stakeholder engagement.
An employment development strategy	Not Applicable
NOTE	The UK has some of the best wind resources in Europe. Improved access to the electricity transmission network would overcome a backlog of connections from renewable energy projects and encourage further investments. There is still room for streamlining the planning and consenting process for both onshore and offshore projects.

Source: IRENA and GWEC, 2012

1. OVERVIEW – EUROPEAN TRAJECTORY

1.1. Wind energy in the world and in Europe

[39], [40], [41], [45], [53], [54]

The development of wind energy has been motivated by diverse drivers, which have evolved over time. The early demonstration programmes initiated in the 1970s were mostly motivated by the oil crisis. At that time, countries realised that their economies were inordinately dependent on imported sources of energy with unpredictable costs. The vulnerability of countries to external energy supply constraints and the willingness to harness indigenous resources have remained a constant driver of renewable energy development.

After the oil market stabilised, wind policy development entered a second phase driven by environmental concerns, the desire for energy diversification, and energy security. The Chernobyl accident (1986) amplified public questioning of the role of nuclear energy, especially in some European countries, leading to alternative solutions being researched and developed.

Environmental concerns added to the public support for renewables during the 1980s and 1990s. The Kyoto Protocol (1997), which was driven by concerns over climate change, became an important instrument for the promotion of renewable energy projects globally. Its Clean Development Mechanism was particularly important in the development of wind energy in China and India.

In Europe, following a white paper on "Strategy and Action Plan for Renewable Energy" in 1997[43], the European Union defined EU-wide targets in both 2001[44] and 2009[45] which were divided into individual national renewable energy action plans (see Annex VI for more detail). These targets were major drivers for the development of wind energy in the individual EU Member States. This development happened in parallel with the liberalisation of the energy market[46], which facilitated the emergence of independent power producers and private developers.

The diversification of energy supply and energy security remained a strong driver for all markets, with some nuances. In the case of Brazil, the early developments came after a major energy supply crisis in 2000 and 2002, which initiated a reform of the energy sector including efforts to diversify the energy mix after a series of droughts affected hydropower generation.

Over the past few years, the cost of wind energy has declined significantly and in some locations, wind is now competitive with conventional sources including gas.

Under specific conditions, the drivers for wind energy development are increasingly becoming purely economic. The reasons for this include a technically advanced and mature supply chain at a global scale, and more recently, the financial crisis, which has reduced the pace of growth, creating oversupply. In parallel, the price of fossil fuels grew significantly, with crude oil increasing from some USD 20 per barrel in 2000, to often over USD 100 per barrel post-December 2008. Gas prices increased in parallel, although the recent development of shale gas has significantly changed the energy landscape, especially in the North American markets.

An additional motivation for countries is the desire to create local economic value, in terms of jobs, additional income, health benefits and manufacturing. Those benefits vary significantly from market to market, and include localised installation and maintenance capacity, component supply or large-scale wind turbine manufacturing, local manpower development, and local investment opportunities.

For prospective wind markets, the main drivers are likely to be environmental, cost-competitiveness, energy independence, diversification of the energy supply, and creation of local value.

By the end of 2012 the cumulative global installed capacity of wind energy stood at 282 GW (see Annex VII for a regional level breakdown and evolution from 2004 to 2012). Figures 1.1-2 and 1.1-3 show the evolution between 1996 and 2012 as far as annual and cumulative installed wind capacity are concerned. The global capacity may reach 490 GW by 2016, according to industry projections.

The main drivers of growth in the global market, as they have been for the past several years, are USA, Germany and the Asian powerhouses of China and India. The four countries together accounted for almost 70% of the global market in 2012 (see figure 1.1-1). Elsewhere, Brazil is beginning to live up to its promise, and along with Mexico will be the major growth markets in the western hemisphere for the coming years; and South Africa has finally taken the decision to get into the wind market in earnest.

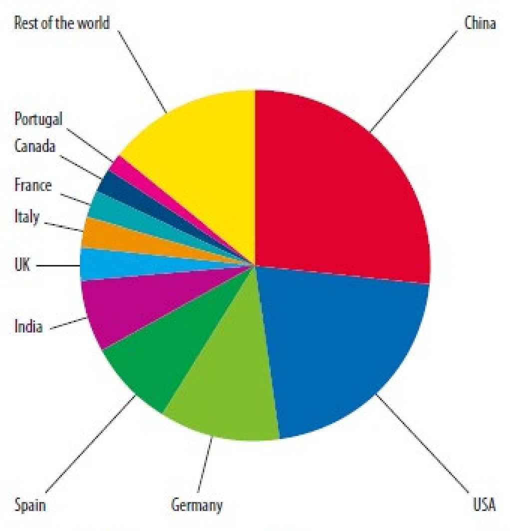
43. It set the goal of doubling the share of renewable energy in the EU's energy mix from 6% to 12% by 2010.

44. Directive 2001/77/EC: A target of 12% of overall energy consumption being produced from renewable energy in the EU in 2010. A share of electricity generated by renewable energy of 22% in 2010 for EU15 (compared with 14% in 2000); and a share of biofuels in diesel and petrol used for transport of 5.75% in 2010 (compared with 0.6% in 2002). This Directive initiated streamlined administrative procedures for new plant installation; support schemes to compensate renewable energy for its positive externalities (environment, contribution to security of supply, etc.); publication of guarantees of origin; and regulation of mechanisms to offset the costs of technical adaptation.

45. Directive 2009/28/EC: Objectives by 2020: 20% share of energy from renewable sources in the EU final energy consumption and a 10% share of energy from renewable sources in transport. This Directive made the 2020 renewable energy targets legally binding and National Renewable Energy Action Plans were required from each Member State setting out how each of them is to meet its overall national target. Member State's progress reports are due to be submitted to the EC every two years.

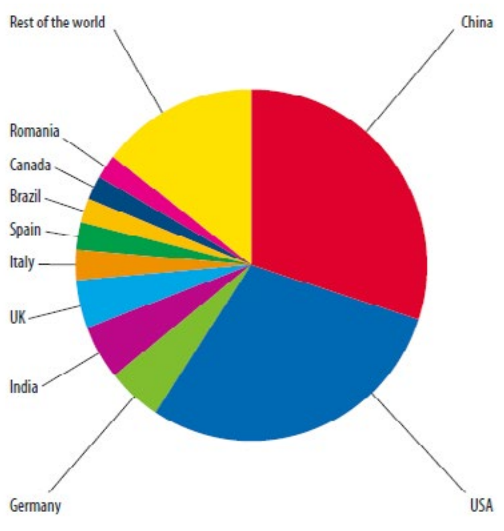
46. The Third Liberalisation Package of 2009 assists the creation of an Internal Energy Market for electricity and gas notably by requiring ownership unbundling which means that large, vertically-integrated energy firms which control both electricity production and transmission assets are entirely broken up. It also creates two new European bodies: the European Network of Transmission System Operators (ENTSO) and the Agency for the Cooperation of Energy Regulators (ACER) which have the duty to constitute a common EU-wide regulatory framework for grid management and market integration by implementing the so-called binding Framework Guidelines and Network Codes.

Figure 1.1- : Top 10 cumulative capacity (Dec 12) [left] and installed capacity (2012) [right]



Country	MW	% SHARE
PR China**	75,564	26.8
USA	60,007	21.2
Germany	31,332	11.1
Spain	22,796	8.1
India	18,421	6.5
UK	8,445	3.0
Italy	8,144	2.9
France**	7,196	2.5
Canada	6,200	2.2
Portugal	4,525	1.6
Rest of the world	39,853	14.1
Total TOP 10	**242,630**	**85.9**
World Total	**282,482**	**100.0**

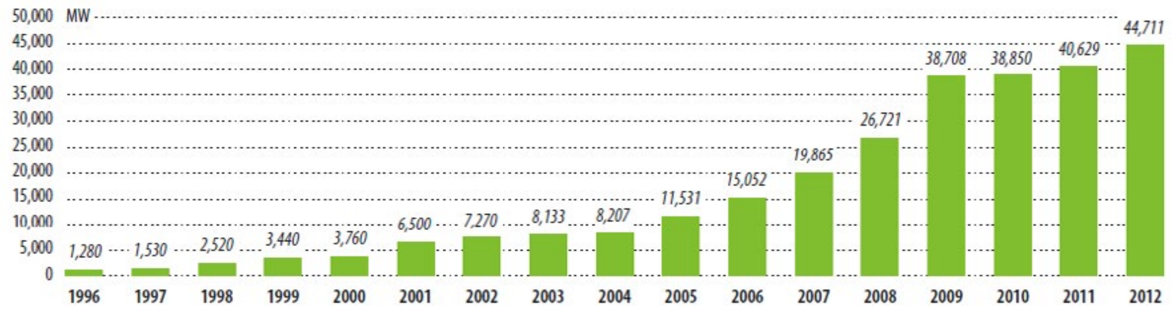
*** Provisional figure*



Country	MW	% SHARE
PR China**	13,200	30
USA	13,124	29
Germany	2,439	5
India	2,336	5
UK	1,897	4.2
Italy	1,273	2.8
Spain	1,122	2.5
Brazil	1,077	2.4
Canada	935	2.1
Romania	923	2.1
Rest of the world	6,385	14.3
Total TOP 10	**38,326**	**85.7**
World Total	**44,711**	**100.0**

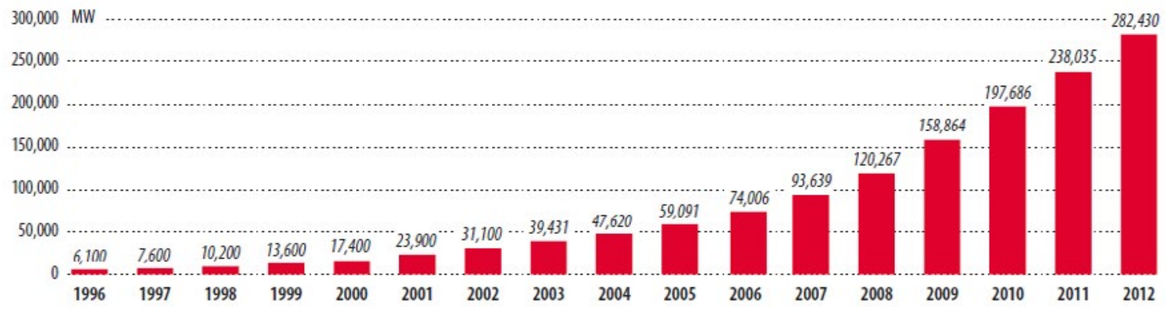
Source: GWEC, 2013

Figure 1.1- : Global Annual Installed Wind Capacity 1996-2012



Source: GWEC, 2013

Figure 1.1- : Global Cumulative Installed Wind Capacity 1996-2012



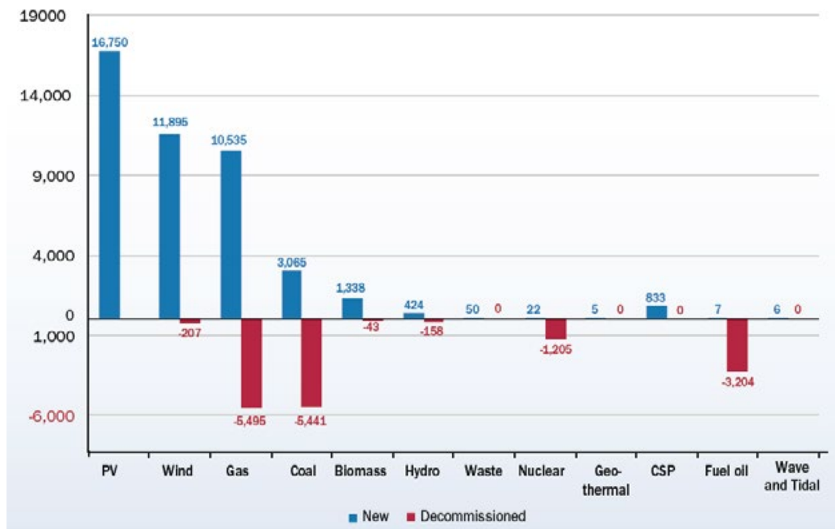
Source: GWEC, 2013

As far as Europe is concerned, during 2012, 12,744 MW of wind power were installed across Europe, of which 11,895 MW were in EU-27 (see Annex VIII). Of those, 10,729 MW were onshore and 1,166 MW offshore. Offshore accounted for 10% of total EU wind power installations in 2012, one percentage point more than in 2011. Investment in EU wind farms in 2012 was between €12.8 billion (USD 16.6 billion) and €17.2 billion (USD 22.4 billion). Onshore wind farms attracted €9.4bn (USD 12.2 billion) to €12.5bn (USD 16.3 billion), while offshore wind farms accounted for €3.4bn (USD 4.4 billion) to €4.7bn. (USD 6.1 billion).

In terms of annual installations, Germany was the largest market in 2012, installing 2,415 MW of new capacity, 80 MW of which (3.3%) offshore. The UK came in second with 1,897 MW, 854 MW of which (45%) offshore, followed by Italy with 1,273 MW, Spain (1,122 MW), Romania (923 MW), Poland (880 MW), Sweden (845 MW) and France (757 MW). It is also important to note the amount of installations in the UK, Italy and Sweden. These three markets represent respectively 16%, 11% and 7% of total EU installations in 2012.

Wind power accounted for 26.5% (11,895 MW) of new installations in 2012, the second biggest share after solar PV (16,750 MW - 37%), the third being gas (10,535 MW - 23%). Overall, during 2012, 44.9 GW of new power generating capacity was installed in the EU (see figure 1.1-4), 1.7 GW less than in 2011, which was a record year for new power capacity installations.

Figure 1.1- : New installed and decommissioned capacity (2012) (MW)
(Total net power installed 30,172 MW)

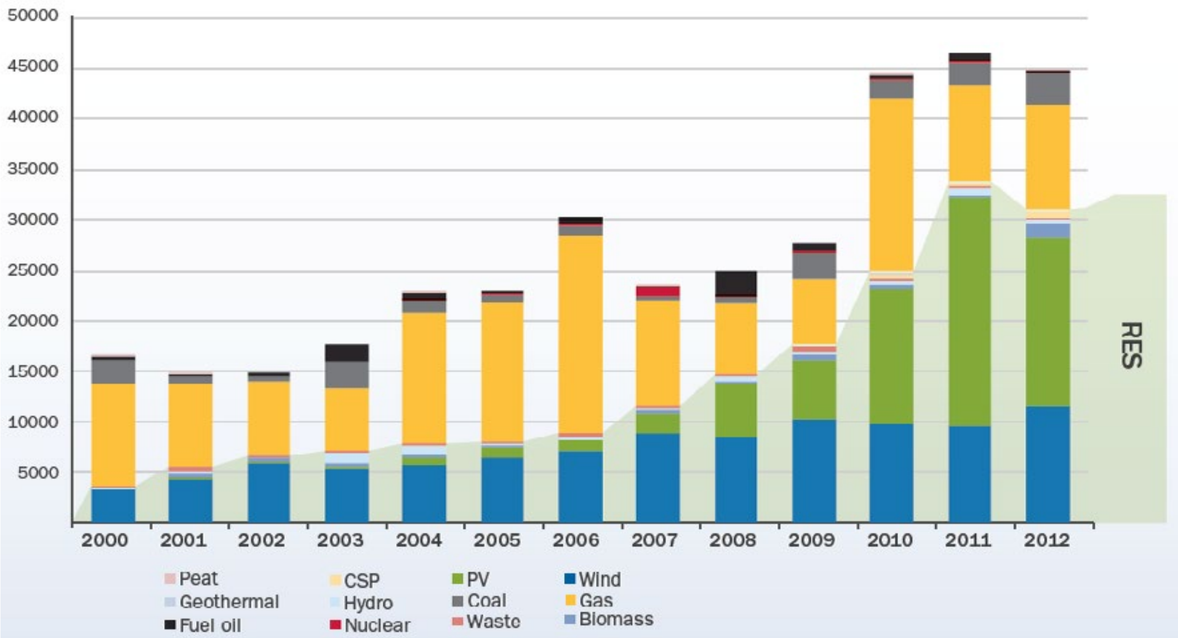


Source: EWEA, 2013

During 2012, 5.5 GW of gas capacity was decommissioned, as were 5.4 GW of coal, 3.2 GW of fuel oil and 1.2 GW of nuclear capacity. (see figure 1.1-4). After two years of installing more capacity than it decommissioned, coal power installations reduced by almost 2.4 GW in 2012.

As regards European renewable energy, in year 2000, new renewable power installations totalled a mere 3.5 GW. Since 2010, annual renewable capacity additions have been between 24.5 GW and 33.7 GW, seven to eight times higher than at the turn of the century. The share of renewables in total capacity additions has also grown. In 2000, the 3.5 GW represented 20.7% of new power capacity installations, increasing to 31.3 GW (70%) in 2012 (see figure 1.1-5).

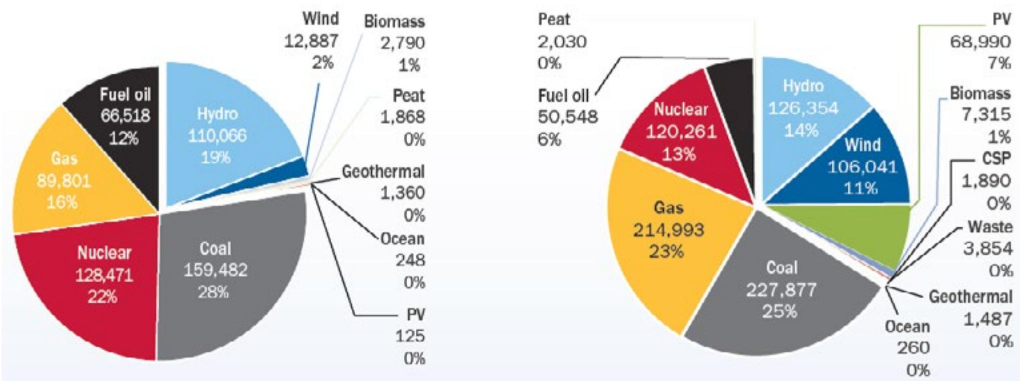
Figure 1.1- : EU installed power generating capacity per year in MW and RES share (%)



Source: EWEA, 2013

Wind power's share of total installed power capacity has increased five-fold since 2000; from 2.2% in 2000 to 11.4% in 2012. Over the same period, renewable capacity increased by 51% from 22.5% of total power capacity in 2000 to 33.9% in 2012. (see figure 1.1-6).

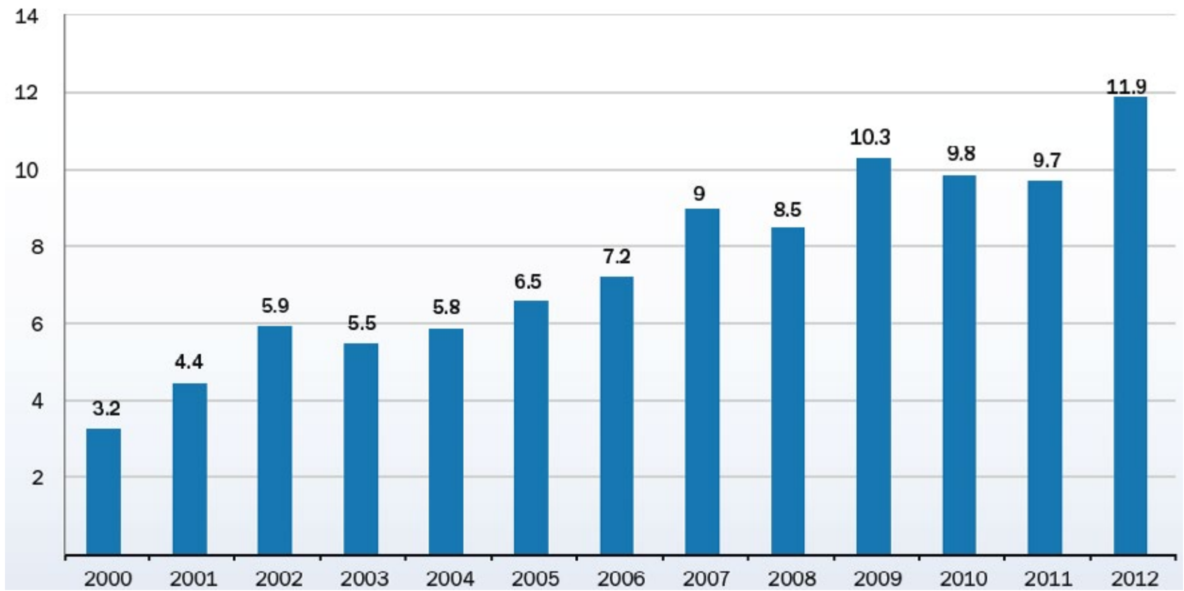
Figure 1.1- : EU power capacity mix in 2000 (left hand side) and 2012 (right hand side)



Source: EWEA, 2013

Annual wind power installations in the EU have increased steadily over the past 12 years from 3.2 GW in 2000 to 11.9 GW in 2012, a compound annual growth rate of over 11% (see figure 1.1-7).

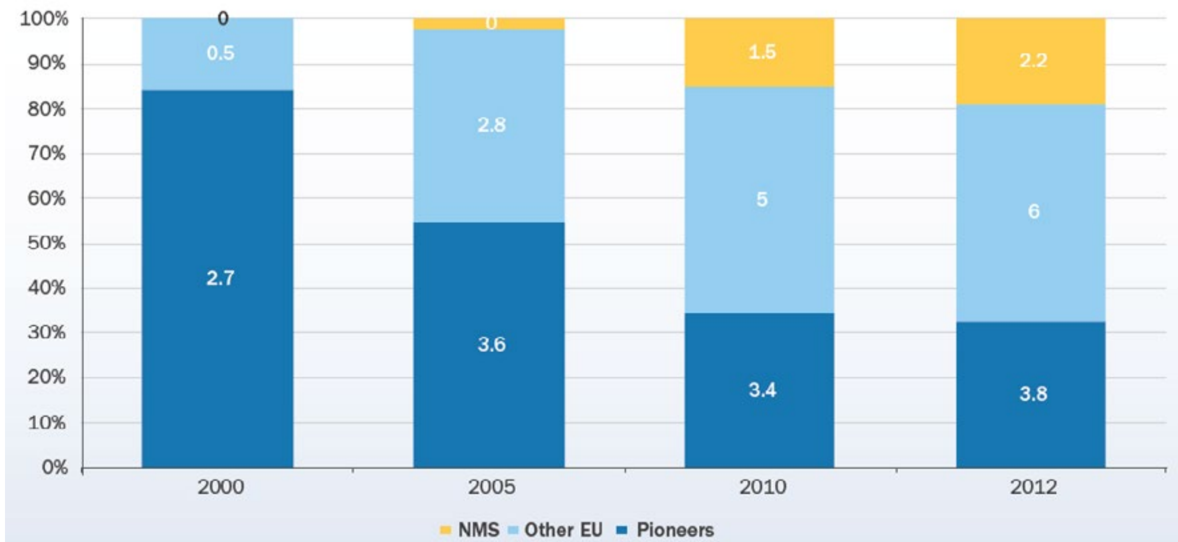
Figure 1.1- : Annual wind power installations in the EU (GW)



Source: EWEA, 2013

Concerning the national breakdown of wind power installations, in 2000, the annual wind power installations of the three pioneering countries – Denmark, Germany and Spain – represented 85% of all EU wind capacity additions. In 2012, this share had decreased to 32%. Moreover, in 2000, the countries that make up, today, the 12 newer EU Member States (NMS[47]) had no wind energy; in 2012, they represented 18% of the EU's total market. (see figure 1.1-8).

Figure 1.1- : Denmark, Germany and Spain 's share of EU wind power market (GW

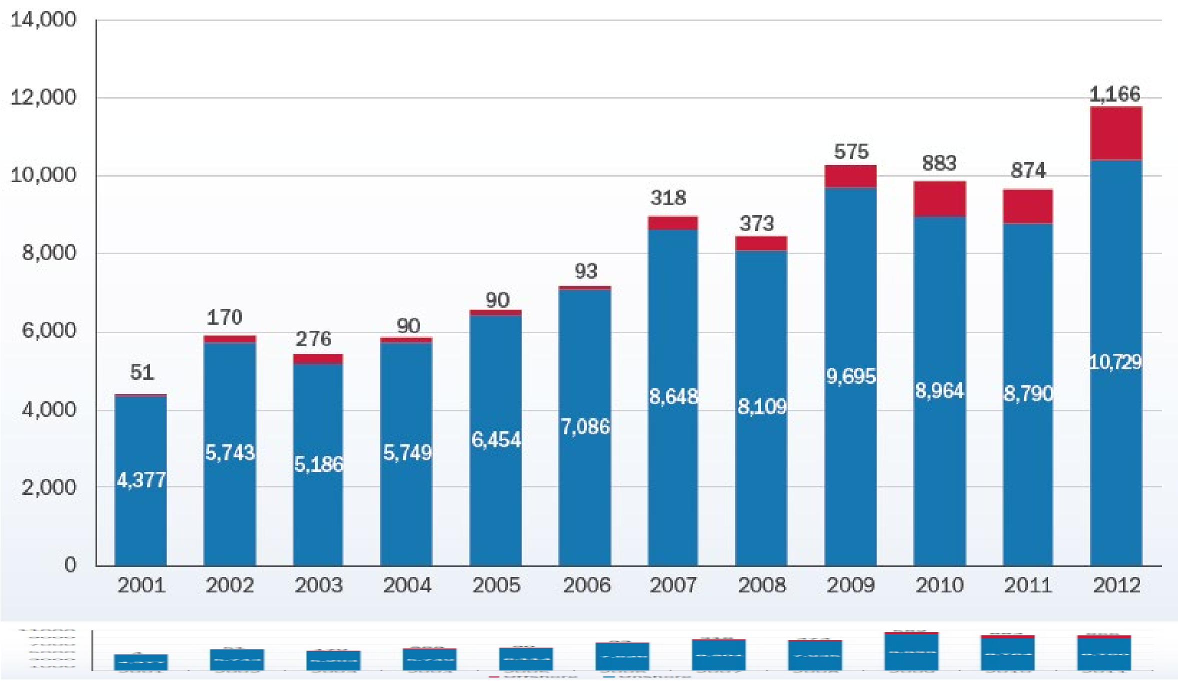


Source: EWEA, 2013

47. Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia.

2012 was a record year for offshore installations, with 1,166 MW of new grid connected capacity. Offshore wind power installations represent 10% of the annual EU wind energy market, up from 9% in 2011. (see figure 1.1-9).

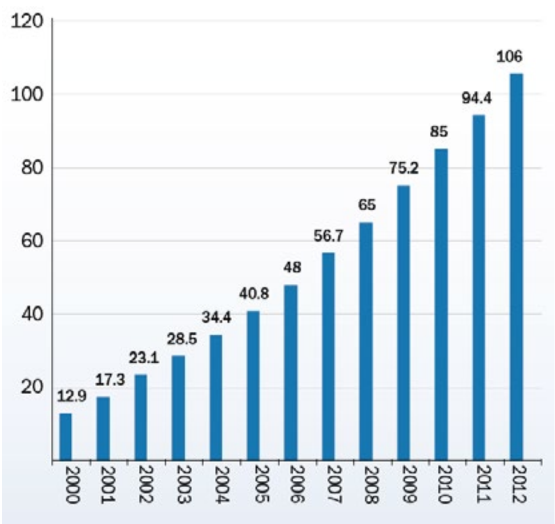
Figure 1.1- : Annual onshore and offshore installations EU-27 (MW)



Source: EWEA, 2013

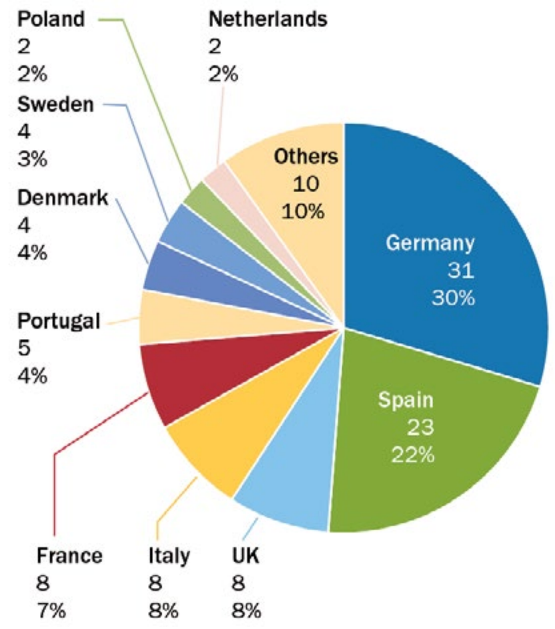
A total of 106 GW is now installed in the European Union, a growth of 12.6% on the previous year and similar to the growth recorded in 2011 (see figure 1.1-10). Germany remains the EU country with the largest installed capacity, followed by Spain, Italy, the UK and France. Ten other EU countries have over 1 GW of installed capacity: Austria, Belgium, Denmark, Greece, Ireland, The Netherlands, Poland, Portugal, Romania and Sweden (see figure 1.1-11. Annex VIII for absolute values).

Figure 1.1- : Cumulative wind power installations in the EU (GW)



Source: EWEA, 2013

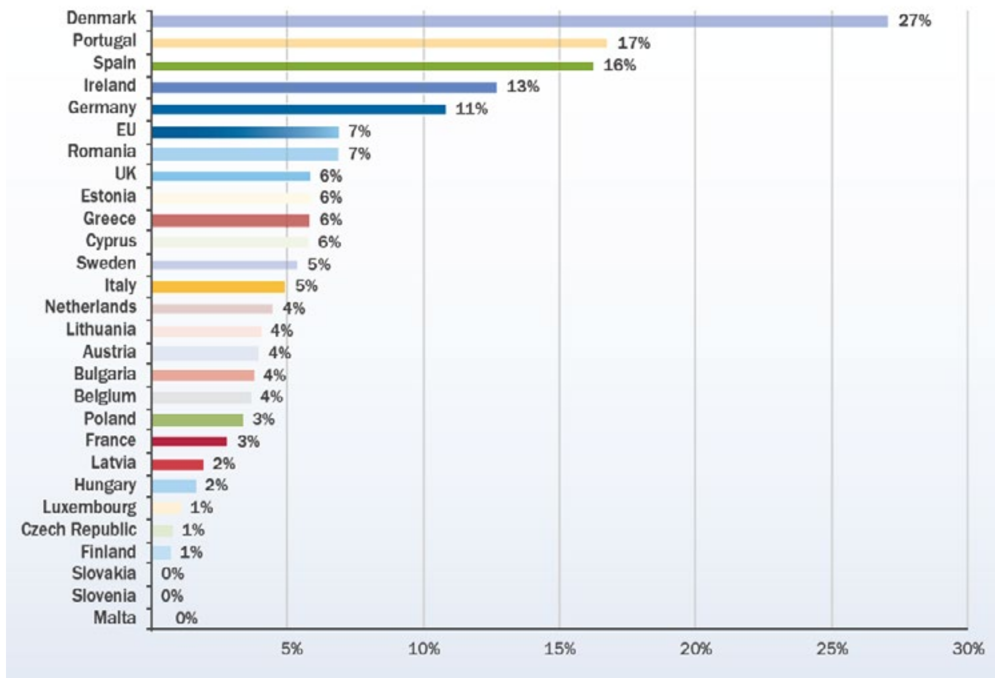
Figure 1.1- : EU MS market shares for total installed capacity at end 2012 (total 105.7 GW



Source: EWEA, 2013

Finally, with respect to energy production, the wind capacity installed at end of 2012 will, in a normal wind year, produce 231 TWh of electricity, representing 7% of the EU's gross final consumption. Denmark remains the country with the highest penetration of wind power in electricity consumption (almost 27.1%), followed by Portugal (16.8%), Spain (16.3%), Ireland (12.7%) and Germany (10.8%). Of the newer Member States, Romania has the highest wind energy penetration (6.9%) (see figure 1.1-12).

Figure 1.1- : Wind share of total electricity consumption EU-27 (end of 2012)



Source: EWEA, 2013

1.2. European electricity markets
[15], [16], [29], [46]

While traded volumes of power in the EU have not grown to the same extent as traded volumes of gas in recent years, power market liquidity[48] showed an almost continuous increase between 2005 and 2011. Increasing market liquidity is essential for the proper functioning of a wholesale market and for the formation of competitive prices, ensuring welfare benefits for consumers. As a direct result of the increasing role of wholesale power trading markets in Europe, electricity prices are increasingly being determined by the relationship of demand and supply in the market.

Table IX-1 in Annex IX provides information on the most important factors that influence the electricity import dependency/exporting capacity of each Member State of the EU. It is clearly observed that the ratio of both power import and export flows are low compared to the electricity consumption in those countries which are either geographically isolated from other European markets, or have only few interconnections (islands such as Cyprus, Malta, the UK or Ireland) On the other hand, smaller countries (such as Luxembourg, Slovenia or the Baltic States), with good power grid connections to their neighbours, have high import or export power flow ratios compared to their annual electricity demand.

Maximum generation capacity plays an important role in import dependency, because Member States that have large generation capacities (e.g. Germany, France, Italy or Spain) are able to produce more electricity than they consume, and to export the surplus power that they generate.

Table IX-2 in Annex IX provides an overview of the trend in the annual average day-ahead wholesale electricity prices in the European power markets between 2009 and 2011. Prices in most of the observed markets in 2010 showed a significant upturn compared to 2009, mainly as a result of the increasing demand for power, in parallel with the economic recovery and increasing fossil fuel prices. In 2011, prices rose further in many markets, although they fell in the Nordic countries due to a milder winter and better hydro availability. The Nord Pool Spot market is one of the largest market coupling areas in Europe, where prices were among the lowest on the continent, due the abundant hydro-based power generation in Norway and Sweden. Spanish and Portuguese power prices were strongly influenced by the availability of renewable energy sources (hydro, wind and solar). In the UK and Italy, where gas fired power generation dominates the power mix, rising natural gas prices led to power prices higher than in major Western European markets.

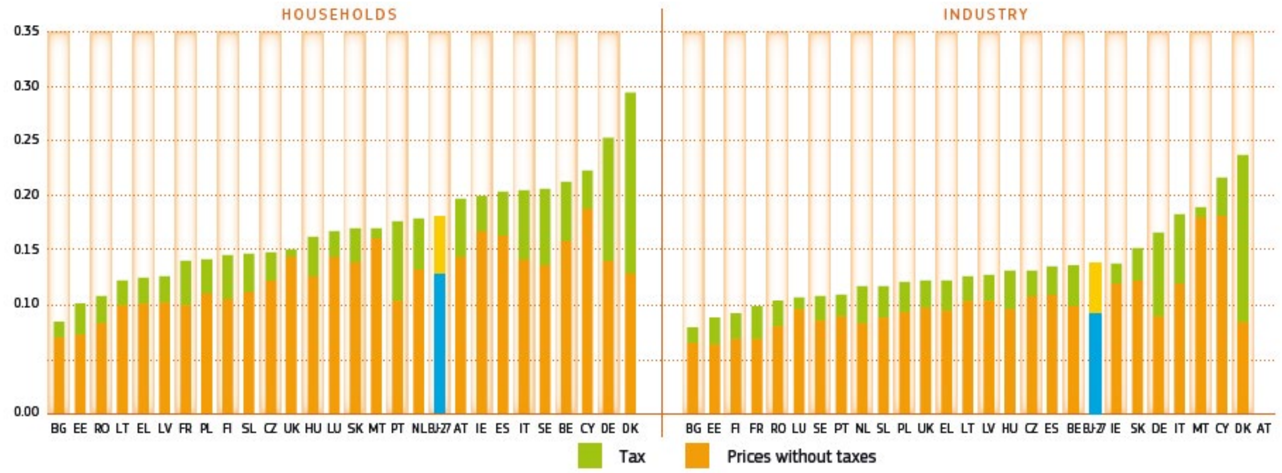
As far as market structure and unbundling are concerned, there are significant differences between Member States in terms of the structure of the electricity generation and retail distribution markets. Although there are between one and eight electricity utilities with more than 5% share of total national generation, the total number of power generation companies representing at least 95% of national generation reached a three-digit or even a four-digit figure in certain EU countries (e.g. Denmark, Germany, Italy, Austria and Portugal, see table IX-3 in Annex IX). However, such a low concentration of electricity generation is unusual in the EU. As the table also shows, concentration in electricity generation is high in most of the EU Member States. However, the link between the concentration in power generation and in the retail sector is not particularly strong, as there are many countries where higher concentration in power generation does not necessarily involve a high concentration in the retail sector or vice versa.

According to data from the national regulators for 2010, the majority of EU Member States have only one TSO. The exceptions are: the Netherlands (two), Austria, the UK and Portugal (where there are three), Germany (four) and Italy, which has eleven TSOs (see table IX-4 in Annex IX).

Although prices between many European wholesale markets have converged to some extent in the last couple of years, significant differences in the retail prices were still being observed in 2011. Households across the EU paid 0.18 Euro/kWh on average for electricity in 2011, while industrial consumers paid 0.14 Euro/kWh. In absolute terms, households and industries in Bulgaria and Estonia paid the lowest electricity prices, while households and industries in Denmark paid the highest prices[49].

The highest prices were paid in those countries where taxes and levies contributed a considerable share of the final consumer price (e.g. Germany, Denmark), or in countries with limited or non-existent interconnections to other countries (Ireland, Cyprus and Malta) (see figure 1.2-1).

Figure 1.2- : Electricity retail prices (households and industrial consumers) (2011) (Eur/kWh)



Source: Eurostat energy statistics

In eight EU Member States, industrial customers were faced with electricity prices where the tax share exceeded 10%. Industrial electricity retail prices in Italy and Germany had a tax component above 25%[50]. High shares of taxes and levies in industrial retail prices often reflect national energy policies that are designed to shift the power generation mixes in the direction of an energy source composition that is more climate-friendly and more sustainable, by promoting an increase in shares of renewable energy use. In the case of household consumers in the large majority of EU Member States, non-recoverable taxes and levies (including VAT) accounted for around 20% or more of consumer prices (see figure 1.2-2).

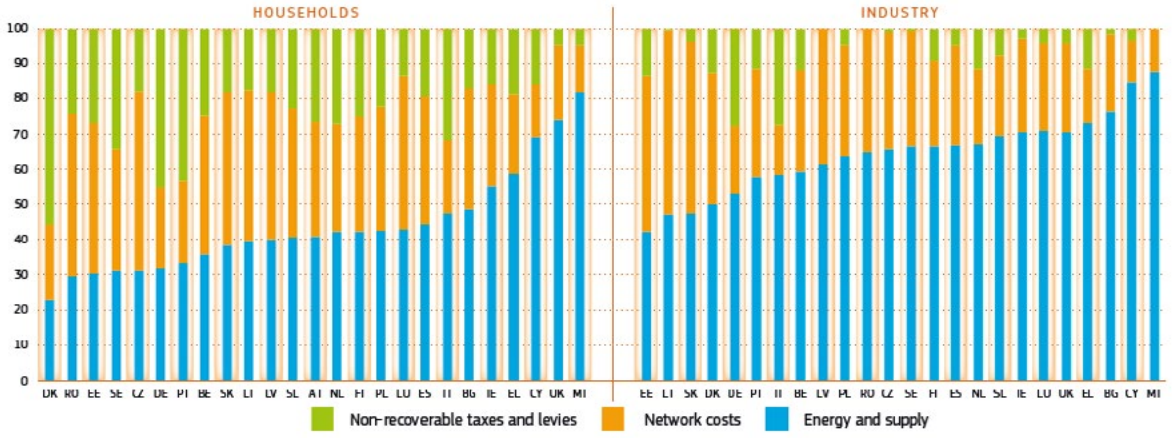
In general, despite current disparity, European national electricity markets are broadly evolving into regional ones and ultimately have to transform into a genuinely single European market for electricity.

48. In business, economics or investment, market liquidity is an asset's ability to be sold without causing a significant movement in the price and with minimum loss of value. Money, or cash, is the most liquid asset, and can be used immediately to perform economic actions like buying, selling, or paying debt, meeting immediate wants and needs.

49. These prices refer to consumption band DC (domestic consumers) for households [annual consumption 2,500 kWh – 5,000 kWh] and IC (industrial consumers) for industry [annual consumption 500 MWh – 2,000 MWh].

50. Note that industrial consumer prices are quoted without VAT due to the fact that industrial consumers recover VAT payments.

Figure 1.2- : Distribution of cost factors within retail electricity prices, 2011 (%)[51]



Source: Eurostat energy statistics

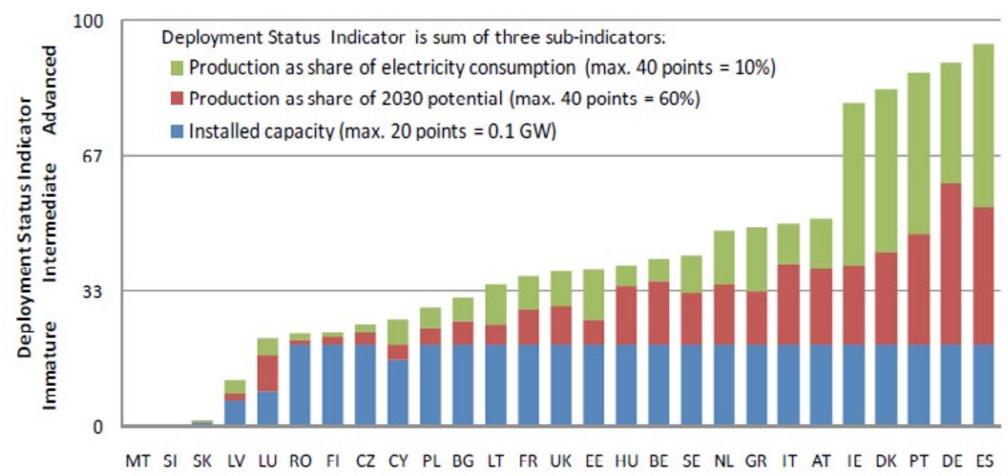
In order to describe the interaction between electricity markets and electricity from RES in general and wind energy in particular, European energy analysts have defined two indicators, namely, the Deployment Status Indicator and the Electricity Market Preparedness Indicator:

The *RES Deployment Status Indicator* aims to quantify the stage of the deployment of a specific RES in a specific Member State: The more of a RET is deployed in a country and the more experienced and professional the involved actors are, the better they can cope with risks associated with increased market integration. This aspect is represented by the Deployment Status Indicator. Analysts differentiate three types of deployment status:
Immature markets: characterized by small market sizes, few market players and low growth rates. Local, regional and national administrations have little experience with the use and the promotion of the RET in question. Also, local banks needed for financing, energy companies and local project developers have little experience with that RET. This goes along with the typical market entry barriers for the RET, e.g. long and unclear permitting procedures, grid access barriers, low or unreliable financial support etc.
Intermediate RET markets: characterized by increased market sizes, typically accompanied by strong market growth and the interest of many market players. The increased market size reflects that the energy sector, the administration and parties involved in financing have gained experience with the RET. In case of fast market growth, growth related market barriers may occur, e.g. infrastructural (rather local) and supply chain bottlenecks (both local and global). Not all intermediate markets show fast market growth, however.
Advanced RET markets: characterized by established market players and fully mature technology. Market growth may start to slow down at this advanced stage. Market players may encounter typical high-end barriers: competition for scarce sites and resources as the most cost-effective RES potential is increasingly exploited, power system limitations like curtailment, etc.

The *Electricity Market Preparedness Indicator* measures the maturity or preparedness of the electricity market for RES-E market integration: the better the design and structure of an electricity market is suited to (fluctuating) RES-E and the more potential obstacles for RES-E projects are reduced, the lower the risk and related cost for RES-E market integration. This aspect is represented by the Electricity Market Preparedness indicator.

Figure 1.2-3 shows that almost all Member States meet (or exceed) the 100 MW installation threshold, and that 16 Member States reach the intermediate or higher deployment status. The results for the five advanced countries illustrate how the sub-indicators balance each other out. The absolute market size and the share of exploited potential is in the medium range for Portugal, Denmark and Ireland (all < 4 GW installed capacity, 26-36 % exploited potential), but wind energy already plays an advanced role in their electricity sector. Germany has developed the largest onshore wind market and exploited 58% of its midterm onshore potential, but the contribution to the electricity sector is not as high as in the other frontrunner countries. Spain is the only country that scores high on all sub-indicators.

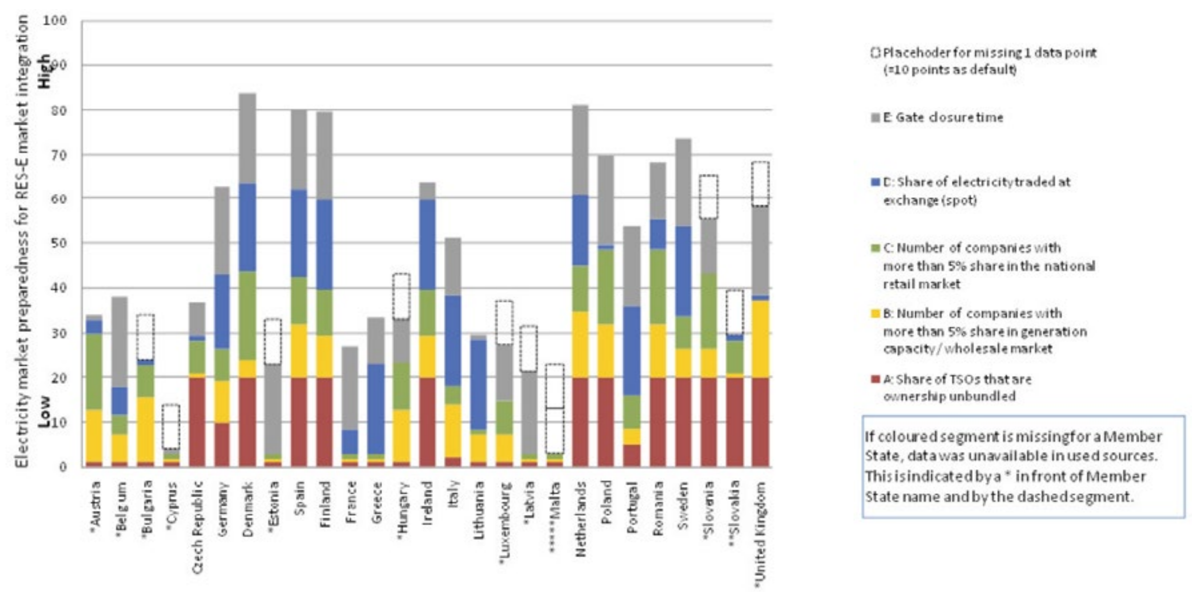
Figure 1.2- : Deployment status indicator for wind onshore - 2010



Source: RE-Shaping project. Mario Ragwitz, et al., 2012

Figure 1.2-4 shows the electricity market preparedness indicator for all RES-E technologies – focusing on market structure and the progress in market liberalisation. It reveals that the electricity markets are better prepared for RES-E market integration in the Nordic countries, Spain, the Netherlands, Poland and probably the UK (data missing) with scores between 70 and 85 points[52].

Figure 1.2- : Electricity market preparedness for RES-E market integration



Source: RE-Shaping project. Mario Ragwitz, et al., 2012

51. Notes: Prices for households are all taxes included. Prices for industrial consumers are VAT-excluded. Consumption bands Dc and Ic according to Eurostat classification. Data for industrial prices in Austria, France and Hungary broken down into cost factors are not available. Data for household prices in Hungary and France broken down into cost factors are not available.

52. Note that these indicators do not correlate with the type of support mechanism selected by the countries: three apply a feed-in premium and three a quota system as the primary support instrument

1.3. Technology, state-of-the-art and costs of wind energy in Europe [3], [5], [8]

Wind energy technology and state-of-the-art

The kinetic energy of the wind is transformed into mechanical energy by the rotors of wind turbines and then, by generators, into electricity that is fed into the grid. Wind speed is the most important factor affecting turbine performance because the power that can be extracted from the wind is proportional to the cube of the wind speed, e.g. an increase in the long-term mean wind speed from 6 to 10 m/s (67 %), produces a 134 % increase in production. Wind speed varies depending on the season, location, orography and surface obstacles and generally increases with height, creating the wind shear profile. Surface obstacles, such as forests and buildings, decrease the wind speed, which accelerates on the windward side of hills and slows down in valleys. Annual variations up to 20% are normal. A wind turbine starts to capture energy at cut-in wind speeds of around 3 m/s (11 km/h) and the energy extracted increases roughly proportionately to reach the turbine rated power at about 12 m/s (43 km/h), remaining constant until strong winds put at risk its mechanical stability, thereby forcing the turbine to stop at the cut-out wind speeds of around 25 m/s (90 km/h). Once stopped and secured, turbines are designed to withstand high wind speeds up to 60 m/s (216 km/h). Generally, utility-scale wind farms require minimum average wind speeds of 5.5 m/s.

There are two main market sectors: onshore and offshore. The differences include more complex installation offshore, working environment (saline and tougher at sea) and facility of access for installation and maintenance. Also, as the wind is stronger and less turbulent at sea, wind turbine electricity production is higher offshore.

Current onshore wind energy technology is mature although it certainly has room for further improvement, e.g. locating in forests and facing extreme weather conditions. Offshore wind, however, still faces many challenges. There is a third sector, small turbines (up to 10 kW) for niche applications such as isolated dwellings, but this sector is unlikely to provide a significant share of the European electricity supply by 2020.

At the end of the last century, a wind turbine design (the three-bladed, horizontal-axis rotor) arose as the most cost-effective and efficient. The main technological characteristics of this design are: an upwind rotor with high blade and rotor efficiency, low acoustic noise, optimal tip speed; active wind-speed pitch regulation; variable rotor speed with either a gearbox connected to a medium- or high-speed generator or direct rotor connection to a low-speed generator; and concrete, steel or hybrid towers.

Wind turbine design

Out of a wide variety of wind turbines, in the 1980s the Danish three bladed, single fixed speed, stall-regulated turbine became the dominant model in the market at rated power levels of less than 200 kW. Since then turbine dimensions have grown steadily and by 2006, 2 MW turbines were commonly installed in onshore projects. Recently, 2 MW or above is the average size of turbines installed in 2011 in most western countries. The main technological characteristics of current turbines are:

- Steel, concrete or hybrid towers reaching 140m of height.
- An upwind rotor with three blades, active yaw system, preserving alignment with the wind direction. Rotor efficiency, acoustic noise, tip speed, costs and visual impact are important design factors. Some turbine designs have only two blades.
- High-wind-speed regulation. Pitch regulation, an active control where the blades are turned along their axis to regulate the extracted power.
- Variable rotor speed. It was introduced to allow the rotor and wind speed to be matched more efficiently in particular at lower wind speeds, and to facilitate an output more according with the needs of the electricity grid.
- A drive train system where a gearbox adapts the slow-rotating rotor to the needs of a fast electricity generator. However, more and more slow generators are used directly coupled to the turbine rotor.

Although simpler designs are cheaper - in terms of up-front investment- and at times more reliable, this technology has proven to increase efficiency of energy extraction, to allow higher power outputs and –a crucial issue- to provide electricity better adapted to the quality demanded by grid operations.

Increasingly demanding grid codes are having an impact on turbine design. Section 3.1, figure 3.1-2 and associated text explain the different wind turbine configurations.

Technology developments are also occurring in the growing offshore wind industry, where the design of foundations and cable connection is as important as that of turbines. The most popular foundations are monopiles and, to a lesser extent, gravity-based foundations for shallow-to-medium water depths. Table 1.3-1 shows the split of installed foundations per type. Jacket foundations are more expensive than monopiles but they are becoming more common because they are cost-effective for multi MW turbines above 4 MW and at depths of 40 – 60 m. Much less common and, in fact, mainly experimental, are tripod, tripile and floating foundations. The latter are being explored in order to capture the very large resource available in deep-water areas; the first deep-water wind farm is envisaged for 2020 in Japan.

Table 1.3- : Split of world offshore installations by foundation type

Foundation	MW	%	Foundation	MW	%
Monopile	3 092	70.0%	Tripile	85	1.9%
Gravity	626	14.2%	Tripod	30	0.7%
Multi-pile	338	7.7%	Floating	4.3	0.1%
Jacket	241	5.4%	Total	4 416	100%

Source: Joint Research Centre – European Commission

Drive train designs

Drive train design is currently one of the most active areas of innovation. New designs are appearing in the megawatt range using permanent magnet generators (PMGs), some of them direct drive (DD) and others with one, two or three stages of gearing.

Direct drive systems are increasingly popular new designs. The long-term established solution on the market is an excited synchronous generator with wound field rotor design offered mainly by Enercon. At the same time with the historical availability of comparatively inexpensive high strength neodymium magnets, in recent years the direction of development was predominantly towards PMG designs.

Main trends in wind drive-train technologies include:

- Speed variation. Various solutions exist from high slip in a single generator to a variety of variable speed systems.
- Direct drive systems and permanent magnet generators are becoming increasingly more common, often both options together.

For example, on the use of permanent magnets in wind turbines, there exist studies on rare earth elements estimating that 20% of global wind turbine installations between 2015 and 2020 are likely to use permanent magnets, rising to 25% by 2030. For Europe these values are estimated to be 15% by 2020 and 20% by 2030.

Materials

The main components of wind turbines are blades, hub, main shaft, gearbox, generator and power converter, all hosted in a nacelle supported by a bedplate, mounted on a tower. Direct drive turbines have no gearbox and are equipped with a low-speed generator. Blades are made of fibre-reinforced polymers (resins) in the form of laminates or sandwich substructure. Traditionally blades were made of glass fibre and polyester resin. Current materials include as well epoxy resins reinforced mainly with glass fibres, and to some extent with the lighter but more expensive carbon fibres. The blades are mostly produced in two halves, the upper and lower part, and are joined using adhesive bonding. The rotor hub, the main shaft, bearings, the bedplate and the tower are basically produced from different types of low-alloy steels and cast irons. The rotor hub is the structure that provides the coupling of the blades, via the pitch bearings, to the main shaft. The main shaft is made of either quenched and tempered carbon steel by means of open die forging, or it can be made of ductile iron, with its surface characteristics treated, for example with coatings.

Large turbines use gearboxes with at least one planetary stage and, in fact, as gearbox sizes increase more and more, double planetary designs are being developed. A planetary drive is extremely efficient to deliver high reduction ratios in a limited space, and to transmit several times the torque of similarly sized, conventional gear units.

Electric generators are basically made of a rotor and a stator. The materials used include magnetic steels and copper for wirings for electromagnet generators and steel, copper, boron, neodymium and dysprosium for permanent magnet generators. High-temperature superconductor (HTS) generators, still in the development phase, basically use HTS wire and ceramics.

The power converter mostly consists of steel, copper and semiconducting materials. The foundation of a land-based wind turbine typically consists of concrete, iron for reinforcing bars, and steel ferrule used to connect and support the turbine tower.

The details of the use of materials are also highly dependent on the wind turbine configuration. For example, the permanent magnets in PMGs replace the copper windings used in the rotor of electromagnet generators, but also introduce new materials, such as rare earth elements.

Costs of wind power

Like other renewable energy technologies, wind is capital intensive, but has no fuel costs. The key parameters governing wind power economics are the:
- Investment costs (including those associated with project financing);
- Operation and maintenance costs (fixed and variable);
- Capacity factor (based on wind speeds and turbine availability factor);
- Economic lifetime; and
- Cost of capital.

Although capital intensive, wind energy is one of the most cost-effective renewable technologies in terms of the cost per kWh of electricity generated.

The levelised cost of energy (LCOE) is the primary metric for describing and comparing the underlying economics of power projects. For wind power, the LCOE represents the sum of all costs of a fully operational wind power system over the lifetime of the project with financial flows discounted to a common year. It is calculated as the ratio of all costs, namely, capital and operation & maintenance costs, over the expected overall energy production. Hence, its units are for example USD/kWh [costs/energy production].

Capital cost of wind energy

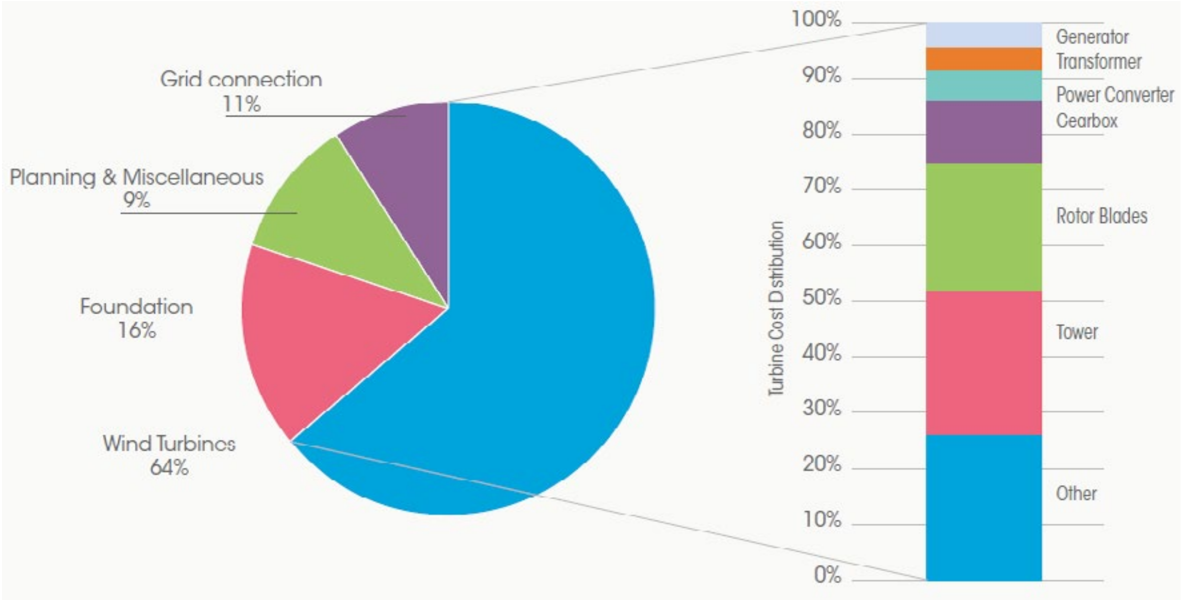
The overall capital cost for onshore wind farms (often referred to as CAPEX) depends heavily on wind turbine prices. They turbine costs account for between 64% and 85% of the total capital costs, with the grid connection, civil works and other costs accounting for the rest. Most, if not almost all, variations in total project costs over the last ten years can be explained by variations in the cost of wind turbines. The capital costs of a wind power project can be broken down into the following major categories (see figure 1.3-1):
- Turbine cost: including blades, tower and transformer

- Civil works: including construction costs for site preparation and the foundations for the towers

- Grid connection costs: This can include transformers and substations, as well as the connection to the local distribution or transmission network

- Other capital costs: these can include the construction of buildings, control systems, project consultancy costs, etc.

Figure 1.3- : Capital cost breakdown for a typical onshore wind power system and Turbine

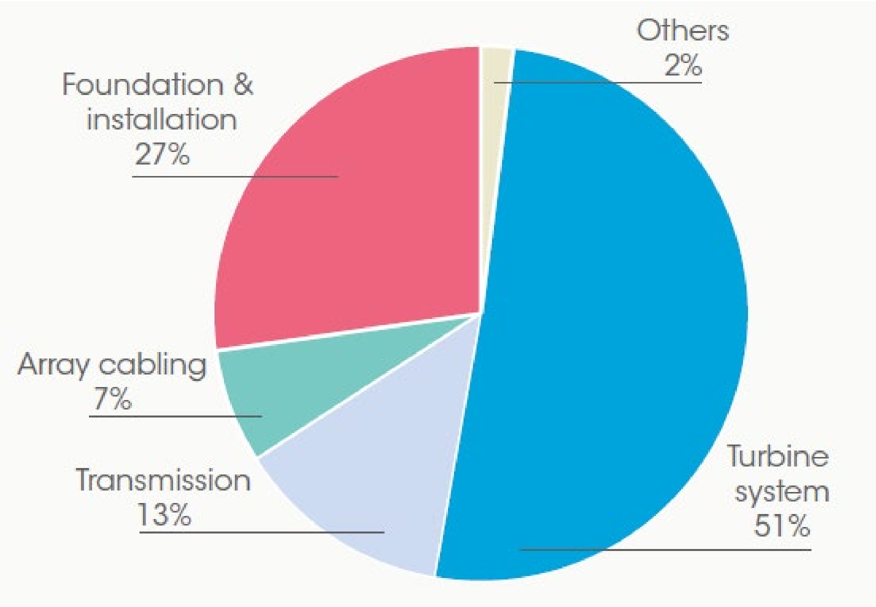


Source: EWEA, 2009

For the turbine, the largest costs components are the rotor blades, the tower and the gearbox. Together, these three items account for around 50% to 60% of the turbine cost. The generator, transformer and power converter account for about 13% of the turbine costs, with the balance of “other” costs being made up of miscellaneous costs associated with the tower, such as the rotor hub, cabling and rotor shaft.

A breakdown of the capital cost structure for offshore wind power systems is shown in figure 1.3-2.

Figure 1.3- : Capital cost breakdown for a typical offshore wind farm



Source: EWEA, 2009

The total installed capital costs, including all other cost factors, are as little as USD 1,300/kW in China and in the range USD 1,850 to USD 2,200/kW in the major developed country markets of the United States, Germany and Spain (see table 1.3-2. See also table X-1 in Annex X for a comparison with other countries).

Table 1.3- : Total installed costs for (onshore wind) in China/India, Europe and North America

	2010	2011 (2010 USD/kW)	2015
China/India	1 100 to 1 400	1 050 to 1 350	950 to 1 250
Europe*	1 850 to 2 100	1 800 to 2 050	1 700 to 1 950
North America	2 000 to 2 200	1 950 to 2 150	1 800 to 2 050

*Note: * These are typical values for the larger European wind markets in 2010 (Germany, Spain, Sweden and the United Kingdom).*

Source: IRENA, 2012

Offshore wind costs remain high at around USD 4,000/kW or more, but installed capacity is still very low, and offshore wind offers the opportunity to have higher load factors than onshore wind farms, increasing the electricity yield, hence cutting down the LCOE. However, O&M costs will remain higher than onshore wind farms due to the harsh marine environment and the costs of access. It is assumed that costs will decline by 8% between 2011 and 2015 to around USD 3,700/kW on average, with costs in the range USD 3,500 to USD 3,900/kW.

The capital costs and the cost of the energy produced by small wind turbines (less than 100 kW) are still higher than large-scale wind turbines. The cost of small wind turbines varies widely depending on the competitiveness of the market and factors affecting installation, but costs for a well-sited turbine tend to range between USD 3,000 to USD 6,000/kW.

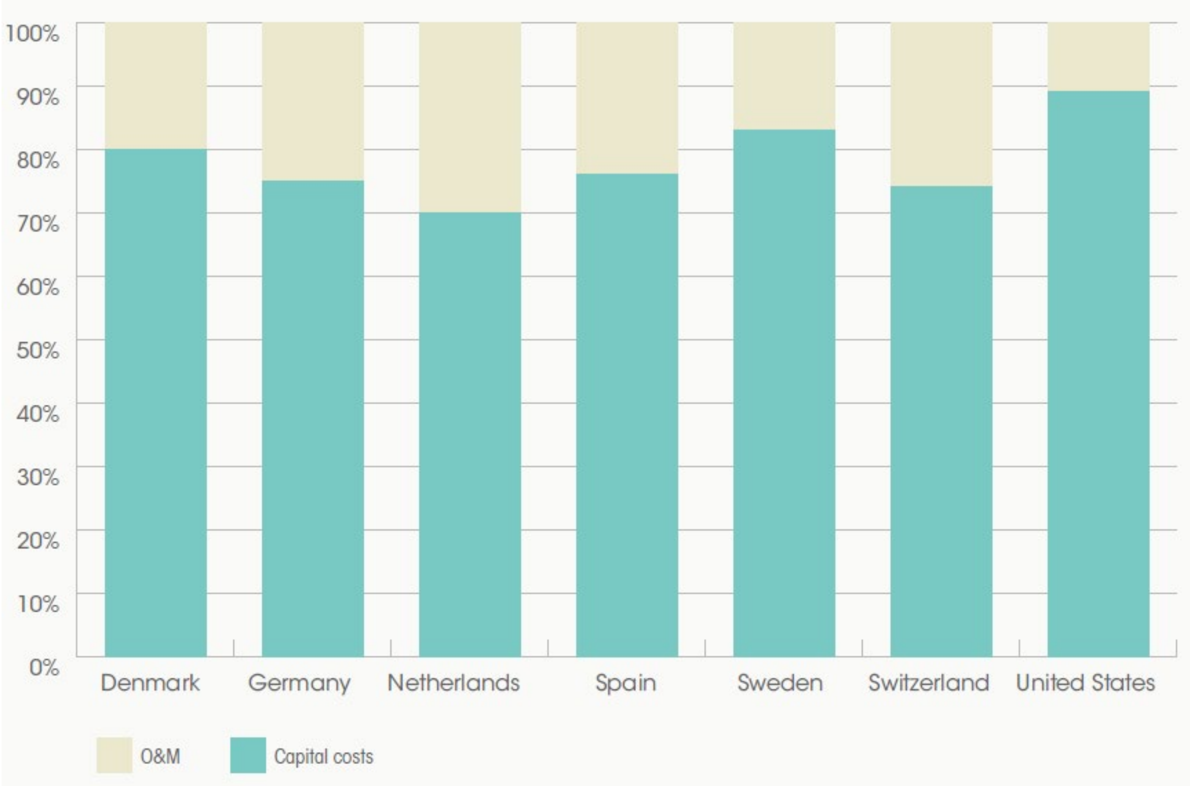
Operation & maintenance costs of wind energy

Fixed O&M costs typically include insurance, administration, fixed grid access fees and service contracts for scheduled maintenance. Variable O&M costs typically include scheduled and unscheduled maintenance not covered by fixed contracts, as well as replacement parts and materials, and other labour costs.

Even though offshore wind offers the opportunity to have higher load factors than onshore wind farms, increasing the electricity yield, O&M costs for offshore wind farms are significantly higher than for onshore due to the higher costs involved in accessing and conducting maintenance on the wind turbines, cabling and towers. Maintenance costs are also higher as a result of the harsh marine environment and the higher expected failure rate for some components.

The overall contribution of O&M costs to the LCOE of wind energy is significant. Data for seven countries show that O&M costs accounted for between 11% and 30% of the total LCOE of onshore wind power. The lowest contribution was in the United States and the highest in the Netherlands (see figure 1.3-3).

Figure 1.3- : Share of O&M in the total LCOE of wind power in seven countries



Source: IEA, 2011

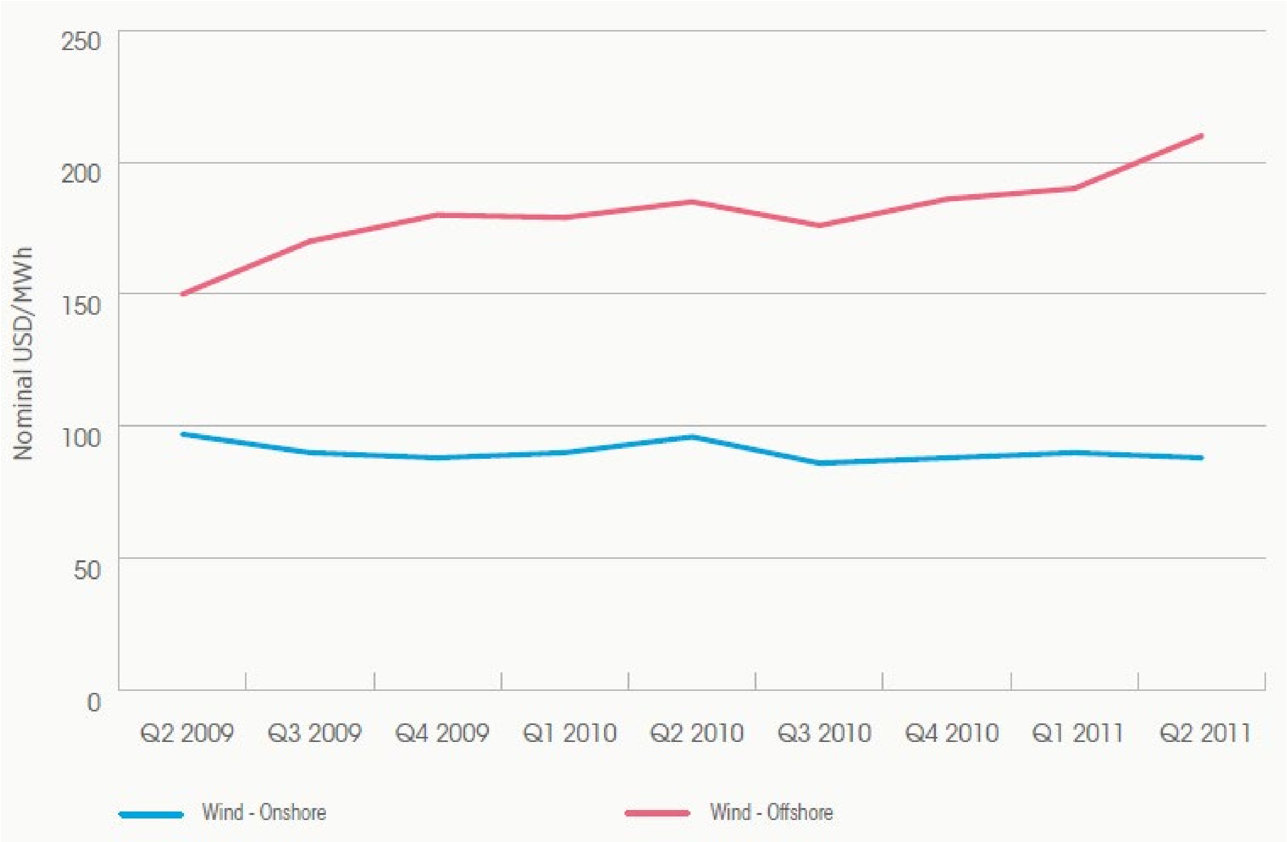
Best practice O&M costs are in the order of USD 0.01/kWh in the United States. Europe appears to have a higher cost structure, with best practice of around USD 0.013 to USD 0.015/kWh. However, average O&M costs in Europe are higher, at around USD 0.02/kWh, even though a trend of convergence at the European best practice level is observed (see table X-2 in Annex X for a comparison with other countries). On the other hand, current offshore wind farms have costs of USD 0.025 to USD 0.05/kWh in Europe. Finally, estimated O&M costs for small wind turbines (less than 100 kW) range between USD 0.01 to USD 0.05/kWh.

Estimates of the LCOE of onshore and offshore wind

The LCOE of onshore wind has fallen strongly since the first commercial wind farms were developed. In Europe the LCOE of wind declined by 40% between 1987 and 2006 for wind farms on good coastal sites. However, the supply chain constraints and demand growth that led to wind turbine cost increases from 2006 also resulted in a slight growth in the LCOE of onshore wind between 2005 and 2010, despite improving capacity factors. Recent analyses estimate the LCOE from onshore wind power projects to be USD 0.06 to USD 0.11/kWh. The LCOE of small wind turbines (less than 100 kW) is in range of USD 0.15 to USD 0.35/kWh.

As can be seen from Figure 1.3-4, the trend in offshore wind LCOE differs significantly from onshore wind, and is increasing gradually rather than decreasing. The main reason for this is the increasing distance from shore. As offshore wind farms are going to be located far from shore, costs increase in all aspects of the supply chain. Turbine prices are increasing due to design improvements to achieve high reliability in the harsh sea environment; and to the larger, more sophisticated wind turbines, in order to increase capacity factors. The construction and cabling costs are also increasing as a function of sea depth and distance from shore.

Figure 1.3- : Wind power LCOE trends for period from Q2 2009 to Q2 2011



Source: BNEF, 2011

1.4. European policy support mechanisms for RES-E
[1], [2], [3], [14], [15], [23], [47]

Different support mechanisms are adapted at different stages in a technology's development: early research and development; demonstration and scale-up; commercial roll-out with economic support; and fully competitive diffusion and maturity. This section considers mainly the policy responses at the stage of commercial roll-out, commonly referred to as "deployment", which are the relevant policy practices as far as this report is concerned. Deployment policies are commonly classified into four categories: fiscal incentives; public finance; regulations; and access policies.

Figure XI-1 in Annex XI gives an overview over main policy instruments used in the renewable electricity sector in the EU; and table XI-1, also in Annex XI, schematically shows their evolution in each Member State from the year 1997 up to 2012. As can be seen, feed-in tariffs, feed-in premiums, quota obligation systems and combinations of these dominate the applied support schemes. Feed-in tariffs (FIT) and premiums (FIP) are applied as the main instrument in 20 Member States, whereas a trend towards feed-in premiums can also be observed. Quota systems with tradable green certificates (TGC) are applied in Belgium, Italy, Sweden, the United Kingdom, Poland and Romania, often in combination with FIT for small-scale projects or specific technologies (Belgium, Italy, UK). Belgium offers minimum tariffs for each technology under its quota scheme, as an alternative to the revenues from the TGC-trade and the electricity market price. Italy offers feed-in tariffs for small-scale applications below 1 MW and the United Kingdom introduced feed-in tariffs for small-scale applications in spring 2010. Tender schemes are not used any longer as the dominant policy scheme in any Member State, but in some cases they are used for specific projects or technologies (e.g. wind offshore in Denmark).

As a simple general classification, support mechanisms can be classified according to four general categories resulting from cross-referencing the period in time (initial investment or generation period) where the Government intervention takes place and the object of support (power installed or energy produced) (see table 1.4-1):

Table 1.4- : general classification of support mechanisms

	Price adjustment	Amount adjustment
Initial investment support	Tax incentives Investment grants	Tendering
Generation period support	Feed-in Tariff (FIT) Feed-in Premium (FIP)	Renewables Obligation (RO) plus Tradable Green Certificates (TGCs)

On the one hand, Governments may decide on the price of the electricity generated (price adjustment), acting either upon the power installed (tax incentives and Investment grants) or the energy generated (feed-in tariffs and premiums); leaving up to the market the amount of renewable electricity produced. On the other hand, Governments may decide on the amount of renewable electricity that should be produced (amount adjustment), once more, acting either upon the installed MW (tendering process defining the amount of power installed) or the MWh generated (renewables obligation plus tradable green certificates); leaving up to the market the price of the electricity produced.

Next, a more thorough classification of policy types is provided:

Fiscal incentives

• Grant and rebates: Non-reimbursable funds offered by a Government to an eligible beneficiary for a specified purpose. Grants (and rebates) help reduce system investment costs associated with preparation, purchase or construction of renewable energy (RE) equipment or related infrastructure.

• Tax credit (production or investment), tax reduction/ exemptions: Allows investments in RE to be fully or partially deducted from tax obligations or income. Reduction in taxes can include but are not limited to sales, value-added, energy or carbon tax, etc.

Public finance

• Investment: Financing provided in return for an equity ownership interest in a RE company or project.
• Guarantee: Risk-sharing mechanism aimed at mobilising domestic lending from commercial banks for RE companies and projects that have high perceived credit repayment risk.
• Loan: Financing provided to a RE company or project by government, development bank or investment authority, usually on concessional terms (e.g., lower interest rates or with lower security requirements).

Regulations

Quantity-driven

Quota obligation with tradable green certificates: All electricity suppliers are obliged to purchase a certain number of tradable green certificates (TGCs) or renewable obligation certificates (ROCs) from RES-E producers, according to a fixed percentage or quota of their total electricity supplied (obligation level[53]). Suppliers can either buy sufficient TGCs/ROCs to cover their obligation or make up the balance by paying a "buy-out" price[54] per MWh not covered by the TGCs/ ROCs. The money raised by the "buy-out" fund is then distributed to suppliers in proportion to their TGCs/ROCs. On the other hand, RES-E generators' income comes from two different sources: selling their electricity at the wholesale electricity price in the electricity market and selling the TGCs/ROCs at the market value they have acquired in the TGC/ROC market. The level of support for a particular RET translates into different ratios between TGCs/ROCs and MWh generated (e.g., onshore wind installations receive 1 ROC/TGC per MWh produced and offshore wind installations are entitled to 2 ROCs/MWh generated, which they can sell afterwards on the ROCs/ TGCs market). This different level of support for different technologies within a quota system is called "banding".

Tendering/bidding: Public authorities organise tenders for a given quota of RE supply and remunerate winning bids on a contract basis at the price resulting from the tender. These energy prices are mostly above standard market levels.

Price-driven: Feed-in tariffs (FITs) and feed-in premiums (FIPs)

FITs allow electricity generators to sell RES-E at a fixed price for a specific period of time (several years or life-time of the plant). In this case, the renewable electricity generator does not participate in the electricity market. Alternatively, the electricity can be sold into the market and the support paid in the form of an additional premium on top of the electricity market price. There exists several design options for a FIT or FIP. Some examples are:

• Stepped or flat tariff: With a flat tariff, the same unit payment is made to all generators, regardless of the type of installation. With a stepped tariff, payments are differentiated by criteria such as technology, size of the installation and the nature of the site. In this way, stepped tariffs aim to avoid over- or under-compensating installations with different characteristics that make them more or less cost-competitive.

• Fixed or premium tariff: A fixed tariff guarantees a fixed price, giving generators certainty about remuneration rates. A premium tariff guarantees a fixed bonus on top of electricity market prices, allowing generators to benefit when energy prices are high, but exposing them to the uncertainty of price fluctuations. Some EU countries offer both fixed and premium tariffs, with generators able to choose their preference. Premiums can also be combined with sliding tariffs using a cap and floor on prices to limit risk.

• Adjustment mechanisms: As time passes, tariff levels must change to reflect changes in generation costs. Options include automatic degression (scheduled tariff reductions), flexible degression (tariff reductions linked to the market growth of a particular technology), ad hoc tariff reviews, scheduled tariff reviews, or a combination of the above. Various options exist for how and when tariff revisions come into effect. In some countries, public spending caps are also used to control costs.

• Duration of support: A longer duration offers greater remuneration to investors but comes at greater cost to consumers. Most FITs guarantee tariffs for 10–20 years.

Quality-driven

Green energy purchasing: Regulates the supply of voluntary RE purchases by consumers, beyond existing RE obligations.

Green labelling: Government-sponsored labelling (there are also some private sector labels) guaranteeing that energy products meet certain sustainability criteria to facilitate voluntary green energy purchasing. Some governments require labelling on consumer bills, with full disclosure of the energy mix (or share of RE).

Access

• Net metering: Allows a two-way flow of electricity between the electricity distribution grid and customers with their own generation. The meter flows backwards when power is fed into the grid and forwards when it is being consumed from the grid. This process lasts up to the end of the 'netting' cycle regardless of whether instantaneous customer generation has occasionally exceeded customer demand. At the end of the cycle net power can be compensated at the retail rate, then the process resumes from scratch.

• Priority or guaranteed access to network: Grants RE supplies unhindered access to established energy networks, provided the safety and stability of the grid is not compromised.

• Priority of dispatch: Mandates that RE supplies are integrated into energy systems before supplies from other sources.

Indirectly, the EU Emissions Trading Scheme (EU ETS), by promoting the investment in clean, low-carbon electricity generation technologies, among other sectors, it also fosters deployment of the CO_2-free electricity from wind energy. The system works by putting a limit on overall emissions from high-emitting industry sectors which is reduced each year. Within this limit, companies can buy and sell emission allowances as needed. This "cap-and-trade" approach gives companies the flexibility they need to cut their emissions in the most cost-effective way. Emission allowances are the "currency" of the EU ETS, and the limit on the total number available gives them a value. Each allowance gives the holder the right to emit one tonne of CO_2, the main greenhouse gas, or the equivalent amount of two more powerful greenhouse gases, nitrous oxide (N_2O) and perfluorocarbons (PFCs).

Finally, as far a supporting renewable energy development is concerned, high-enough, mandatory target setting is of foremost importance, since it sends a clear signal to private investors regarding the reliability and level of commitment of the specific country's support policies.

53. In the UK, the current obligation level for suppliers from April 2012 to 31 March 2013 is 0.158 ROCs for each MWh they supply to customers in England and Wales, in other words, 15.8% of their supplied electricity must come from RES.
54. In the UK, the buy-out payment owed to Ofgem by the suppliers to cover any shortfall in the number of TGCs/ROCs requirement has been set at £40.71 (USD 61) per ROC/TGC for 2012/13.

2. BARRIERS TO WIND ENERGY DEPLOYMENT IN EUROPE

This chapter briefly describes some of the most important barriers to wind energy deployment in the EU. The structure chosen for their classification aims at highlighting the main feature of each group of barriers and at granting them their right weighting, in order to help their understanding and their solution-finding process. Nevertheless, some other categorisations might have been possible since, in many cases, not only these barriers are closely interrelated but they could also be seen as stretching across several categories.

Therefore, wind power penetration in the EU mainly faces five set of barriers, namely, economic; technological and technical; policy, administrative and grid connection; large-scale integration of wind power in the electricity grid; and environmental impacts, social and attitudinal.

2.1. Economic barriers

{1], [2], [3], [5], [6], [8], [9]

This section throws a glance at two very general economic aspects of wind energy projects, that is, the malfunction of power markets in setting the proper price for electricity produced from wind resources, and the perceived financial risks (and the reasons for it) associated to this technology.

Inadequate market pull

Among others, this can mainly be explained by the long-lasting existence of *electricity market failures*.

Electricity markets do not properly factor in the external effects or externalities of power generation. This imperfection of the market is called, in economics, *market failure*. It originates when agents responsible for an activity do not take full account of this activity's impact on society. In other words, costs and benefits for the agent buying or selling in the market are different from those borne or enjoyed by society as a whole when buying the product.

There are two types of externalities, i.e., external costs and external benefits. External benefits, such as those provided by technologies harnessing clean, autochthonous and renewable sources, lead to an undersupply of beneficial goods to society, since the producer of those goods is not fully rewarded for the benefits provided to the public. External costs, e.g., pollution costs, lead to an undeserving excessive demand for a certain activity since the consumer is not bearing the full cost for society.

Besides these environmental positive externalities, there exist other important examples of external benefits from wind power generation or external costs from conventional power plants, from both perspectives, i.e., societal and security of energy supply:

With different degrees, fossil fuel power plants are characterised by being subjected to volatile fuel prices. In addition, the more their holding of a dominant position in the power market the easier it becomes to pass on these fuel price risks to the electricity consumers. Along those lines, introducing wind energy, for which operating costs (including fuel costs, which are zero) are known in advance with great certainty, means introducing a fuel price risk-mitigating power generation technology into the electricity market from which all consumers benefit.

Furthermore, energy prices are crucial for setting up national manufacturing costs, as well as key drivers for price formation, which is why the four global economic recessions have been triggered by oil price rises [3]. Thus, relying on an indigenous energy source and on a technology with predictable electricity generation prices, such as wind power, the system is reducing the overall risk and cost of the national economy and increasing its security of energy supply.

Finally, other than market failures, the still insufficient consumer awareness on wind power benefits, along with the limited consumer influence on the development of this technology, also take the blame for the insufficient market demand-pull as regards the deployment of wind energy technologies.

Financial and project funding risks

This barrier to wind power uptake is largely the consequence of the high upfront capital costs intrinsic to wind energy projects, a poor know-how on wind power project assessment, and the long and unpredictable planning and permitting procedures.

The installed cost of a wind power project is dominated by the upfront capital cost[55] (often referred to as CAPEX) for the wind turbines (including towers and installation). It can constitute more than 80% of the total outlay, while for other non-RE energy systems this cost may remain in the range of 40 to 60%. This characteristic might render wind energy developments unaffordable to potential investors, since they are compelled to secure a substantial volume of financing, which, depending also

55. This cost depends on the cost of raw materials (steel, concrete, copper, rare earths), supply bottlenecks and low competition among second/third-tier suppliers (e.g. in offshore cable supply, drive shaft, brakes, drive-train bearings, etc.), high grid connection costs, administrative barriers, risks and uncertainties perceived by private investors and financial institutions, etc.

on external macroeconomic (like the current financial crisis) and political factors might prove, at best, a fairly difficult endeavour. On top of that, financial institutions, factoring in their perceived extra-risk for certain wind energy projects (mainly offshore wind) may require high interest rates, thus increasing the cost of capital, adding to the already higher upfront capital costs.

Concerning wind project financial viability analysis, it is common that financial markets are not well informed about the benefits of wind energy, about the uncertainty of the alternative options and about the fact that its fuel being free, it may offset the higher capital costs disadvantage by mitigating the overall risk during the operation of the wind farm. Therefore the financial resources needed at the initial stage of the project might readily be rejected in favour of less capital-intensive technologies.

As for the impacts on wind energy development stemming from regulatory and administrative systems for land use, such as spatial planning and permitting procedures, they will be analysed in the section “Policy, administrative and grid connection barriers”, however, this section superficially explores some of the economic components of this barrier:

These regulatory systems and the grid connection costs often have a considerable impact on wind development costs. Furthermore, many European countries bear even a higher cost risk owing to the unclear procedures regarding cost sharing of potential grid reinforcement investments previous to the grid connection of the wind farm.

As a clear example of the barrier, these types of risks make it particularly difficult to efficiently organise tenders for wind power, particularly when it is common practice that the majority of the permitting process takes place after the successful bids have been awarded and therefore many projects risk failing to get permission thus jeopardising their implementation, which is one of the key problems in most tendering schemes

2.2. Technological and technical barriers [5], [7], [8], [9], [10], [11], [13]

Technological improvements will help in reducing the cost of energy (COE) from wind power and in achieving the European objectives[56] as far as the penetration of this technology is concerned; however, other barriers discussed in this document already prevent a more significant deployment of wind energy.

Even so, in order to increase wind power competitiveness against conventional electricity production, improve its efficiency of energy capture[57], reliability, integration into the grid, its adaptation to new harsh environments (e.g., offshore), and to reduce its overall cost, new designs, materials and components are needed.

The technological aspects of wind energy include [8]:

- Wind turbine components: blades, forgings (e.g. main shafts), castings (e.g. hubs, bearing housings), pitch control and yaw systems, generator, gearbox, bearings and shafts, and power electronics.

- Design for manufacture, transport and installation; turbine assembly; testing facilities.

- Offshore foundations design and manufacture; foundations, cable and turbine installation.

- Substations: switchgear, transformers, cables, circuit breakers, etc.

Other aspects as regards wind power integration into the electricity grid, such as interconnections, wind resource assessment, etc., are mostly discussed in the section “Barriers and challenges for large-scale integration of wind power in the electricity grid”. However, those grid integration matters related to the technical requirements (grid codes) wind farms must comply with when connected to an electricity grid are considered here.

The main barriers to overcome or goals that need to be achieved are the following:

Developing large scale turbines (10-20 MW) intended for offshore applications

Meeting the European Commission’s ambitious objectives of enabling a 20% share of wind energy in the EU electricity consumption by 2020 requires a significant portion of that target to be provided by offshore wind power.

Expanding offshore involves not only new technologies, but also upscaling wind turbine dimensions among other things. On the other hand, scaling up turbines faces many challenges, such as achieving a better design which would offset a reduction in the use of materials. This better design should be accomplished by using a systems approach, since modifications in a single component of the turbine will define the new overall response of the whole turbine (system). However, the systems approach might prove difficult for component manufacturers. As an example, a tower manufacturer, in order to reduce cost, might design a thinner tower. In turn, if the new tower design now gives rise to resonance of the offshore substructure, then thicker and stronger foundations might be a possible solution, but it involves a different manufacturer.

Improving reliability of wind turbine components through the use of new materials and designs, decreasing the cost of turbine parts, advanced rotor designs and control and monitoring systems

To further increase reliability, in general, scientists and designers need better knowledge of loads and of load and electrical effects in the mechanical and electrical elements of the turbine. They also require materials and basic components (e.g. electronic components of the electricity subsystems) that can withstand higher temperatures and increase their performance at normal

56. The 2020 European objectives are: achieving an average 20% reduction of wind energy electricity production costs, compared with the state-of-the-art in 2009 and attaining 20% share of electricity from the wind in the final EU electricity consumption.

57. There are now scarcer sites with good wind resources. Therefore, there is a need for more efficient machines at lower wind speeds for a wind power project to achieve economic viability.

operating temperatures.
As regards materials and specific components and subsystems, some important requirements are:

• New rotor blade control systems for very large rotors should be developed and tested.

• Blades need to reduce their cost, become lighter and at the same time see their stiffness increased. As a matter of fact, in some cases the materials already exist but they are still too costly.

• More detailed data is needed to improve the overall design in order to prevent gearboxes from failing due to unexpected loads originated elsewhere, such as those stemming from the turbine rotor or its control system as a consequence of constraining the generator to maintain the same frequency as the grid.

• Permanent magnet electricity generators (PMG) require better-performing magnets, especially at higher operating temperatures. This would bring further reductions in PMG size and as a result, in nacelle weight as well.

• One of the main causes of failure of wind turbines are power converters. More and improved testing of power electronics is necessary, simulating the dynamic behaviour of the wind turbine, so as to reduce their failure rate.

• As for the towers, there exists a trade-off between amount and quality of the steel used, i.e., tower diameter being constant, higher-specification steel grade reduces the amount of steel needed, but at the expense of higher steel unit costs. Solutions need to be found in order to reduce the amount of steel in a tower.

• New materials technically enabling innovative solutions need to be addressed. Some examples are nanomaterials, fibres and polymers for blades and permanent magnets. There is also a need for materials that withstand extreme and harsh operating conditions (offshore, cold climate) and materials that allow an easy automation of component manufacturing.

Further automate and optimise manufacturing processes such as blade manufacturing through cross industrial cooperation with automotive, maritime and civil aerospace

As an example, synergies exist between the offshore sector and the oil and gas (O&G) industry in areas such as the manufacture of installation vessels. This sector can bring in experience and know-how to the offshore wind sector, in particular on substructure installations and on operation and maintenance issues.

Offshore technology

The main challenges revolve around developing innovative logistics including transport and construction techniques, in particular in remote, weather-hostile sites; new stackable, replicable and standardised substructures for large-scale offshore turbines such as tripods, quadropods, jackets and gravity-based structures; floating structures with platforms, floating tripods or single anchored turbine; and manufacturing processes and procedures for mass-production of substructures.

There also exist two important bottlenecks for the uptake of offshore wind power, namely, cables manufacturing and cable-laying vessels. Very large three-dimensional spaces are needed for their manufacturing, which poses local permitting problems, and they are neither cheap nor quick to build.

Grid integration

In order for an electricity grid to operate safely and efficiently from the generation point of view, electrical generators connected to a network need to comply with certain technical requirements, commonly referred to as "grid codes", which, throughout the years have become stricter in respective EU Member States.

Modern wind turbines are able to comply with specific

national grid codes; however, especially as variable wind power penetration into the national electricity mix gains importance, growing efforts need to be made in order for wind farms to increasingly contribute to grid stability. The most common groups of technical requirements electrical generators[58] need to abide by so as to assure stability, safety and efficiency of the network are the following:

• Tolerance: To ensure stability of the system, wind power plants must operate between minimum and maximum voltage and frequency limits. Operating on a wider frequency range basically translates into higher working temperatures for power electronic components. As regards voltage limits, during serious system faults, such as short-circuits, where voltage drops take place for short periods of time, wind farms are required to stay connected to the electricity grid and maintain normal operation[59].

• Control of reactive power: System operators control voltage levels by adjusting reactive power production and consumption by electricity generators.

• Control of active power and frequency response: In order to maintain frequency values within specified limits, transmission system operators (TSOs) require generators to increase or decrease the active power they fed into the grid and control the ramp rates at which this power is supplied or reduced. Pitch-regulated turbines can more easily reduce their output, thus making some room so as to increase it later on at the required ramp rate, should it be necessary. However, accurate negative ramp rates might be more difficult to achieve if the wind stops abruptly and unexpectedly[60].
• Protective equipment: In order to safely deal with a fault in the network, there are requirements on the maximum and minimum levels of fault current that are allowed to flow from the wind turbine to a nearby fault. In addition, protective devices also seek to prevent the disconnection of non-faulty equipment.

• Power quality: This term covers several separate issues that determine the impact of wind turbines on the voltage quality of an electric power network. Its relevance increases when referring to distribution grids (as opposed to the transmission network), since the former are more prone to voltage fluctuations passed on by generators. The group of parameters defining the quality of the electricity fed into the grid are: active and reactive power values, voltage fluctuations (flicker), number of switching operations and harmonic currents.

• Visibility of the power plant in the electricity grid: TSOs need to have access to real-time information on the numerous decentralised power generation units participating in the electricity mix. For the correct operation of the network, and especially in systems with high wind energy penetration, it is crucial that wind farm operators swiftly and reliably transmit the necessary signals to TSOs, such as active and reactive power values, technical availability and other relevant status information.

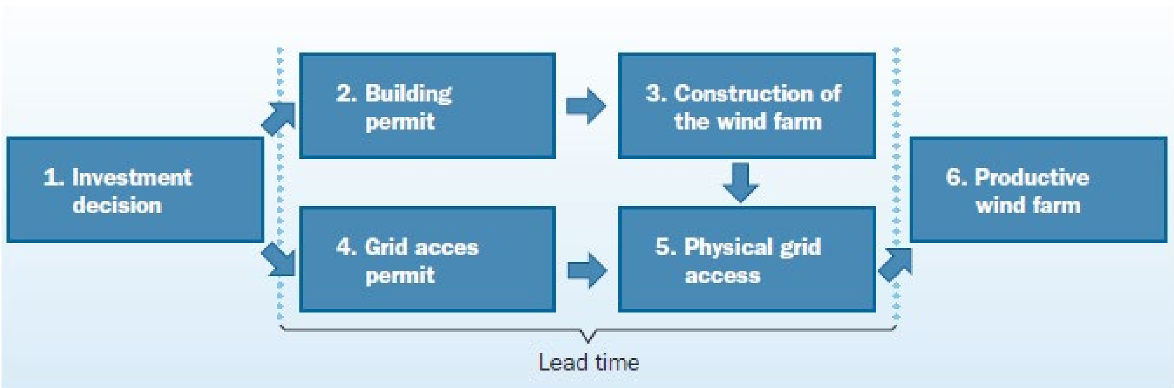
58. In some European countries grid codes have been issued specifically for wind power plants. This practice has been supported by the EWEA.
59. This behavior is known as fault ride-through (FRT) capability.
60. Advanced forecasting tools might be able to predict wind speed reductions, so that wind power output can be gradually reduced before the wind starts slowing down, thereby enabling wind farms to adjust more closely to the required negative ramp.

2.3. Policy, administrative and grid connection barriers
[1], [2], [3], [4], [6], [14], [15], [16]

In EU-27, project developers need to obtain building and grid connection consents in order to install a wind farm and connect it to the electricity grid. This section explores the barriers concerning the acquisition of both types of permits. Additionally, it examines policy-related barriers, regulatory barriers and those involving support mechanisms for the development of electricity from renewable energy sources.

The application steps for building and connecting a wind farm can run in parallel. Figure 2.3-1 below depicts the process. The lead times are calculated from the moment the project developer first submits the permit applications to the point in time the wind farm enters online. Therefore, three different, however interlinked, lead times are generated, namely, administrative lead time, grid connection lead time and total lead time. The average EU total lead time for obtaining all needed permits is 54.8 months for onshore projects and 32 months for offshore. Urgent action is needed to reduce these lead times to the EWEA recommended average of 24 months for both onshore and offshore projects.

Figure 2.3- : Process for obtaining the consent to build and connect a wind turbine

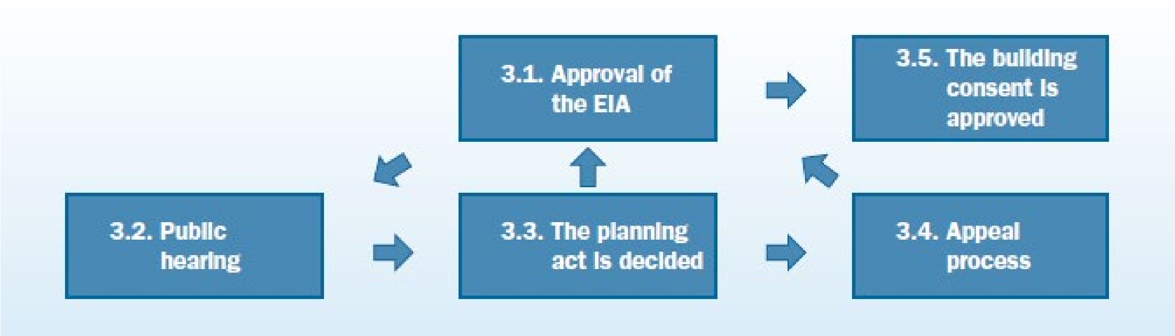


Source: Danish Wind Industry Association (DWIA)

Barriers in administrative procedures

Figures 2.3-2 below summarises the process for obtaining the building permit, by detailing the steps within box 2 of figure 2.3-1.

Figure 2.3- : Process for acquiring the building consent



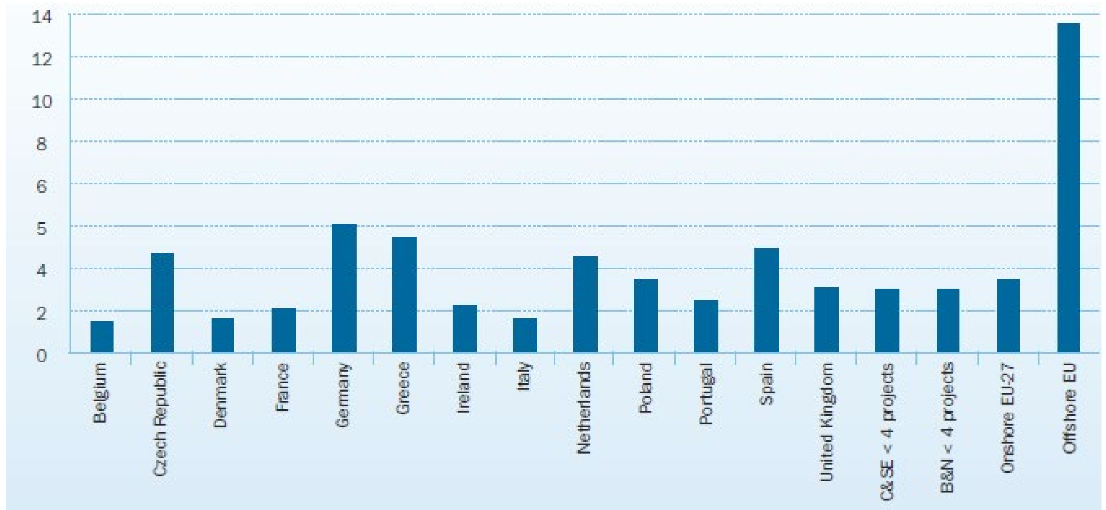
Source: Danish Wind Industry Association (DWIA)

During the approval process of the Environmental Impact Assessment (EIA) disagreements as regards the scope of the EIA and the spatial planning are common, together with the need to contact too many authorities in order to obtain the necessary permits. Approval of the EIA is normally followed by a public hearing, confronting barriers related to NIMBY mentality and to a negative attitude from local authorities. Then, if the planning act does not adjust to the wind farm, the project can either be rejected immediately or compelled to re-enter a new EIA process. The appeal/complaint process very often lack transparent, clear and fixed deadlines, adding to the developers' uncertainty and wasting considerable time while waiting for the outcome of the process. Once/if the building consent is approved, the project developer can start building the wind farm.

The EU average administrative lead time for an onshore wind power project is 42 months (18 months for offshore wind), substantially differing from country to country. The five best performing are Finland, Austria, Romania, Italy and Belgium, whose lead times are less than 20 months. On the other end Greece, Spain and Portugal exceed 50 months on average. According to the EWEA they should be reduced to a maximum of 20 months.

On average, administrative costs in the EU amount to 2.9% of the overall project costs (14% for offshore wind, due to the high costs of the EIA studies); almost doubling EWEA recommendations of 1.5% of total costs. Figure 2.3-3 shows a comparison of the performance in each Member State. These differences in national administrative costs in Europe are explained by varying fees, lead time lengths and number of requested studies.

Figure 2.3- : Administrative costs as a percentage of total project costs in the EU



Source: DWIA and Fraunhofer Institute for Systems and Innovation Research (Fraunhofer ISI)

The most common barriers for developers are the authorisation and scope of the EIA and complying with spatial planning procedures. Along those lines, almost half of the projects are delayed by lawsuits during the EIA phase[61] and a third of them by environmental NGOs' position and activeness during the public hearing stage.

There are also many projects that are blocked during the administrative process. The most common reasons for this are political decisions, EIA, NIMBY syndrome, number of studies, lawsuits and spatial planning procedures.

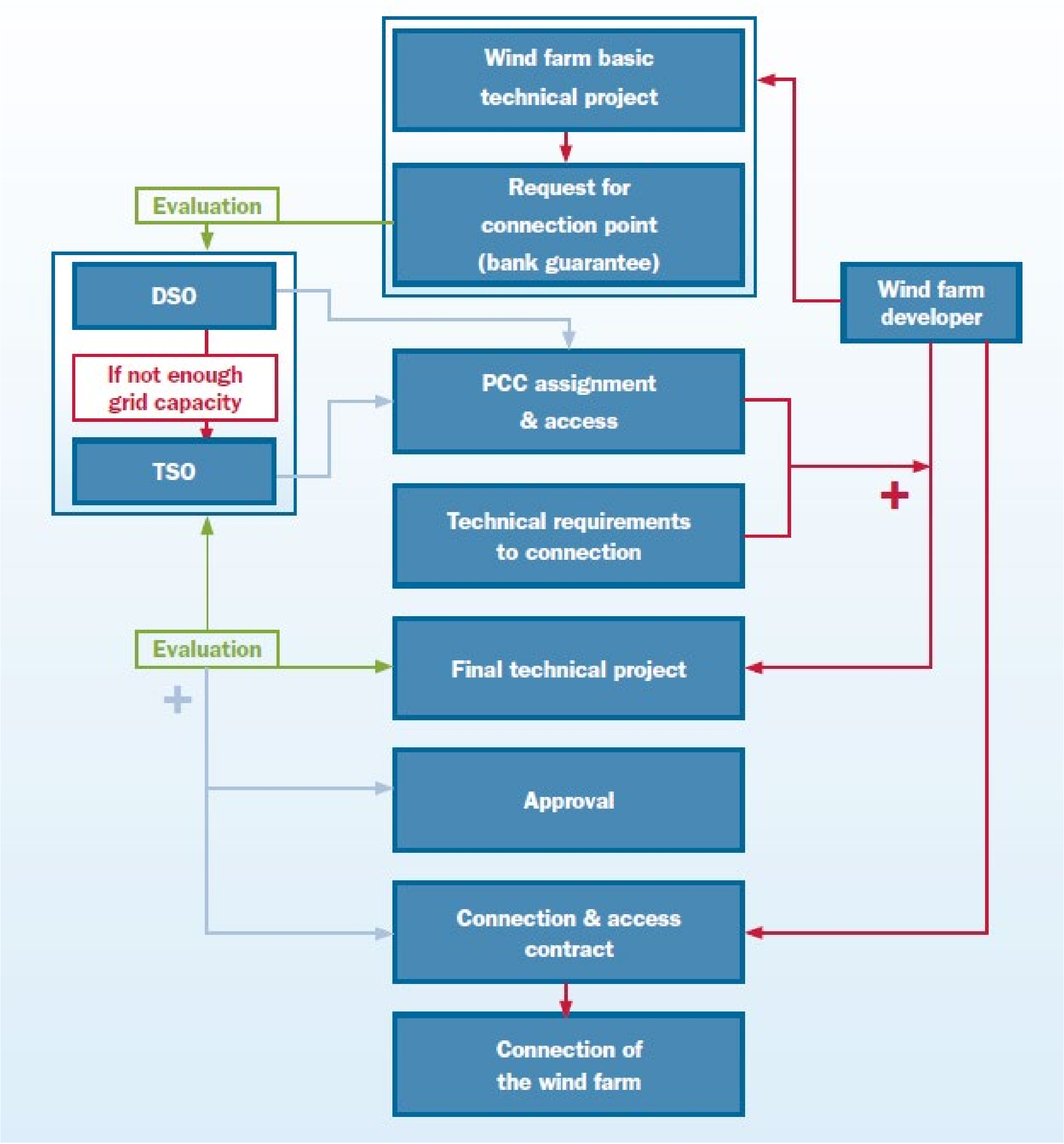
As regards offshore wind power projects, they present shorter total and administrative lead times than onshore, mainly because more efficient and streamlined decision-making processes, adding a Maritime Spatial Planning (MSP) with a strategic impact assessment, have been put in place, thus greatly lowering investment risks for developers.

61. 30% of the aborted projects are due to lawsuits and public resistance

Barriers to grid connection

The sketch presented in figure 2.3-4 models the grid access procedure in Europe, developing boxes 4 and 5 of figure 2.3-1. The main two blocks of this process involve, firstly, the application by the project developer for a grid access permit describing the main technical characteristics of the project, such as the total capacity, layout, chosen point of evacuation, etc.; and secondly, the definition of a connection point and date by the system operator, after having analysed the application and its subsequent versions.

Figure 2.3- : Generic scheme modelling the grid access process in Europe



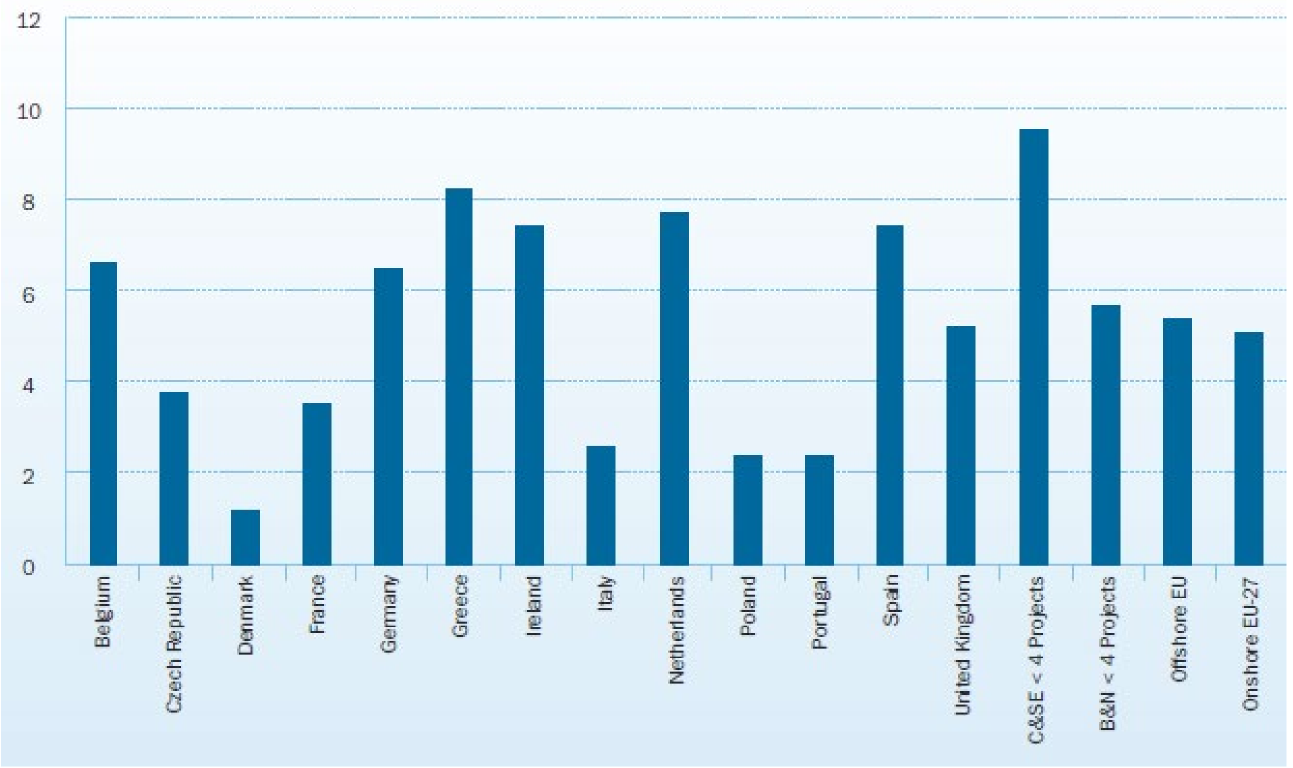
Source: Asociación Empresarial Eólica (AEE): Spanish Wind Energy Association

Common barriers encountered during the evaluation of the project are the lack of grid capacity preventing the connection at the requested point and the overloading of the system operator's treatment capacity due to a high connection demand. During the last step of submission of the final project there might appear delays during the project's evaluation and negotiation of the grid access contract. As for the economic aspects, on the one hand, there is no clear procedure for sharing the connection costs between the grid owner and project developer, and on the other, different national grid codes and other technical requirements are one of the main reasons for the current unequal connection costs among Member States.

The EU average grid connection lead time of an onshore project is 25.8 months (14 months for offshore). There are eight countries performing considerably better than average (Denmark, Austria, Finland, France, Germany, Romania, Belgium and the UK) and five countries operating significantly worse than average, i.e., Ireland, Spain, Estonia, Hungary and Portugal, all of them having going beyond 31 months. According to the EWEA, lead times shorter than six months would be plausible.

Concerning EU grid connection costs, these add up in average to 5.13% of total onshore project costs (5.43% for offshore wind projects, due to the need for grid improvements). Figure 2.3-5 below shows they range between 1% for Denmark and almost 10% for the Central and Southeastern European Countries; Austria, Hungary, Bulgaria and Lithuania exceeding that threshold, deviating far beyond from the 2.5% EWEA recommends.

Figure 2.3- : Mean grid access costs as a percentage of total project costs in the EU



Source: AEE and Fraunhofer ISI

As for projects being brought to a halt at this stage, the main reason has to do with EIA issues and, especially, lack of grid capacity.

Policy and regulatory barriers

Markets with no regulatory policy do not automatically ensure that goods and services are produced and distributed in a satisfactory socially and environmentally manner. Therefore, market regulation to a certain extent is the backbone of public policy. Developing renewable energy policy and its support mechanisms aims at internalising all externalities related to these technologies, which otherwise are not integrated by the market (q.v. section 2.1). Hence, in order to compensate the market failures and provide a fair level playing field for renewable electricity in general, and wind power in particular, government policies need to promote the deployment of this technology via different schemes. This section explains the primary barriers to overcome or objectives to attain when it comes to optimising the current renewable energy policy and support mechanisms for wind power development in the EU.

Firstly, there exist some general renewable energy policymaking barriers which include a lack of understanding by policymakers about a suitable design option to promote RETs; difficulties in quantifying and internalising external costs and benefits; and lock-in to existing energy technologies and policies. That is, many policymakers lack the required knowledge on the available policy options; the way they work and should be implemented; their cost; their main benefits and drawbacks; their experiences and best practices in other countries; etc. Also, there are still some divergent opinions about the interactions between purely climate policies (e.g. Emissions Trading Schemes) and RE policies, which adds to the already complex task of policy design. Last but not least, the strong momentum of the existing and more organised conventional energy system, with considerable lobbying capacity and influence in policy design, dampens the drive for the implementation of new renewable energy policies.

Secondly, there are some features a global support mechanism should fulfil, irrespective of the number of support instruments it aggregates; and designing the correct policy system that satisfies and optimises all of them has been the object of multiple analysis and literature not only around Europe, but also worldwide. Therefore, the underlying barrier is trying to achieve and improve the following characteristics in a renewable energy, and by extension wind energy, support scheme:

• *Support a wide range of RES-E technologies*: Promotion also of currently less cost-efficient and non-mature technologies can stimulate additional research and sustained growth that enables innovation and the development of a manufacturing base –dynamic efficiency-, it can as well encourage diversification and geographical spread. Research studies have shown that the total deployment of two different RES requires longer time period under serial promotion that under simultaneous support.

• *Providing predictability, reliability and long term stability*: A framework characterised by long term stability has been considered by some stakeholders as the most important feature of any support scheme, so as to attract investors and project developers.

• *Optimisation of effectiveness and efficiency*: A support scheme should have the capacity to deliver renewable energy; and at the same time it should do so at the lowest possible cost. Nonetheless, admitting that the financial support must always be equal or higher than the generation costs.

• *Integration into the market and the electricity grid*: The support mechanism should provide “exit strategy” functionalities so as to help RETs progressively play within the liberalised market rules, phasing out support levels as the technology gains competitiveness, so as to leave a functioning and sustainable sector in place. Especially as regards RES-E and their increasing penetration into the electricity grid, features like improving forecast methods, coping and assisting with instabilities from the grid, etc., should be present during the design process of the support scheme.

• *Transparency and simplicity*: Uncomplicated support, with low administrative barriers, clear guidelines and easy to implement largely contribute to consolidate investors’ confidence and attract private investment.

• *Efficient interaction with other schemes and other national policy frameworks*

• *Accuracy in target achievement*: Generally, targets are set by taking into consideration RES potentials, overall economic impact, capacity of integration into the system, etc. Therefore, accurately reaching the target should be given preference over any downward or even upward deviation.

As one of the keystones of any support mechanism, giving transparency and fuelling motivation, it is important that targets be mandatory rather than indicative; so as to reinforce industry confidence and stimulate Government intervention. Moreover, the policy scheme should help the benefits of wind power and other renewables to be felt at local and regional level, at the same time as it increases public acceptance of RETs.

And finally, more specifically, the European support schemes have faced negative and at times, unexpected and counterintuitive results, whose roots, or design defects, need to be eradicated. Some examples are as follows:

• In some countries, high support levels compared to generation costs have been observed, which, despite the important expenditure, have not necessarily led to significant capacity growth. This is usually due flaws in the support instrument, high risk premiums, administrative or grid connection permits, etc.

• In some cases, when the market development is at an advanced stage, the effectiveness has decreased due to saturation effects or reduced policy efforts (e.g. onshore wind deployment in Denmark).

• The use of price-based policy instruments (FIT or FIP) in particular, entails the risk of significant policy costs for consumers if technology prices depress faster than expected or a cost-intensive technology experiences an unexpected boost along its learning curve and, at the same time, support levels for new projects are not quickly adjusted in response. This happened within the solar PV sector in Spain and Czech Republic in 2008/09, in Germany in 2010-11 and in the UK in 2011. The risk also exists, to a lesser extent, in quota systems with technology-specific banding or minimum prices.

• Currently, in all 27 Member States different policy instruments are implemented at national level. At the moment a renewable energy generation plant can only receive support from the country where it is located, and only if that technology is eligible for support in that country. That is a high barrier to RES-E deployment since it undermines the potential economies of scale and increased efficiency a harmonised European support mechanism shall provide.

• When the support mechanism is a quota system based on tradable green certificates, since demand is not consumer driven, but established by the mandatory quota, when the target is close to be met, it can lead to a halt in demand and hence a crash of TGCs’ prices. These uncertainties about the support scheme (e.g. price development of TGC) have resulted in higher risk premium requirements (reduced efficiency) or reduced policy effectiveness.

• One possible drawback for tender systems is that if competition for the concession is too strong, the prices offered might be too low and projects are not implemented. As happened in the UK under their Non Fossil Fuel Obligation (NFFO), in force from 1990 to 1998. As a consequence, the NFFO was not very effective a mechanism in promoting RE deployment. In addition, tender schemes have featured a stop-and-go nature failing to provide a stable investment framework.

• With uniform RE quotas, such as those used in Sweden for example, only lowest-cost RE options have significantly developed, this is because such policies fail to trigger immediate deployment, enhancements and cost reduction of RE technologies which are currently still more expensive [2].

2.4. Challenges for large-scale integration of wind power in the grid

[1], [2], [10], [11], [15], [17], [18]

As wind energy deployment and penetration into the European electricity system has significantly increased over the years, its sustainable integration into the grid has become a key challenge for wind power development. This challenge is system specific and differs depending on the level of wind energy share within the specific electricity mix.

Historical development of wind power in Western Europe indicates that in early market stage, system and grid integration of up to 5% penetration is negligible and the transmission system operator can deal with it very easily, all the better if the system is equipped with modern wind turbine generators, where 10-15% share of electricity generated from the wind is readily being absorbed by some grids. Likewise, medium levels of wind electricity penetration of up to 20% share in the electrical energy demand, depending on the system's characteristics, does not generally face extreme technical or economic barriers.

However, when confronting penetration levels typically higher than 25% of variable electricity[62], new power concepts may be necessary. These already enable proper management of the considerable penetration levels attained in Denmark, Spain, Ireland and some regions of Germany.

More in detail, the small Danish electrical control area has achieved instantaneous wind energy penetration levels of up to 100% of electricity demand; made possible by its strong synchronous connection to the much larger Continental European system. The medium size Spanish and Portuguese control areas, fairly isolated from the European system, have dealt at times with 64 and 71% instantaneous wind power penetration, respectively.

The obstacles for absorbing high penetrations of wind energy are rooted in the partially dispatchable feature of this technology. In other words, wind power cannot be fully controlled (dispatched), since its resource, the wind, is time-varying by nature and difficult to predict. The power output of a wind power plant may vary from zero to its rated installed capacity according to the prevailing weather conditions. Currently the main strategy to control it is by purposely reducing its output, while other dispatchable electricity generation technologies can be simply controlled by increasing or reducing fuel supply, without incurring in primary energy waste.

Therefore, in order to enable the successful integration of wind power into the electricity grid and market, some of the important challenges and barriers, classified in the 6 different areas listed below, are briefly explained:

System design and operation

The main challenges have to do with reserve capacities and balance management, short-term forecasting, demand-side management, energy storage and contribution of wind power capacity assessments to system adequacy as regards forecast and planning.

One increasingly worrying issue when it comes to current methods used by wind farms to provide flexible electricity generation is the frequent resort to "curtailment", with important economic implications at times. It simply means that in order to regulate active power output, wind turbines either stop or reduce the amount of electricity that could possibly be generated should the entire instantaneous wind potential be harnessed. The main flexibility features provided by wind turbines via this method are downward active power regulation (by briefly curtailing production), creating some room for upward active power output (by partially or totally curtailing generation for long periods), ramp rate control or even contributing to stability, when TSOs of small control areas like Ireland are concerned about low system inertia, meaning increased risk of grid instability due to high instantaneous wind energy penetration and low system load. In any case, a properly designed market should aim at zero or near-zero wind power curtailment and load shedding.
TSOs need to balance real time electricity demand in their control area with the generation units they operate. In a system characterised by a medium/high variable wind power penetration, TSOs' requirements for conventional power plants involve additional start-ups, shut-downs, part-load operation and ramping in order to maintain the supply/demand balance. Furthermore, some TSOs often choose to increase the amount of short-term reserves, anticipating the potential decline in wind speed, so as to preserve system security, yet at the expense of higher costs for the system. The additional flexibility demanded from conventional power stations entails less efficient part-load operation, resulting in higher emissions from fossil fuel generators, increases in maintenance costs and wear and tear on boilers and other equipment, and consequently reductions in power plant lifetime.

Along those lines, state-of-the-art wind forecasts are often found to be a key factor in minimising the impact of wind energy on market operation and balance. System operators should make adequate use of short-term wind power forecasting in combination with short-gate closure times[63] to mitigate the need for additional reserve capacity at higher wind power penetration levels.

Also for balancing purposes, experiences from Denmark, Germany, Spain and Portugal show that system operators need to have on-line real-time variable renewable generation data, together with forecasts of expected production. Accordingly, dedicated control centres for wind power, such as those used in Spain, should be implemented to improve the coordination for the joint operation of the European network. This might prove difficult to set in place since wind power plants are sometimes spread out in small clusters and connected to distribution grids.

Not only in autonomous energy systems, like some European islands, where the use of energy storage may be essential, but also in interconnected Member States with high wind energy shares, hydropower with large reservoirs and some pumped hydro are considered good balancing options that need to be implemented.
As regards system design, advanced planning methods are necessary so that upgrade and expansion of the electricity grid is optimised towards the efficient connection of wind farms and other renewables supplying a variable output of electricity and probably distributed over large geographical and remote areas. Specifically, in order for planners to better assess the capability of electric systems to accommodate wind energy, thereby rendering a safe and robust system against likely contingencies, there is a need for considerable progress in the development and validation of electric system models of wind turbines and wind power plants, imitating the generic models of typical synchronous generators already in use in standard software tools for several decades.

Finding out the proper amount of wind power capacity that should be installed in an electricity system in order to reliably meet demand, the model first needs to assign a capacity credit[64] value or firm wind power capacity to the wind energy share in that particular power system with that specific electricity generation mix. This value for wind power ranges between 5 and 40%. The higher end of the spectrum corresponds to a system featuring low penetration of wind power, high average wind speeds, high wind season when demand peaks, low degree of system security, high capacity factor for the overall wind energy mix and good wind power exchange through interconnection. It is important that further progress be made in considering the optimisation of wind power capacity credit values during electric system modelling and design.

In relation to the choice of wind power plants' location, even though the methods for carrying out wind resource forecasts are well established, their accuracy needs to be increased, since wind forecasting has a major impact in predicting a site's energy production, and hence, its profitability.

Finally, strong transmission interconnections to neighbouring countries are needed to provide access to short-term reserves and other flexible resources, especially involving those more electrically isolated

62. Depending on the effectiveness of the forecast methods this variability can be predicted to a certain degree, therefore decreasing the uncertainty, which, otherwise, associated to the variability and high penetration could seriously aggravate the barriers faced by the grid integration of wind energy.

63. This means that in order to control the possible large incidental forecast errors, reserve scheduling should be carried out in time frames that are as short as possible.

64. Capacity credit for wind power is the amount of installed wind power that contributes to the guaranteed or firm capacity of a system. The latter being the value TSOs use to calculate weather they have at their disposal enough reliable (firm) generation to meet the expected demand. The capacity credit will be a fraction of the total installed power for a particular technology. For example, for a fossil fuel unit it revolves around 90%, whereas for a wind farm it ranges between 5 and 40%, depending on several system factors.

Member States.

Grid connection of wind power[65]: involving the continuous adaptation of grid codes and the development of specific wind power grid codes in the framework of the European network code.

Network infrastructure issues: related to congestion management, extensions and reinforcements, specific topics for offshore wind power, international interconnections and smart grids.

In general, wind power plants are distributed over existing networks. However, access to areas of high wind resources (offshore or remote onshore), adding large quantities of wind electricity to the network, often located at a distance from electricity demand centres, requires the addition, extension or upgrade of transmission channels.

In many European countries, the main bottleneck for the integration of higher shares of renewable energy is the lack of transmission capacity, which is why many European systems report the need for new electrical grid infrastructure, not only for meshing consumption and generation centres within the country but also for interconnecting with adjacent Member States or regions. According to the European wind power industry, this situation severely jeopardises the achievement of the 2020 EU's renewable energy objectives.

In addition, one of the pressing challenges to develop network infrastructures for wind energy revolves around coordinating the time disparity between the 2 to 3 year period employed for the entire process of implementing a wind farm, and the 5 to 10 years that takes planning, obtaining permits and constructing a transmission line, mainly because of the lengthy planning and permitting procedures the latter involves, which are strongly influenced by social acceptance problems.

As regards economics, cost allocation mechanisms for multi-country and multi-user transmission lines need to be properly defined, owing its importance to the substantial amount of capital needed for network upgrades.

65. This area has been dealt with in section 2.2 of this report.

Innovative and effective measures need to be deployed such as "smart grids" assisted with adequate monitoring and control methods to manage high concentrations of variable generation, especially at distribution level.

Concerning offshore wind power, a transnational offshore grid should be constructed and its implementation coordinated at European level, in order to connect the expected increase in offshore wind energy capacity.

Electricity market design: defining the necessary power market rules for wind power integration.

The absence of properly functioning markets is a barrier to the integration of wind power. Traditionally, electricity market rules in Europe were aimed at nationally contained power systems with large thermal power plants centrally organised. Barriers include the low level or market access for small and distributed wind power generators and the lack of information about spot market prices in other adjacent markets as part of the allocation of cross-border capacity. In order for a power market to be truly competitive, sufficient transmission capacity is required between the market areas and a suitable legal and regulatory framework is required to enable efficient use of interconnections between participating Member States.

Summarising, in order for the European market to be able to efficiently absorb large amounts of wind power further market integration and the establishment of intra-day markets for balancing and cross-border trade are of key importance.

Institutional and regulatory aspects[66]: financing schemes, framework for cross-border transmission management, etc.

66. Part of this area, such as that dealing with some regulatory barriers and with support mechanism for wind power has been covered in section 2.3

Some regulatory challenges include the development of support schemes for pan-European transmission, the design of harmonised planning and authorisation processes and the establishment of a clear legal framework for cross-border transmission management via binding framework guidelines and network codes.

Research and development: such as connecting offshore wind farms with HVAC and HVDC lines, architecture and operational tools of transmission technologies, virtual power plants, etc.

Research priorities for wind integration are [11]:

Solutions for grid connections between offshore wind farms and HVAC and HVDC grids, and the development of multi-terminal HVDC grids.
Wind power plants that can provide system support, innovative control and operating modes such as virtual power plants.

Balancing power systems and market operation increasing power system flexibility.

Transmission technologies, architecture and operational tools.

More active distribution networks and tools for distributed generation and demand-side response.

Tools for probabilistic planning and operation, including load and generation modelling, short-term forecasting of wind power and market tools for balancing and congestion management.

2.5. Environmental impacts, social and attitudinal barriers

[2], [11], [19], [20], [21], [22], [23], [24], [25]

As with other industrial activities the construction, operation and dismantling of wind power technologies can potentially have damaging consequences on the environment and on human activities and well-being. However, care must be taken when defining the global net impact of this technology and hence the scale of the environmental and social barriers opposing its deployment, since its negative effects should be contrasted with its positive contributions, such as displacing emissions from fossil fuel electricity generation, needing insignificant amounts of water, producing little waste, requiring no mining or drilling to obtain its fuel supply, job creation and local industrial and economic stimulation, which point out only some of its environmental and social benefits.

The main barriers to wind energy development in this section have been classified into three main categories, namely, environmental (ecological barriers, emissions and effect of climate change on wind energy development and on its associated electricity grid), public attitude and finally, human activities and well-being.

Environmental impacts

Ecological effects: Evidence to date indicates that wind farms properly designed and sited, generally do not pose any threat to biodiversity. However, it might happen that individual wind energy projects or plans be harmful to their surrounding protected wildlife and nature areas. On the other hand, there are also examples where wind farms have delivered overall net benefits for biodiversity, especially in areas where the natural environment is already impoverished.

The effect of a particular wind farm on its surrounding environment must be analysed on a case by case basis, owing to the difficulty of its assessment and the fact that it is very much dependent on the locally existent wildlife and the location and design of the specific wind farm.

The study of impacts of wind energy developments on nature and wildlife during the initial construction, operation, repowering or decommissioning phases involve the influence of wind turbines as well as those of their associated installations, such as access roads, construction and maintenance works, anemometer masts, concrete foundations, electrical cabling, substation, control building, etc.

Potentially, the types of ecological impacts on wildlife that might take place are:

Collision risk: bird and bat fatalities on account of collisions with wind turbines and associated structures such as electricity cables and meteorological masts, are among the most advertised environmental concerns associated with wind power plants. The level of collision risk are power plant-, species-, and region-specific, and can vary with site characteristics, season weather, visibility factors, turbine size, height and design.

Certain European studies have found bird mortality estimates ranging from 1 to 12/MW/yr. Other estimations place bat fatality rates between 0.2 and 54/MW/year. The impact on bat populations is of particular concern since they are long-lived species and have low reproduction rates.

Most of the bird fatalities reported in the literature are of songbirds (Passeriformes), which are the most abundant bird group in terrestrial ecosystems, however, raptor fatalities are considered to be of greater concern as their populations tend to be relatively small. As offshore wind energy develops, the alarm has also been raised over seabirds; however, they seem to succeed in detecting and avoiding large offshore wind farms. Research does not suggest that offshore plants pose a much larger risk to birds relative to onshore wind energy.

As regards repowering, switching to fewer, larger and higher turbines in Europe have shown a reduction of the collision risk on birds and a rise on bats, the reason being that nocturnally migrating bats may fly at lower heights than birds.

However, the extent of avian fatalities provoked by wind power technologies should be contextualised by comparing it to the number of fatalities caused by

other anthropogenic factors (e.g., vehicles, buildings, windows, communication towers, etc.), the latter being orders of magnitude higher.

Disturbance and displacement: this risk is applicable to birds, bats and marine mammals. Negative disturbance impacts, which can lead to displacement, include underwater sounds and vibrations and increased human activity (notably during the construction phase and maintenance visits), electromagnetic fields, visual impacts, etc. Conversely, the wind farm physical structures may, however, provide protection for breeding and act as artificial fish aggregating devices (FADs). Nevertheless, additional research is required on those impacts and their long-term and population-level consequences, especially in comparison to other sources of energy supply. In any case, for the time being, the impacts do not seem to be excessively large.

Barrier effect: large wind farms may force birds to change direction, both during migrations and, more locally, during regular foraging activities. The extent of this impact depends on the size, alignment and spacing of the turbines, etc. Anyhow, avoidance of wind farms is common practice among a wide range of bird species and this has been observed not to significantly impact the birds' fitness.

Habitat loss or degradation: habitat loss arising from constructing a wind farm and related infrastructure is determined by its size, location and design. More in detail, onshore turbine bases, substations, access roads, etc., could, if placed inappropriately, involve the direct loss of breeding or feeding habitats for certain birds. As for offshore, its impact risk on direct habitat loss is much less pronounced, however, attention must be paid to weather sandbanks is shallow waters are used by birds as feeding areas.

Mild ecological impacts on local climate might be caused by wind power plants' extraction of momentum from the air flow, which is eventually transformed into electricity. This reduces the wind speed behind the turbines and introduces turbulence, which increases vertical mixing of different layers of air. Some models have found that in areas with substantial wind deployment, changes in surface temperature could attain 1 C and several meters per second concerning surface winds. All the same, the impact of wind energy on local climates remains uncertain and in order to properly assess its severity it should be contrasted with the impact induced by other structures of anthropogenic origin.

Greenhouse gas (GHG) emissions: GHG emissions savings with wind energy far outweigh the direct and indirect emissions it induces. However, although it is a small barrier for wind power deployment, its different sources of emissions must be identified and analysed so as to determine the commensurate actions to reduce them.

First, for comparison and contextualisation purposes, some values for emissions reduction accredited to wind energy will be given and the widely recognised general method lying behind their calculation will also be introduced.

This method is grounded on the "merit order" principle, which is a cost optimisation rule applied in electricity markets. It basically states that plants with the lowest short-run marginal cost[67] (SRMC) are used first to meet demand, with the more costly power plants being brought on-line later if needed. Therefore, as long as the short-run marginal costs of wind power are lower than the price of the most expensive conventional plants, the spot market price of electricity goes down as wind energy share increases, since wind energy is displacing the most expensive and, incidentally, the most polluting generation technologies. This is called the "merit order effect" (MOE).

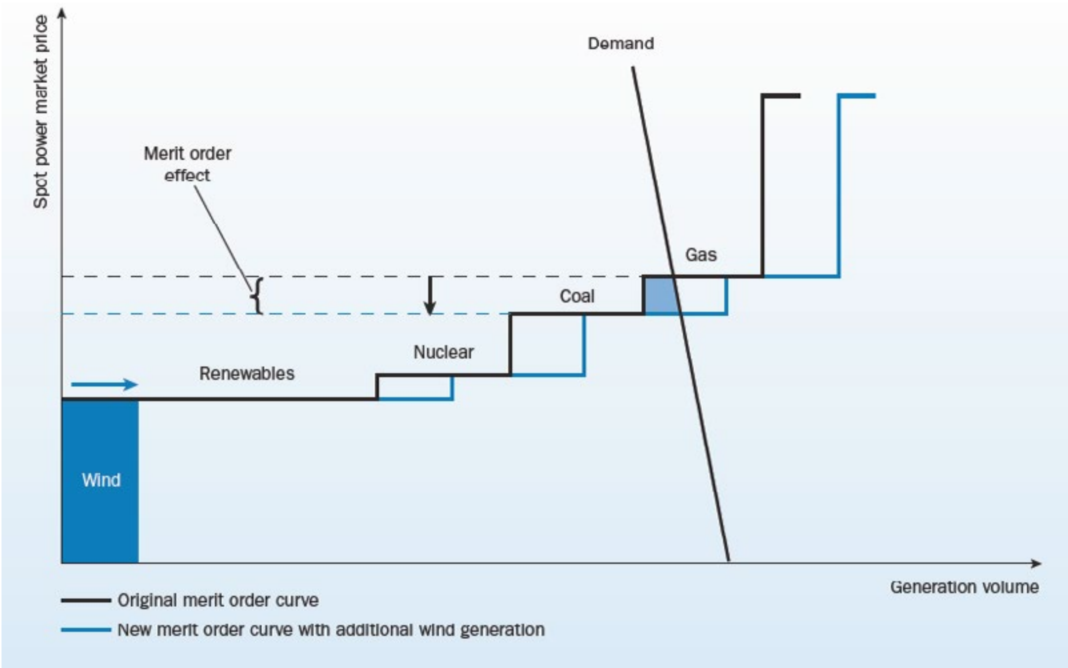
Figure 2.5-1 shows a supply and demand curve for a typical power exchange. As a result of its low operation and maintenance costs and inexistent cost of fuel, bids from wind power enter the supply curve at the lowest level (blue rectangle on the bottom-left corner). In the generic merit order curve in a typical European electricity market, renewable energy technologies are followed by nuclear, coal and CHP plants, whereas gas-fired plants are on the upper side of the supply curve, since they present the highest marginal costs of electricity production. Consequently, should the share

67. These exclude investment costs, so only operation and maintenance costs are accounted for

of wind power go up, the power supply curve will be shifted to the right, illustrated in the figure by the blue "new" merit order curve, resulting in a lower electricity price, which has been determined by the new intersection point of the supply and demand curves.

The displaced technologies happen to be biggest GHG emitters. This implies that wind energy penetration avoids emissions from these technologies, their exact combination being market-specific.

Figure 2.5- : Merit order effect of wind electricity generation



Source: EWEA

As for specific relative values concerning emission savings calculated under the umbrella of this principle, table 2.5-1 shows that CO_2 avoided by wind power installed in the EU alone reaches the equivalent of 70% of the EU's domestic[68] Kyoto target by 2012. It also can be observed that by 2020 wind power has been estimated to avoid 77% of the entire EU domestic target across all sectors.

Table 2.5- : Reduction effort met by wind energy

	2010 (KP)	2012 (KP)	2020 (20%)
Yearly Reduction Effort (Mt)	446	446	1,113
Wind avoided CO_2 (Mt)	126	156	342
Wind % of reductions	28%	35%	31%
Wind % of domestic reductions	56%	70%	77%

Source: EWEA, October 2011

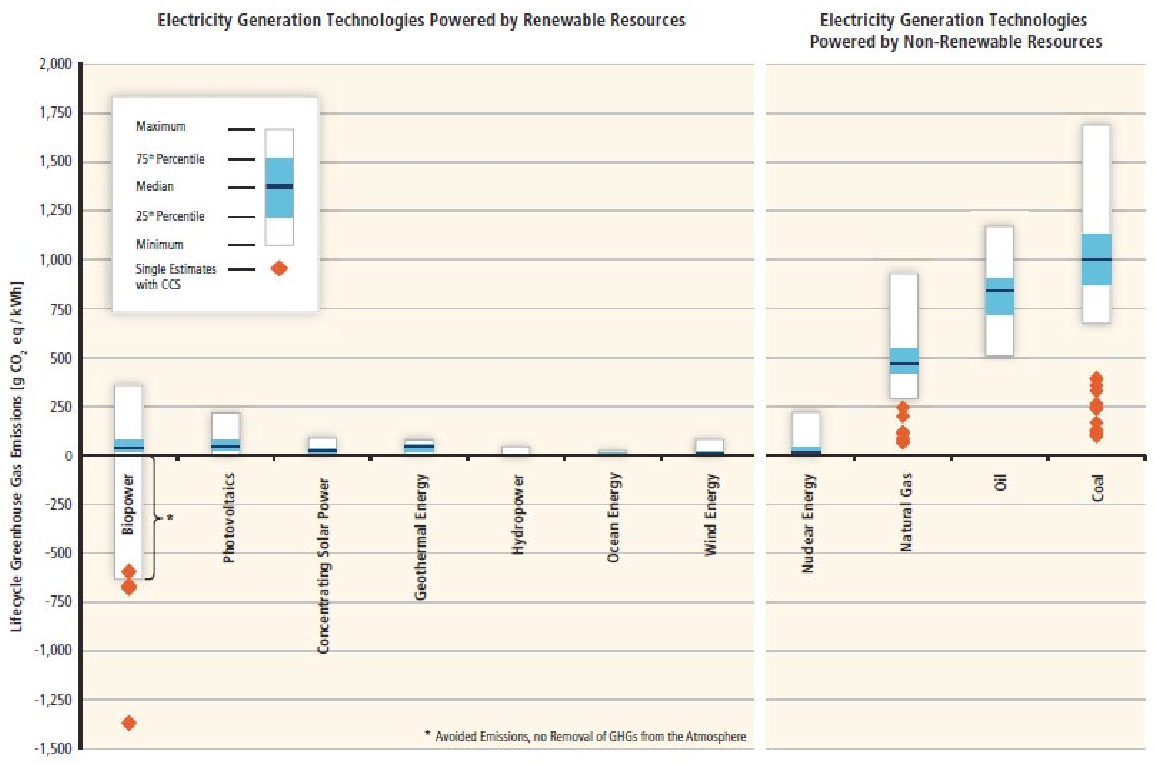
Now, the direct and indirect emissions that can potentially be caused by wind power deployment can be broken down into three main groups, i.e., additional emissions stemming from higher needs of short-term balancing reserves and their adjusted operation to integrate wind energy; lifecycle emissions of the wind power technology; and unintended consequences ensuing interactions between renewable energy and climate policies.

Wind energy penetration increases the need for short-term balancing reserves in order for the system operator to maintain security and reliability of the system. TSOs also need to arrange for additional start-ups, shut-downs, part-load operation and ramping of conventional generation units, which results in lower efficient operation and thus, higher emissions. Some studies have calculated emission penalties of individual power plants ranging from 3 to 8% for a wind energy penetration of 12%.

Other emissions arise from the manufacturing, transport, installation and operation of wind turbines, and their subsequent decommissioning. These are analysed by lifecycle assessment (LCA) methods. The calculations show that the average energy payback time for wind power plants is of 5.4 months. Energy payback time represents the amount of time a wind power plant must operate in order to produce an equivalent amount of energy that was required to build, operate and decommission it. On top of that, the DWIA has estimated that a typical turbine, over its 20 year lifetime, provides almost 80 times more energy than was used to construct, operate and dismantle it.

Figure 2.5-2 shows a comparison of lifecycle greenhouse gas emission for wind energy, other renewables and fossil fuel-based electricity generation technologies.

Figure 2.5- : Estimates of lifecycle GHG emissions (gCO_2 eq/kWh)



Source: IPCC, 2012

Finally, a clear understanding of the interplay among multiple policies is essential in order to address counterintuitive or unintended consequences. For example, adding RE policies on top of an emissions trading scheme could potentially reduce carbon prices, which in turn, could make carbon-intensive technologies (e.g., coal) more attractive compared to other non-RE abatement options such as natural gas, nuclear energy or energy efficiency improvements (rebound effect). However, in the particular European experience, the EU Emissions Trading System (ETS) has not provided the

68. Domestic reduction has been interpreted as 50.01% of total reductions since the Kyoto Protocol states that "*the majority of the reductions shall be made domestically*", therefore, as far as these calculations are concerned, emissions' share from CDM and JI credits have been considered to represent 49.99%.

expected reduction in emissions, since due to the 2008 economic downturn and its resulting lower industrial activity and consumption, it exists a surplus of carbon allowances, dramatically reducing prices for emissions certificates, which does not stimulate CO_2 savings. For that reason, analysts concur that the ETS mechanism and the promotion of RETs have not presented a negative interaction as far as GHG emissions are concerned. In addition, the values shown in table 2.5-1 evince that wind energy has had a major contribution to the CO_2 reductions achieved so far.

Climate change impact on wind energy development: Climate change is expected to have an impact on the electricity sector. That is, global climate change may alter the geographic distribution, the inter- and intra-annual variability of the wind resource, the quality of the wind resource, the prevalence of extreme weather events that may impact wind turbine design and operation, etc.

This possibility might lead to a need to invest in adaptation measures for electricity facilities in the near future. Research in this field is nascent and there are just a few studies that have aimed at specifying and quantifying these needs according to the relevance and expected scale of climate change impacts on the different technologies:

Increased turbulence due to climate change could lead to higher structural loads and higher efforts for corrective maintenance. Also, the lifetime of wind turbines could be shortened, though no quantitative information is available. As regards operation of onshore wind farms, minor impacts from climate change are expected. For instance, a reduction of the average wind speed of 0.3 m/s may only incur a 2% decrease of electricity generation.

For wind electricity, the uncertainty in predicted output of wind farms is relatively large. Therefore, utilities developing wind farms are used to making business cases taking into account significant margins with regard to the expected output of a wind farm. This applies to both onshore and offshore wind farms. In that sense, uncertainties due to climate change are not new, and add only a small margin of uncertainty. Therefore, utilities that operate (onshore and offshore) wind farms are not so concerned about impacts from climate change.

Furthermore, the lifetime of onshore wind turbines is not so long that climate change may impact their design or operation significantly during that period. For offshore wind, investigations as regards the impacts may be needed if foundations would last longer than the turbines.

Overall, however, research to date suggests that these impacts are unlikely to be of a magnitude that will greatly impact the global potential of wind energy deployment.

On the other hand, research on the impacts of climate change on electricity networks, which indirectly affect wind power deployment, is fairly recent. Most has focused on two factors: wind conditions and temperature. Flooding has received attention in EU Member States that have occasionally experienced flood damage.

Evaluating the impacts of climate change and assessing adaptation strategies has been a low priority for network operators in Europe. In the short term, they expect that the changes needed to integrate new variable electricity sources will outweigh the impacts of climate change. Even the impacts of increasing storms and flooding, which are considered most worrying, are relatively minor and unpredictable. The first in-depth analysis has recently started in countries like Sweden and the UK, primarily driven by legislative requirements and recent experience of weather-related damage.

Human activities and well-being

Wind energy development may impact human activities and well-being in various ways. Some examples are: land and marine usage; visual impacts; proximal

"nuisance" impacts that might occur in close range to the turbines such as noise, flicker, health and safety; and property value impacts.

Visual impacts, and specifically the way wind turbines and related infrastructures adapt to the surrounding landscape, are often among the top concerns of communities when it comes to wind power plants. In order to efficiently harness the strongest and most steady winds, wind turbines have increased in size and are often placed at high locations; both features rendering them much more visible.

A variety of proximal "nuisance" effects are also at times raised with respect to wind energy development, the most prominent of which is noise. Concerns about noise emissions may be especially great when hub-height wind speeds are high, but ground-level speeds are low.

In addition to sound impacts, rotating turbines blades can also cast moving shadows (i.e., shadow flicker), which may be annoying for people living nearby.

There is also an almost negligible probability turbines shed parts of or whole blades as a result of an accident (turbines could also shed built-up ice).

Finally, concerns that the visibility of wind power plants may translate into negative impacts on residential property values at the local level have sometimes been expressed. However published research has not found strong evidence of any widespread effect in this regard.

Public attitude

Despite the possible impacts described above, surveys of public attitudes across Europe and in specific countries show consistent and strong support for renewable energy and wind power in particular. Translating this broad support into increased deployment, however, often requires the support of local communities and decision makers.

In general, research has found that public concern about wind energy development is greatest directly after the announcement of a wind power plant, but that acceptance increases after construction when actual impacts can be assessed.

On the other hand, one important barrier to the expansion of the electricity grid, necessary for large wind energy deployment, has been public opposition to new power lines, causing very long lead times.

3. BEST PRACTICES FOR WIND ENERGY DEPLOYMENT IN EUROPE

This chapter intends to gather a summary of the best practices or actions close to being or already implemented in Europe so as to overcome the barriers to wind energy deployment examined in the previous chapter.

The best practices have been organised in four groups according to the type of barriers they were primarily designed to tackle, namely, technological and technical; policy and administrative; grid integration; and environmental and social best practices. That said, this does not mean that one good practice from a particular group will exclusively address barriers defined within that specific group. Far from it, a single best practice will more often deal with barriers belonging to different groups. As an example, policy and planning best practices are aimed, among others, at increasing legal certainty and providing a stable framework and a commensurate level of support, in order to internalise externalities and decrease financial risks (economic barriers); they are also designed for streamlining administrative procedures and shortening planning lead times (policy and administrative barriers); for reducing wind power's negative environmental effects by setting up regional planning practices or zone definitions to avoid protected areas, etc. (environmental barriers); etc.

3.1. Tecnological and technical best practices

While private sector engagement in the R&D process is essential, and ultimately comprises the majority of investment, governments need to play a crucial role in funding R&D; the reason being that private companies are reluctant to accept the high capital investment, associated risk and lengthy process together with the uncertainty of future payoffs involving RE R&D ventures. However, notwithstanding the current national R&D lack of financing for wind energy in some Member States, partially due to the perception that wind energy is a mature technology; at European level important public and private R&D efforts are being made with their lines of action and implementation plans successfully designed and steered by the robust structure in place.

Since 1998 the EU has funded more than 40 projects on wind energy with a total contribution of more than EUR 60 million or USD 80 million since 2002. The projects involved advanced knowledge in components and systems for turbines and farms; integration of wind power into the grid; wind resources forecasting; and demonstration of large scale systems for onshore and offshore wind farms.

Between 1998 and 2005 (Fifth Framework Programme - FP5) the EU funded a number of smaller projects that dealt with a great variety of topics. Building on these projects, larger ones were funded between 2002 and 2006 (Sixth Framework Programme - FP6) that brought together a great number of participants and addressed more ambitious challenges. Since 2007 (Seventh Framework Programme – FP7) the EU has concentrated its support on improving reliability of wind turbines, wind predictability and the integration of offshore wind platforms into the electricity grid.

Among EU plans and initiatives stand out the Strategic Energy Technology Plan (SET-Plan), aiming at supporting the development of low carbon technologies; the European Wind Energy Technology Platform (TPWind), which started as an industry-led initiative officially launched on October 2006 with the full support of the EC and the European Parliament. The Platform is led by a Steering Committee of 25 members, representing a balance between the industry, R&D community and national representatives from European countries. Besides identifying and prioritising areas for increased innovation, it formulates funding recommendations to the EU and national public authorities intended for wind power R&D support. Another initiative is the European Energy Research Alliance (EERA), founded by fifteen leading European Research Institutes[69]. The key objective of the EERA is to accelerate the development of new energy technologies by conceiving and implementing Joint Research Programmes in support of the SET-Plan. One of them is the Joint Programme on Wind Energy, whose goals are providing strategic leadership for the scientific–technical medium to long term research; supporting the European Wind Initiative (EWI) of the SET-Plan and within its scope; initiating, coordinating and performing the necessary scientific research.

The engine behind European RD&D is the European Wind Initiative (EWI), which is one of the eight European Industrial Initiatives (EII) rooted in the EU SET-Plan and whose purpose was to involve the industrial sector in the identification of priorities, objectives and activities as regards RD&D for wind energy. The EWI was launched in June 2010 and is now being implemented by the Wind European Industrial Initiative Team (Wind EII Team), composed of EU institutions, Member States, the EERA and the TPWind. Its budget for the 2010-2020 period is EUR 6 billion (USD 7.8 billion), shared between private and public funding. Its main objective is to make wind one of the cheapest sources of electricity and to enable a smooth and effective integration of massive amounts of wind electricity into the grid. Operationally, the Wind EII Team translates the EWI into Implementation Plans and yearly Work Programmes, in order to ensure its proper roll out. The conclusions and funding recommendations of the Team are validated by the SET-Plan High Level Steering Group, made up of senior EU and national representatives. The EWI is therefore implemented by coordinating all available EU and national funding schemes and focusing them on the priorities identified by the Wind EII Team.

In particular, figure 3.1-1 shows the main four R&D areas on which the EWI focuses and summarises the primary actions within each area, grouping R&D priorities with similar goals (table 3.1-1 lists these actions for period 2013-2015). The areas are called EWI Strands, and include: new turbines and components; offshore structures; grid integration; and resource assessment and spatial planning.

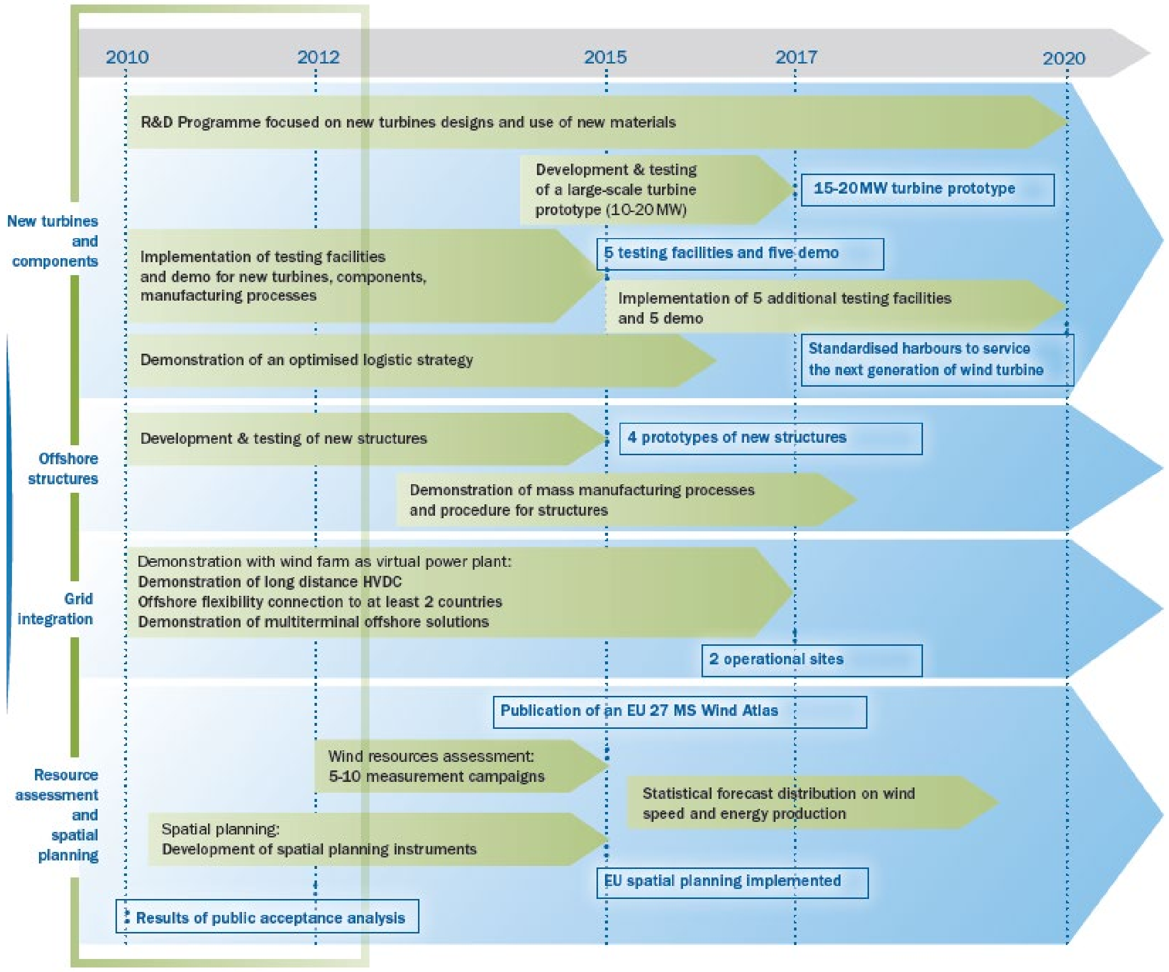
Table 3.1 - : Summary of the main activities within the four EWI Strands for period 2013-2015

New turbines and components	Grid integration
• Introduce large scale turbines and innovative design for reliable turbines rated 10–20 MW	• Connect wind farms to multi-terminal offshore grids
• Improve reliability of large wind turbines and wind farms	• Improve HVDC connected wind power plants
• Optimise and demonstrate turbines for complex terrain and cold climates	• Improve electrical design of wind power plants and connection to networks (AC or DC, onshore or offshore)
• Define methods and standards for testing large wind turbine components	• Develop wind plant modelling for system studies
• Improve size and capabilities of system-lab testing facilities for 10 - 20 MW turbines	• Provide better grid support services
• Provide field testing facilities for 10 - 20 MW to increase reliability	• Test wind power plant capabilities (methods and facilities)
• Encourage mass production of large scale turbines, and develop cost effective methods to transport and install these machines	• Analyse wind power impact on electricity markets
Offshore technology	• Improve wind power forecasting techniques
• Introduce new bottom fixed substructures minimising lifecycle costs	**Resource assessment and spatial planning**
• Devise new modelling techniques	• Analyse wind and weather conditions in the EU
• Facilitate mass manufacturing of substructures and improved logistics	• Study wind resources and loads
• Develop and demonstrate multi-MW floating platforms	• Reduce noise emissions
• Improve facilities, infrastructures and logistics for offshore wind	• Recycle turbines and devise end-of-life scenarios
• Reduce installation noise and environmental impact	• Improve passive and active turbine aerial markings
• Increase reliability and improved O&M strategies	• Analyse wind energy environmental impacts and benefits
• Extend turbine life-time and plan decommissioning	• Improve offshore planning procedures
• Improve design models and practices	• Analyse present and future wind energy costs
• Improve measurement technology	• Analyse the economic and social costs and benefits of wind power
• Develop an EU offshore atlas	• Review the impact of industrial policies for wind

Source: EWI, 2013

69. A list of European research institutions and organisations, members of the EERA can be found in Annex I

Figure 3.1- : European Wind Initiative Research & Development focus



Source: European Commission, "A Technology Roadmap" - SEC(2009) 1295

There exist several EU projects that have been launched to implement the EWI under the support of the European Framework Programmes (FP6 and FP7). One of them is the UPWIND project, which is a large initiative composed of 40 partners and brings together the most advanced European specialists of the wind industry. It is an integrated wind turbine design activity aimed to tackle the challenges of designing very large turbines (8 to 10 MW), both for onshore and offshore. UPWIND focuses on the design tools for the complete range of turbine components. It addresses the aerodynamic, aeroelastic, structural and material design of rotors. Critical analysis of drive train components is also being carried out in the search for breakthrough solutions. A full overview of the rest of the projects is provided in Annex II.

On a global cooperative level the EU is engaged in the Implementing Agreement on wind energy of the International Energy Agency (IEA), where national technology experts and policy experts from 20 countries work together on an agreed R&D strategy.

Next, some examples of lines of action concerning technological evolution and current technology trends are provided:

The most important driver allowing large scale deployment of wind power is diminishing its cost of energy (COE) production, for which efforts focus on minimising capital and operation and maintenance costs and maximising reliability and energy production. These drivers translate into: design adapted to the wind characteristics; grid compatibility; aerodynamic performance; and adaptation for offshore conditions. Technical considerations that cover several of these goals include turbine weight reduction; larger rotors and advanced composite engineering leading to higher yields; and design for offshore installation, operation and maintenance.

Throughout the years the electricity grid codes in the EU Member States have become stricter and now require that wind turbines highly support the grid by having, for example, fault ride-through capabilities and a high-quality electricity output. This, along with the quest for increased wind uptake efficiency, caused an evolution of wind turbine technology from fixed to variable rotor speed; from stall control to blade-individual pitch control; from low output control (no converter) to full output control (full power converter), and so on.

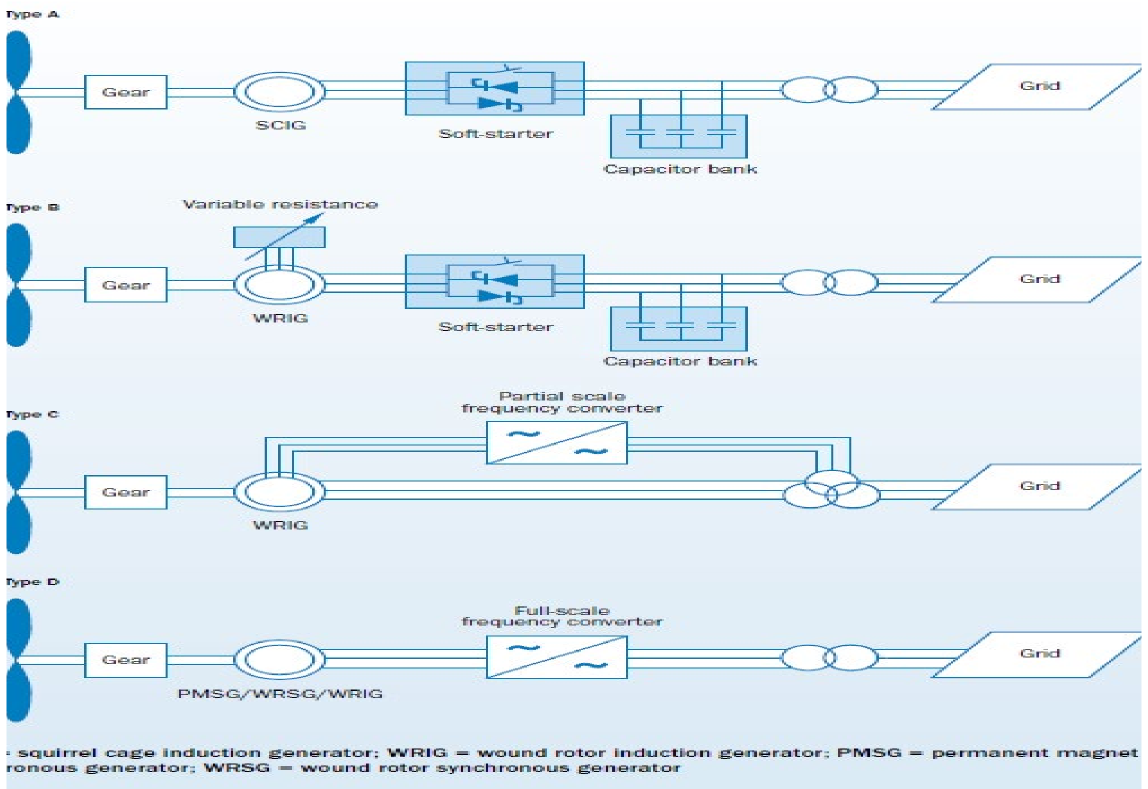
The production of the magnetic field in wind turbine electricity generators is the object of another key technological evolution, from electromagnets to permanent magnets (PMG), providing increased reliability, higher partial-load efficiency, and more flexibility of integration with compact gearboxes or power electronics.

As regards turbine configuration, type C (see figure 3.1-2) is currently the most popular design, but type D offers more flexibility thanks to a full power converter. In particular along with a permanent magnet generator (PMG), a type D configuration allows easier compliance with the most demanding grid "fault ride-through" capabilities required by recent grid codes. The transition from type C to type D is accelerating as power electronics become increasingly more affordable and reduce the importance of one of the key cost arguments for type C, the high cost of power electronics.

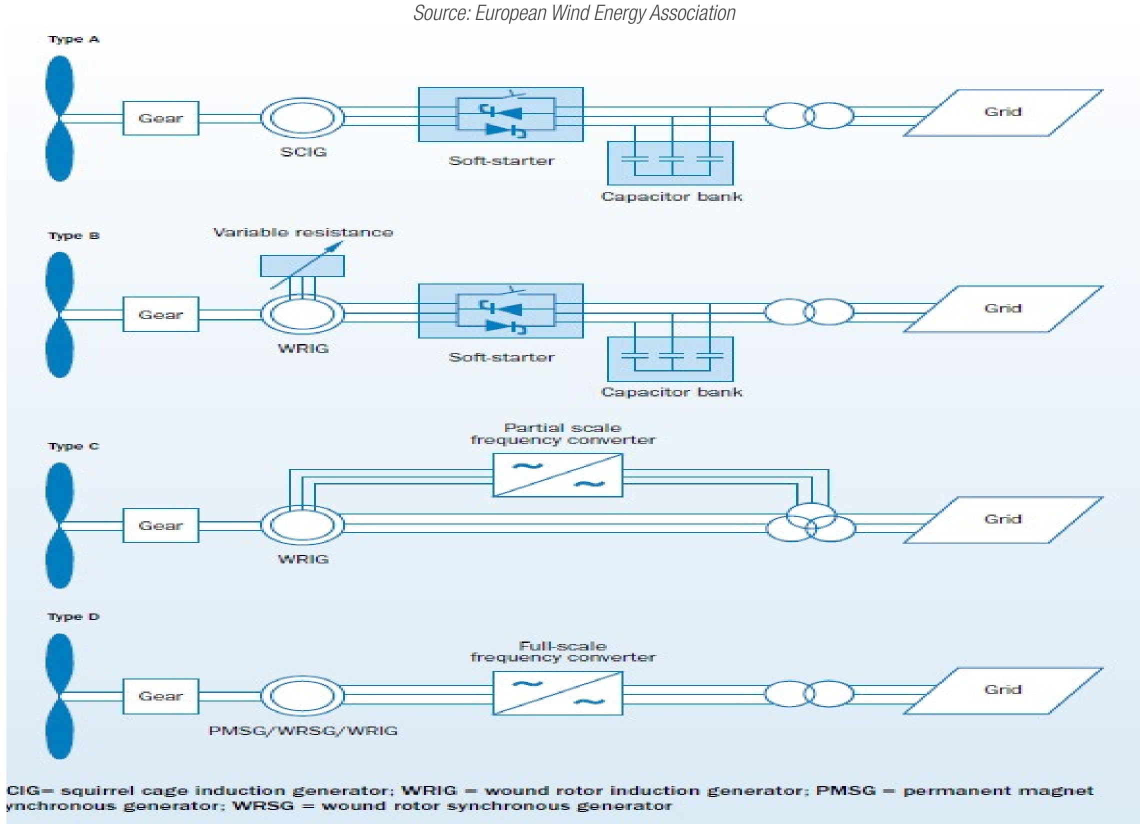
Figure 3.1- : Wind turbine configurations (types A, B, C and D)

Type A
Type B
Type C
Type D

Source: European Commission. Joint Research Centre



Source: European Wind Energy Association



Source: European Wind Energy Association

Even though there are first some necessary developments in terms of power market liberalisation and the implementation of the European internal electricity market, there is a strong initiative stemming from the wind energy industry aimed at harmonising grid code requirements specifically for wind power, which will considerably improve the process of wind power integration.

The trend towards ever larger wind turbines continues. The largest wind turbine now in commercial operation has a capacity of 7.5 MW, and most manufacturers have introduced designs of turbines in the 4 – 10 MW range (up to a total of 43 different designs) mostly for offshore use.

Rotor diameters which, in general stabilised since 2004 at around 100 m, have, during the last two years, started to grow again and nowadays a significant number of turbine designs include rotors with diameters greater than 110 m.

Two key trends in turbine development are towards weight reduction of drive trains and, in general, of the top head mass[70], towards taller towers onshore. However, offshore turbines tend to stabilise hub heights at 80 - 100 m. This is because offshore wind shear is lower and there is a trade-off between taller towers yielding slightly higher production but needing heavier, increased foundation loads involving higher tower and foundation costs.

Finally, mainly because of costs, offshore foundations for deeper waters (30-60m) are expected to diversify away from monopile steel into multi-member (jackets, tripods) and innovative designs.

70. The top head mass (THM) is the weight of all the elements mounted on the tower: rotor (including blades) and nacelle with all its components (drive train, generator, yaw system…)

3.2. Policy and administrative best practices

[1], [2], [3], [6], [14], [15], [16], [23], [27], [28], [43]

This section reviews the most relevant European best practices and the main findings drawn on European experiences intended to overcome, to the greatest extent, the economic, policy, regulatory, administrative and grid connection barriers examined in sections 2.1 and 2.3. However, as noted in the previous section, other barriers, even if to a lesser degree, are also concerned by the effects of the practices and findings included in this section.

The contents have been organised in three different themes, "administrative procedures", "grid connection" and "policy, regulation and support mechanisms".

Administrative procedures

At European level the main global driver for the mandatory national implementation of measures seeking to improve the administrative procedures for renewable energy projects is article 13 on "Administrative procedures, regulations and codes" of the European Directive 2009/28/EC on the promotion of the use of energy from renewable sources, published on 23 April 2009. It states that "all Member States must apply all proportionate and necessary rules concerning the authorisation, certification and licensing procedures for the production of electricity, heating or cooling from renewable energy".

The rest of the article defines the responsibility of the Member States to take the necessary steps in order to ensure:
Clear administrative structures and rules for certification and licensing at all administrative levels: local, regional and national.
All the actors involved in the authorisation, certification and licensing application for renewable energy installations have clear and concise information on what is required.
Administrative procedures are simplified and streamlined at all levels for all stakeholders involved in the authorisation and permitting processes.

Some of the findings that should be implemented by all Member States, after analysing administrative procedures' practices in different European countries and drawing on best performing methods, are as follows:
Performing an Environmental Impact Assessment (EIA). Public authorities should gather data and studies collected under the EIA process and make them public.
Reducing the number of irrelevant documents and making clear requirements on EIAs: fixed deadlines, number of EIAs that need to be carried out depending on the size of the park and its location.
Developing spatial planning by defining the most appropriate locations for onshore and offshore wind development areas. This will lower investments risks and will streamline project application procedures. Along these lines, the European Seaenergy 2020 project seeks to facilitate offshore renewables (wind, wave and tidal) through marine spatial planning (MSP).
Training and allocating enough civil servants to handle the expected applications.
Developing and implementing the one-stop-shop approach in all Member States, where the applicant would have to contact a single entity in charge of coordinating the application process.
The authorities should disseminate clear information to developers on the administrative procedures and decision-making processes.

Grid connection

The global European driver for establishing efficient and effective grid connection procedures for renewable energy projects is article 16 of Directive 2009/28/EC on grid access and technical operation of the grid. It defines Member States' responsibilities concerning renewable energies and grid connections:
Developing transmission and distribution grids.
Providing access to the grid, including priority or guaranteed access for renewables.
Giving renewable energies priority when dispatching, especially in the case of curtailments that should be avoided and clearly justified when they occur.

The rest of the content of the article defines the actions to be taken to implement the above objectives and more specifically to develop new requirements or strengthen existing ones for the TSOs/DSOs. This can be done by modifying the frameworks and rules established in regulations and technical grid codes. These requirements include:
Defining and making public the rules for connection and costs. These rules should not discriminate against new types of electricity production. The article stresses that connection conditions have to be homogeneous for all power generating sources.
Defining how the costs of connection are shared between developers and TSOs/DSOs. In some cases, Member States can stipulate that the TSOs/DSOs share costs or even cover them entirely.
Making information available to all producers: on estimated connection costs, planned time frames for the approval of projects and planned deadlines for obtaining connection at a given point.
The establishment of the distribution and transmission tariffs which should not discriminate against renewable energy sources and especially not dispersed renewable energy sources. These tariffs should be realistic and in accordance with the expected benefits from the plants.

Some of the findings that should be implemented by all Member States, after analysing grid connection procedures' practices in different European countries and drawing on best performing methods, are as follows:
Training and allocating the necessary civil servants to handle the expected applications.
Developing the grid infrastructure: providing clear definitions of grid connection requirements; reinforcing the onshore and offshore transmission system through cooperation between different EU Member States; upgrading the grid within reasonable costs; etc.
Close collaboration with grid operators is required.
The use of the land should be guaranteed for the entire length of the project.
Harmonisation of specific grid codes for wind power at EU level. They need to be realistic and compatible with the latest technology.
Feasibility studies should identify the voltage range for the connection. This will affect the final line tracing and the costs and time schedule.
Clear information about grid costs should be provided to developers at an early stage of project development in order to reduce investment risks.
Unbundling of vertically integrated power companies would make grid access fairer.
Information on the characteristics of the grid should be widely publicised.

Policy, regulation and support mechanisms

Important ingredients for the design of successful renewable energy policies are: the participation of well-documented decision makers and general public awareness, in both cases concerning the advantages of renewable energy development; the available of policy options to support RE, the benefits, drawbacks, costs and reasons to implement these public support mechanisms; the most relevant technical aspects, etc.

Along those lines, at European level its exists the European Energy Network (EnR) which is a mesh of 24 European energy agencies, with responsibility for the planning, management or review of national research, development, demonstration or dissemination programmes in the fields of energy efficiency and renewable energy and climate change abatement.

EnR organises its efforts into eight working groups and addresses them towards joint activities, providing a channel for pan-European technical support on matters of energy policy, strategy, evaluation, programme design and delivery and marketing communications. Set up in 1998, the overall aim of the EnR Renewable Energy Working Group is to contribute to the implementation of renewable energy strategies in the EU and Member States by providing a leading forum for communication and cooperation. Nationally, along with raising public awareness, EnR member agencies provide institutional support to their respective governments and technical advice in all aspects concerning renewable energy, among other things. A list of these energy agencies can be found in Annex III, together with the members of the Renewable Energy Working Group.

Another important mainstay providing political and public capacity building services as far as wind energy is concerned is the European Wind Energy Agency (EWEA). Thus, through its engagement in the political decision-making processes, the EWEA's objective is to facilitate national and international policies and initiatives that strengthen the development of European and global wind energy markets, infrastructure and technology.

One of its roles is to communicate the benefits and potential of wind energy to politicians, opinion formers, decision makers, businesses, the media, the public, NGOs and other stakeholders.

In general, essential requirements for an effective and strong renewable energy policy and support mechanisms are transparency, predictability and long-term stability. Mandatory target setting practices at national and regional level have been found to be effective in this regard. They provide clear signals to private investors regarding the reliability of the countries' support policies. At European level, Directive 2009/28/EC, sets the general mandatory target of achieving 20% share of energy from renewable sources in gross final energy consumption by 2020. Other European objectives by 2020 specific to wind energy involve reaching an average 20% reduction of wind energy electricity production costs and attaining 20% share of electricity from the wind in the final EU electricity consumption.

As concerns support systems for wind energy, the usual justification for their economic support is that they seek to correct market and/or regulatory failures, since various external costs[71] do not appear in the financial calculations surrounding the viability of RETs. However, in reality, owing to the complex and uncertain task of assigning a cost to externalities, the support level for most of the price-based support mechanisms addressed to wind power and other renewable energy technologies is based on estimated production costs and the electricity price rather than on external costs.

Prior to the design of a portfolio of policies, attention should be paid to the interactions between the variety of renewable energy design options considered and the purely environmental policy schemes already in place, since potentially adverse consequences, such as carbon leakage and rebound effects[72] could emerge. However, as observed in section 2.5, because of the extremely low carbon prices, this situation has not been a source of concern in Europe. On the contrary, the EU ETS, by putting a sufficiently high price on carbon and thereby giving an important financial value to each tonne of emissions saved, it would also promote investment in clean, low-carbon technologies, such as low-cost renewable energies.

More in detail and in order to provide a first approach of best practices in Europe having to do with the choice of support mechanisms for renewable energy, it is noted that most Member States have opted to support the use of renewable energy through regulating either price or quantity of electricity from RES. That is, either through price-based (feed-in tariffs and feed-in premiums) or quantity-based (quota system based on tradable green certificates) systems. Price or quantity regulations are applied only to the supply side of the electricity market rather than the end consumer. This means that the supplier of wind energy is either paid an above-market price for the energy leaving up to the market the amount of RES-E produced[73], or the supplier is guaranteed a share of the energy supply (or installed power) while the market determines the energy price.

The number of Member States using feed-in tariffs (FIT) and premiums (FIP) has increased steadily from 9 in year 2000, to 18 in 2005 and 24 in 2012. 20 out of 27 Member States use feed-in systems as main instrument, and a trend towards feed-in premiums can be observed. Quota systems with tradable green certificates (TGC) are applied in Belgium, Italy, Sweden, the UK, Poland and Romania, often in combination with FIT for small-scale projects or specific technologies. In addition, FITs and FIPs have been the dominant regulatory instrument in developed and developing countries alike and by early 2012, 65 countries worldwide where using them. On the other hand, tax incentives and Investment grants; and tendering schemes are not normally used in Europe as the main policy scheme, but as additional policy tools, complementing quota systems or FITs/FIPs.

With regard to the evolution of design options for the support schemes, towards the end of the 1990s most of the feed-in tariff schemes were modified to diminish RE investors' rent-creating potential, as from a public policy point of view this was deemed an undesirable effect. Hence the schemes were amended to include limits on the length of the time period or the number of full load hours, for projects eligible for FIT support. Other frequent modifications were the yearly automatic degression of tariffs (for new plants) in order to adapt revenues to the learning curve of the technology (lower costs) and the differentiation of tariffs in relation to the size of the wind resource or the actual production on each site. In general, most of these schemes are differentiated so that different sources of renewable energy receive different tariffs.

Before entering the comparative analysis of the main support mechanisms in Europe it is essential to highlight the importance of two features of RE policy that have been key to maintain investors' confidence, namely, guaranteed grid access and priority of dispatch. Driven by the EU Renewable Energy Directive, some European countries, particularly those using FITs/FIPs, have implemented connection regulations stating that if certain stability criteria are fulfilled, TSOs must guarantee connection to the grid of RE power plants and priority of dispatch, in case of capacity conflicts, of renewable energy over conventional energy[74]. Closely linked to these policy options and similarly stemming from the RE Directive is the appropriate allocation of grid connection and reinforcement costs between TSOs, DSOs and RE producers, whose allocation rules should be clearly stipulated.

Firstly, concerning the complementary support schemes some identified best practices and lessons learned are outlined next:

Tax incentives and investment grants: They are often used as supplementary support to address upfront costs of wind farms. They have also proven to be useful in the early stage of market development to foster demonstration projects. In addition, according to the IEA, a combination of tax credits and financial incentives has fostered substantial growth in wind power.

Tender schemes: Renewable energy tenders are used in a number of Member States, especially for offshore wind[75]. They have had, however, a very bad track record in Europe, even though theoretically they (as well as quota systems) make optimum use of market forces. The obstacles faced were that government tendering systems in particular have often had a stop-and-go nature that has not been conducive to stable investment conditions. In addition to private investment-related risks, there is also the risk that low-bid projects may not be implemented, partly due to lack of penalty for non-delivery, long project lead times and complex spatial planning procedures. It is believed that spatial planning studies carried out before the bid has started, defining suitable areas for wind energy development, plus strong penalties for non-completion of the project should considerably improve tender schemes' efficiency and effectiveness.

Secondly, follows a comparison between the two main policy schemes drawing on European studies and experience:

Feed-in tariffs and Premiums vs. quota systems based on tradable green certificates:

Figure 3.2-1, shows that countries with the highest average effectiveness during the period studied (Germany, Spain, Portugal and Ireland) apply feed-in tariffs to promote electricity produced by onshore wind power plants. It also illustrates that these countries enjoy an "advanced deployment status indicator" for onshore wind, characterised by established market players and fully mature wind onshore technology. Whilst Germany and Spain effectively supported onshore wind electricity before 2003, the onshore wind development in Ireland and Portugal caught up after 2004. Regarding Ireland, the change from the tendering system to a feed-in tariff, which took place in 2006, helped to speed-up the development of onshore wind energy.

71. Some of these externalities have been examined in section 2.1

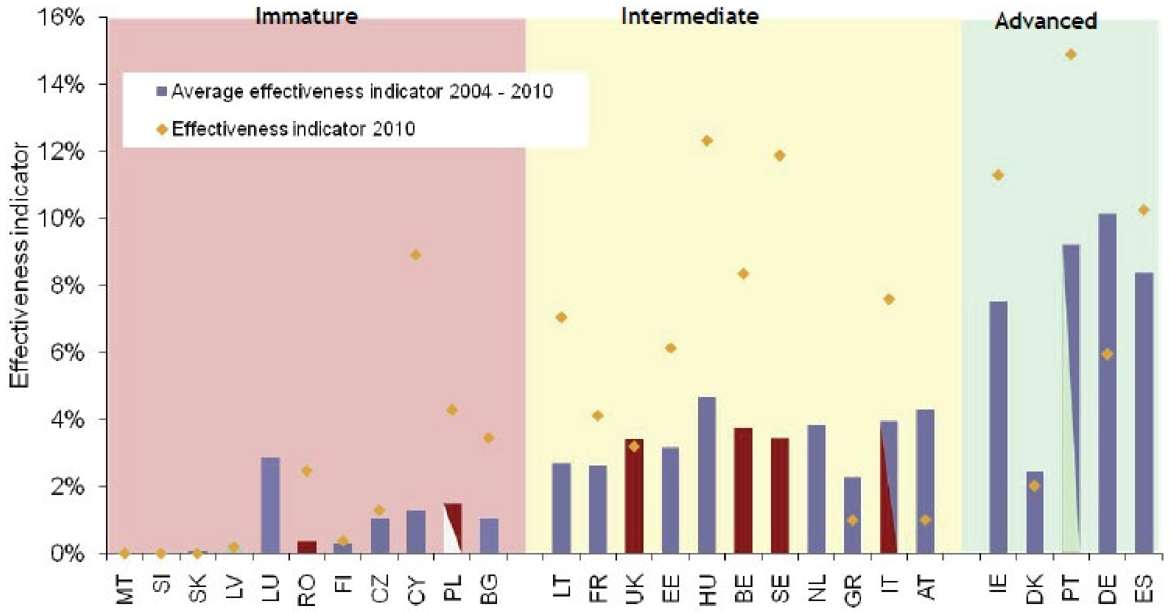
72. Carbon leakage: RE policies in one jurisdiction or sector reduce the demand for fossil fuel energy in that jurisdiction or sector, which, other things being equal, reduces fossil fuel prices globally and hence increases demand for fossil energy in other jurisdictions or sectors. Rebound effects have been explained in section 2.5 of this report.

73. except for those systems with capacity caps, such as Spain with PV

74. In some countries, a FIT/FIP is defined for electricity from renewable energy sources in combination with a purchase obligation for the system operator. In such a case, priority access has inherently been given.

75. Denmark combines feed-in premiums and tender procedures for offshore projects

Figure 3.2- : Policy effectiveness indicator for EU-27 onshore wind farms (2004-10)

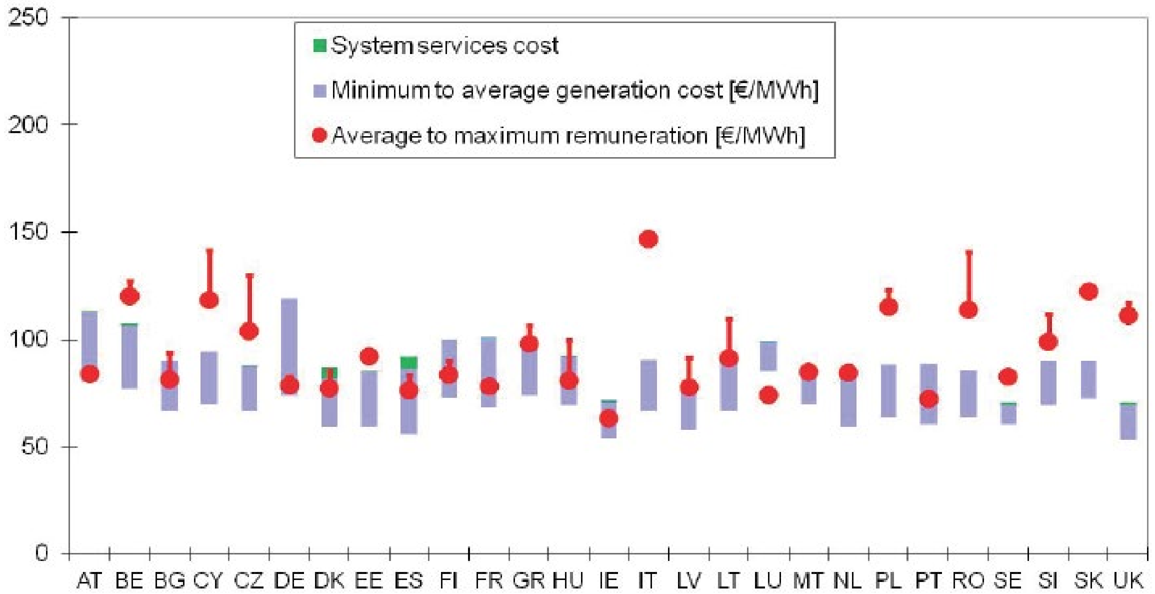


Source: Mario Ragwitz et al. *Project RE-Shaping. Intelligent Energy Europe. February 2012*

From figure 3.2-2 it can be observed that almost all EU Member States appear to provide a sufficiently high level of support (compared to the generation costs) for onshore wind electricity. Only in Luxemburg is the support level slightly too low to cover the lower limit of electricity generation costs. In contrast, countries applying a quota obligation with tradable green certificates such as Belgium, Italy, Poland, Romania, and the UK provide a support level which clearly exceeds the average level of generation costs. The feed-in tariff in Cyprus is comparatively high. The system services costs (grid extension/reinforcement costs and balancing costs) displayed in the figure notably contribute to the generation costs in Denmark, Spain and the Netherlands.

Figure 3.2- : Remuneration ranges onshore wind in 2011 (EU-27)

Average to maximum remuneration compared to the long-term marginal generation costs (minimum to average costs)

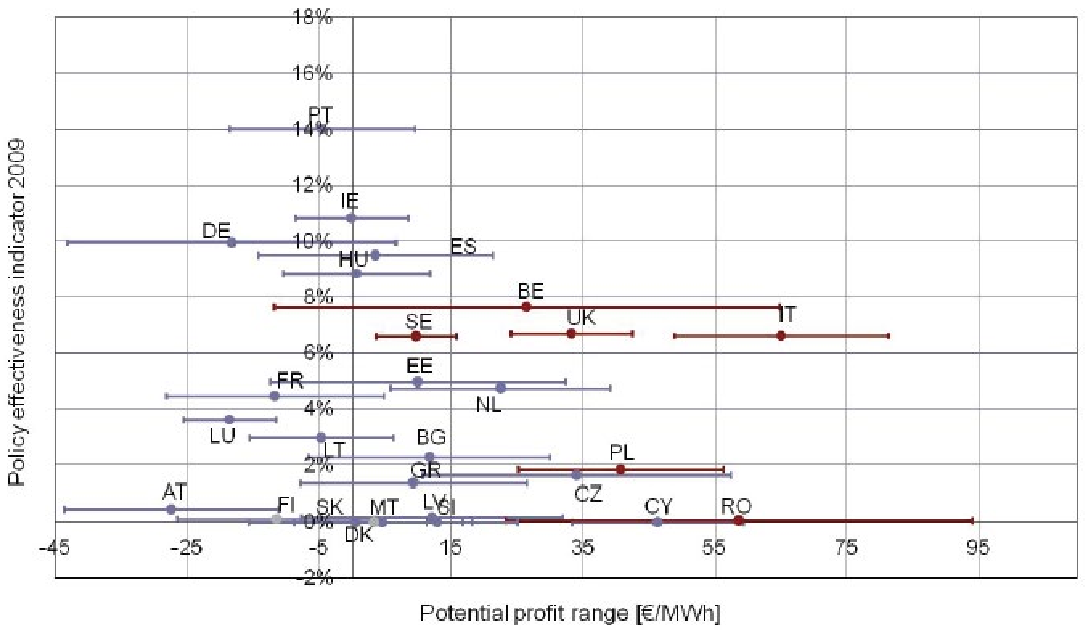


Source: Mario Ragwitz et al. *Project RE-Shaping. Intelligent Energy Europe. February 2012*

The combined illustration of the expected profit from an investment in onshore wind power plants and the policy effectiveness indicator (see figure 3.2-3) shows that, in general, the countries using feed-in systems such as Portugal, Ireland, Spain, Hungary and Germany have achieved higher policy effectiveness at reasonable profits in 2009. The effectiveness of countries supporting onshore wind power plants with a quota obligation including Sweden, Belgium, the UK and Italy, has clearly improved comparing the year 2009 with previous years, by about 6 to 8%. However, compared to most countries applying feed-in tariffs, it seems that the quota system still generates considerably higher profits for onshore wind electricity, involving higher risk premiums and windfall profits for investors, which means higher costs for consumers. In the Eastern European countries of Poland, Romania, Cyprus, the Czech Republic and Latvia we observe a very low effectiveness despite high potential profit opportunities. The Austrian feed-in tariff is apparently too low to stimulate further investments in onshore wind power plants.

Figure 3.2- : Potential profit ranges and policy effectiveness indicator (onshore wind 2009)

Potential profit ranges (average to maximum remuneration and minimum to average generation costs) available for investors in 2009 and policy effectiveness indicator for onshore wind in 2009. Combining concepts of figures 3.2-1 and 3.2-2.



Source: Mario Ragwitz et al. *Project RE-Shaping. Intelligent Energy Europe. February 2012*

One of the intrinsic effects of uniform RE quotas, for example in Sweden, is that only most mature, lowest-cost RE options achieve notable levels of deployment. To overcome this drawback, technology-specific support can be introduced via a banding approach (e.g., UK and Italy).

The higher risk under quota systems includes price risk (fluctuating power and certificate prices), volume risk (no purchase guarantee), and balancing risk; all three risks increase the cost of capital. It should be noted that in the last years (e.g. in the UK) quota system risk for investors has been reduced substantially – from an investment risk perspective the system has evolved in the direction of a less risky feed-in premium system[76].

With regard to market compatibility, the policies are quite different. Under a FIT with fixed payment or tariff, a RE producer is assured of selling all generated electricity at a fixed price into the power market; with all other

76. In the UK Renewables Obligation 'headroom' was introduced, reducing the revenue risk of extremely low certificate prices when the quota is reached. Headroom works by providing a set margin between the predicted RE generation (supply of TGCs) and the level of the obligation (demand of TGCs). This helps reduce the possibility of supply exceeding the obligation and thus crashing the value of TGCs. This allows investors feel more confident that there will always be a market for their TGCs.

systems (including quota systems and FIPs), generators must participate and compete directly into the power markets, without assurance on the price obtained for their electricity. Because electricity market prices do not influence the remuneration of generators in fixed-payment FIT systems, there is generally no incentive to produce power according to market demand and/or to react to price signals.

Although they have not succeeded in every country that has enacted them, price-driven policies have resulted in rapid renewable electric capacity growth and strong domestic industries in several countries, most notably Germany and Spain. In addition, the IEA argues that the key for countries like Germany, Spain and Denmark has been high investment security. This has been partly produced by the higher certainty provided by long-term guaranteed fixed prices.

Below there is a list of best-practice design elements and lessons learnt from the European experience:

• Utility purchase obligation.
• Priority access and dispatch.
• Clear connection standards and procedures to allocate costs for transmission and distribution.
• Different tariffs based on cost of generation: differentiated by technology type (technology differentiation design) or project size and wind yield (stepped tariff design, within the same technology), with carefully calculated starting values.
• Regular long-term design evaluations and short-term payment level adjustments[77], with incremental automatically defined tariff degressions[78] built into law (transparency). The tariff/premium level depends on the year (or quarter) the RES-E plant starts to operate. Each year the level for new plants is reduced by a certain percentage. It provides incentives for technology improvements and cost reductions. Examples are Germany, Greece, Slovenia and Spain.
• Tariffs guaranteed for a long enough time period to ensure adequate rate of return.
• Support for autoproducers through net metering: was introduced in a number of countries with the aim to decrease the grid load and limit the support expenditures. Under this scheme, the producer is able to compensate the value of electricity consumed with the value of electricity produced in different periods, thus reducing the producer's electricity bill. Therefore, there is no direct remuneration for (excess) electricity fed into the grid but an exchange of the value of electricity consumed and produced. Common practice in Italy.
•In Austria, a big number of renewable installations are on the waiting list due to previous budget ceilings. The government now offers these installations to accept a cheaper tariff instead of remaining on the waiting list. This might be an innovative solutions for countries in a similar situation.

Regardless of whether a national or international support system is concerned, a single instrument is usually not enough to stimulate the long-term growth of electricity from renewable energy sources (RES-E). Whereas investment grants are normally suitable for supporting immature technologies, feed-in tariffs are appropriate for the interim stage of the market introduction of a technology. A premium, or a quota obligation based on tradable green certificates (TGC), is likely to be a relevant choice when markets and technologies are sufficiently mature and the market size is large enough to guarantee competition among market actors.

Some analysts argue that market-based harmonisation of the currently fragmented European national markets for renewable electricity generation can bring substantial benefits to the EU in terms of significantly lower support costs. These result from gains from trade, economies of scale and technological innovation brought about by cost-reducing competition between technologies. In this respect, the envisaged start of a common Swedish-Norwegian renewable electricity certificates trading scheme is due to mark a significant first step on the way towards a pan-European renewable electricity support scheme.

However, diverging projections of potential savings of EU-wide harmonisation of renewable electricity support measures have been made, according to the type of common support system used (quota, FIT, FIP, etc.).

77. Especially in feed-in tariff systems for technologies characterised by rapid cost reductions

78. The formula decreasing the FIT to a lesser or greater extent should be linked to the achievement or lack thereof of yearly or quarterly established objectives of installed power. In case growth is stronger than envisaged, the tariff degression is increased.

3.3. Grid integration

[1], [2], [10], [11], [30]

This section uses the same six-fold classification as section 2.4 in order to organise best European practices, main findings, lessons learned and possible recommendations supported by the European experience involving high shares of wind energy penetration.

System design and operation

In order to enable a power system to integrate large amounts of wind power, optimised wind power operation, management and control are necessary. Next, some of the concepts that need to be considered are briefly explained:

Wind farm aggregation - larger balancing areas: moving to larger balancing areas or clustering wind farms into virtual power plants decreases forecasting deviations (if the aggregation involves wide areas) and increases the controllability of the combined system for optimal power system operation. Practical examples, such as in Spain, demonstrate that the operation of wide-spread variable wind power sources in a coordinated way improves the management of variability and enhances predictability.

Aggregating wind power from dispersed sites using and improving the interconnected network increases its capacity credit at European level. Latest studies based on experiences from high wind power penetration systems (e.g. Spain, Denmark, Germany, Ireland) and current common capacity credits for wind energy indicate that up to 15% of reserve capacity is required at a penetration level of 10%, and up to 18% at a penetration level of 20%.

Short-term flexible balancing, operation, management and control: Innovative wind farm operational control, involving a control unit between system operators and wind farm clusters considerably improves wind farm control strategies. Along these lines, Spanish power transmission company, Red Eléctrica (REE), is a pioneer in RES control. Its Control Centre for Renewable Energies (CECRE) is a model of how to maximise renewable energy production (see figure 3.3-1). This control centre allows renewable energy, especially wind energy, to be integrated into the national power system under secure conditions by managing and controlling the output of RE producers by anticipating sudden losses in power generation. It collects real-time data from the production units (reactive power, voltage, connectivity, temperature, wind speed); then REE software models, by breaking down into each individual wind farm and aggregating by transmission node, simulate the amount of wind power that can be safely fed into the grid; and finally it sends the necessary adjustment orders to the wind farm clusters through generation control centres which pass them on to each single wind power plant.

Figure 3.3 - : Control Centre for Renewable Energies (CECRE). REE, Spain

Source: Red Eléctrica de España (REE)

Flexible generation, such as hydropower provides a very quick way of reducing power imbalance due to its fast ramp-up and ramp-down rates. Also envisaged as an energy storage option[79], Portugal and Spain

79. However, if a country does not have favourable geographical conditions for hydro reservoirs, storage is not the first solution to look after;

have planned new pump hydro accumulation storage (PAC) facilities in order to increase the flexibility of their respective power systems, and mainly addressed to avoid having to resort to wind energy curtailment practices. Compressed air energy storage (CAES) is an attractive energy storage solution, which is available for large-scale use. However, energy storage entails an energy loss due to the conversion processes involved, which in the case of storage in the form of hydrogen are substantial.

Moreover, with demand-side management (DSM) measures loads are controlled in different ways in order to respond to power imbalances by reducing or increasing power demand. Some examples are: in Spain, load management possibilities, addressed to the industry sector offer financial benefits in exchange of more flexible contracts, allowing power-cuts when needed (load shedding); also, electric vehicle (EV) development has taken place in most Member States, since it has been strongly promoted by the 2009 Renewable Energy European Directive, among other reasons, for its contributions to system flexibility through controlled battery charging at off-peak periods of low electricity demand.

Interconnection capacity available for power exchange between countries is also a significant source of flexibility in a power system. The Danish example, with the worldwide highest electricity penetration from the wind, demonstrates the benefits of having access to markets for flexible resources and having strong transmission interconnections to neighbouring countries. Denmark electricity system operates without serious reliability issues in part because the country is well interconnected to two different electric areas, in particular the interconnection with the Nordic system, which provides access to flexible hydropower resources. Transmission interconnections, in conjunction with wind power output forecasting, also allow wind energy to be exported to other markets and help the Danish operators manage wind power variability.

Finally, wind power forecasting has become essential for operating systems with a significant share of wind power, such as Spain, Germany, Denmark and Ireland, where wind farm operators routinely forecast output from their wind farms. These forecasts are used by system operators to schedule the operations of other plants, and for trading purposes. Fields of power system operation where TSOs specifically benefit from wind power forecast include:

- Routine forecasts: increasing the confidence levels
- Forecasting in critical periods, e.g. times of maximum load (including ramps)
- Forecasting of significant aggregated wind power fluctuations (ramps)
- Severe weather forecasts

Grid connection of wind power

Wind farms, managed by control centres, and under strict compliance of national grid codes, need to respond to requirements involving limitation of power output, energy control, capacity control, ramp rates, etc. The technical aspects of this have been covered by section 3.1.

Network infrastructure issues

There is number of attractive short term actions that can optimise the use of the existing infrastructure and transmission corridors and do not involve excessive expenditure, but instead, avoid or postpone more costly network investments. These will help the European transmission system to take up the fast-growing wind power installed capacity, while maintaining high levels of system security. Some of these measures have already been adopted in different European regions having large amounts of wind power:

Dynamic line rating with temperature monitoring: it allows optimising the use of existing power lines by operating them at higher capacities while monitoring their temperature. As an example, Germany has changed the standard transmission line rating calculation so as to increase the utilisation of the existing grid. By taking into account the cooling effect of the wind, together with ambient temperature they determine the transmission constraints. This allows them to increase transmission capacity and/or delay the need for network expansion. It has also had the effect of reducing the amount of wind power curtailments, since, due to overload risks of lines and electrical equipment, Germany had used curtailments as a temporary solution while waiting for grid expansion.

Rewiring with high temperature conductors: using high temperature conductors to rewire existing lines with low sag offers the possibility to increase the overhead line capacity by up to 50%, as electrical current carrying capacity directly depends on the power line sag and the line temperature[80].

Power flow control devices: installing these devices in selected places in the grid can help optimising the utilisation of the existing network. Flexible AC Transmission Systems (FACTS[81]) are widely used to enhance stability in power systems; in addition some FACTS solutions also support power control. Thus, this technology allows increasing controllability of existing power lines, hence ensuring their maximum possible capacity is not underused.

Distributed wind plants to improve transmission operation: technical capabilities of strategically placed wind farms along the transmission grid, combined with technologies that improve the control of reactive power, has a similar effect than installing FACTS for grid support[82].

As for long-term transmission planning in Europe, crucial political decisions have been taken at European level in the past seven years, including the RES Directive 2009/28/EC and the next big step in energy liberalisation, i.e., the Third Package. The most relevant development in terms of network infrastructure is the creation of a pan-European association for network operators, ENTSO-E, as well as reviewing European legislation spelling out the role of network operators and regulators in a more liberalised market.

The 3rd Energy Package mandated ENTSO-E to publish a biannual, non-binding, Ten-Year Network Development Plan (TYNDP). The TYNDP is designed to increase information and transparency regarding the investments in electricity transmission systems which are required on a pan-European basis and to support decision-making processes at regional and European level.

Electricity market design

The ongoing market integration across Europe, notably the implementation of regional markets, is an important building block for a future power system characterised by flexible and dynamic electricity markets, where market participants, including at the level of power demand, respond to price signals, fuel price risk and carbon price risk. Existing initiatives at regional level, such as the Nordpool market, the Pentalateral Energy Forum, the Irish All-Island market and the Iberian MIBEL are all helping the integration of bigger amounts of variable renewables. Additionally, the "North Seas Countries' Offshore Grid initiative" offers a way to create a North Sea market enabling the integration of large amounts of offshore wind power.

Encouraging market integration is the high level of market liberalisation in the EU, where most countries have liberalised their power markets. Nationally, day-ahead power markets exist in most Member States and intraday markets in several of them, including France, Belgium, Germany, the Netherlands, Spain[83] and the Nordic countries. Now, considering international trade, explicit auctioning is the most common way of allocating cross-border capacities (yearly, monthly and daily). However, faster and more responsive markets[84] do exist in Europe, namely, the Iberian market (MIBEL) is a day-

because of the limited economic impact on system cost at moderate wind power penetration levels (up to 20%)

80. It might be a very interesting option since, depending on the specific situation, this practice might be carried out without needing a permit

81. They can provide series compensation (on long lines, when a large current flows, this causes a large voltage drop. To compensate, series capacitors can be connected, decreasing the effect of the inductance) or shunt (parallel) capacitive compensation (to improve the power factor when an inductive load is connected to the transmission line) or shunt inductive compensation (with low loads connected at the receiving end, very low currents and high voltages may appear induced by shut capacitances in the transmission line, thus, to compensate, shut inductors are connected across the transmission grid).

82. With the advantage of wind farms over FACTS that they produce energy in addition to providing grid support

83. As regards electricity market design, penalisation of deviations in forecasted production, as practised in Spain, is an important policy regulation that favours the development of forecasting methods as well as grid and market integration of wind energy

84. These markets use "market couplings" which means implicit auctions are taking place in which players do not actually receive allocations of cross-border capacity themselves but bid for energy on their exchange markets.

ahead and intraday market with a "market splitting" mechanism in case of congestion between Spain and Portugal. The Iberian market constitutes the second supra national single market in Europe after Nordpool, which is also a day-ahead and intraday market and it was the world's first multinational exchange for trading electric power. Day-ahead couplings also exist between the Netherlands, Belgium and France.

Institutional and regulatory aspects[85]

Institutional changes are required to enable fluid interaction between neighbouring systems and electricity markets, with the underlying assumption that adequate interconnection capacity is in place. For that reason was created the European network of transmission system operators for electricity (ENTSO-E), which is the first continental association of TSOs with legal obligations to establish a pan-European grid plan and binding rules for cross-border network management.

Research and development

Over the 2010-2012 period, R&D activities focused on developing tools and techniques to ensure the integration of large amounts of variable electricity in the EU system. Relevant actions from the European Wind Initiative (EWI) mainly addressed grid connection and power transmission; secure and stable system dynamics; and balancing and market operation.

As a result, two major initiatives were launched to speed up grid integration of wind power:

• The FP7 TWENTIES project, which aims at demonstrating how new solutions can be used to ensure wind power integration
• The EEPR, which provided considerable support to offshore grid development

85. Most of these aspects, such as best practices involving support mechanisms and some policy regulations relating to priority of dispatch, etc., have been dealt with in section 3.2

Other specific EWI actions with respect to wind power grid integration include:

• Connection technologies for offshore and onshore wind power plants to AC and DC networks (including multi-terminal HVDC grids)

• Wind power capabilities for system support and Virtual Power Plant operation

• Wind energy in the power market

• Resource assessment and spatial planning. Two important objectives of this action are:

- To assess and map wind resources across Europe and to reduce forecasting uncertainties of wind energy production

- To develop spatial planning methodologies and tools

3.4. Environmental and social best practices

[2], [10], [19], [20], [22], [23], [31], [32], [33], [34], [35], [36], [37], [38], [44]

The discussion in this section is organised using the same classification as section 2.5, which analysed and assessed the importance of the environmental impacts and social and attitudinal barriers of wind energy deployment in Europe. However, first of all, a general introduction, will examined the main European instrument to avoid or limit all environmental and social impacts from wind energy development in Europe, which will set up the framework for the rest of the section. This instrument is constituted by four thorough pieces of European legislation, in the form of binding directives addressed to all EU Member States.

Also acting in all areas dealt with in this section there exist numerous environmental organisations and government agencies spread all around Europe (a list is included in Annex IV), which seek to protect, analyse and monitor the environment against misuse or degradation from human forces.

Concerning two of the four pieces of legislation, the Birds[86] and Habitats[87] Directives are the cornerstones of the EU's biodiversity policy. They enable all 27 EU Member States to work together, within a common legislative framework, to conserve Europe's most valuable species and habitats across their entire natural range within the EU, irrespective of political or administrative boundaries.

The overall objective of the Birds Directive is to maintain and restore the populations of naturally occurring wild bird species present in the EU (ca. 500 species) at a level which will ensure their survival over the long term. The Habitats Directive has similar objectives to the Birds Directive but covers species other than birds as well as habitat types. Its aim is to ensure the conservation of a further 1000 endangered wild animals and plants as well as 230 rare and threatened habitat types which are in danger of disappearing.

As regards wind farm developments, there are two aspects of these two EU Directives to bear in mind in particular, depending on the location of the development:

86. Directive 2009/147/EC on the conservation of wild birds
87. Directive 94/43/EEC on the conservation of natural habitats and of wild fauna and flora

• In and around Natura 2000[88] sites: any wind farm development that is likely to affect one or more Natura 2000 sites has to undergo a step-by-step Appropriate Assessment (AA) procedure and, where necessary, apply the relevant safeguards for the species and habitat types of Community interest. As part of this process, the developer/planner can be asked to propose suitable mitigation measures (e.g. changes to the siting, design, scale of the wind farm and its associated infrastructures) or certain conditions or restrictions involving the development permit may be set as a pre-condition for approving the plan or project (e.g., as regards the timing of the construction works or restrictions on the operation of the wind turbines, for instance during peak dispersal and migration periods).

• Anywhere within the EU: the two directives also require that Member States protect species of Community interest throughout their natural range within the EU. Thus any wind farm development must also take account of its potential impacts on species covered by the two directives outside Natura 2000 sites as well.

Two other key pieces of EU environmental legislation are directly relevant to wind farm developments:

• Directive 2001/42/EC on the evaluation of the effects of certain plans and programmes on the environment (commonly referred to as "SEA" Directive).

• Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (commonly referred to as the "EIA" Directive).

The SEA Directive applies to a wide range of public plans and programmes (e.g. on land use, transport, energy, waste, agriculture, etc.). The SEA procedure can be summarized as follows: an environmental report

88. Natura 2000 is an ecological network of protected areas, set up to ensure the survival of Europe's most valuable species and habitats.

is prepared in which the likely significant effects on the environment and the reasonable alternatives of the proposed plan or programme are identified. The public and the environmental authorities are informed and consulted on the draft plan or programme and the environmental report prepared. As regards plans and programmes which are likely to have significant effects on the environment in another Member State, the Member State in whose territory the plan or programme is being prepared must consult the other Member State(s).

The EIA Directive is in force since 1985 and applies to a wide range of specific public and private projects, which are defined in its annexes I and II (wind energy projects are included in annex II). The EIA procedure can be summarized as follows: the developer may request the competent authority to detail the EIA information to be provided by the developer (scoping stage); the developer must provide the necessary information on the environmental impact (EIA report); the environmental authorities and the general public (and affected Member State(s)) must be informed and consulted; the competent authority decides, having taken into consideration the results of consultations.

There are similarities between the procedures for SEA and EIA, and the Appropriate Assessments (AA) carried out for plans or projects affecting Natura 2000 sites under the Habitats Directive. However this does not mean they are one and the same, there are some important distinctions too (see table in Annex V). Therefore, SEA and IEA procedures cannot replace, or be a substitute for, an Appropriate Assessment as neither procedure overrides the other.

Environmental best practices

Ecological: besides the previous environmental European legislation there are some examples of best practices worth mentioning, specifically addressing ecological and social impacts. Among them, strategic planning[89], which is a useful tool widely used by Member States for ensuring that a rapid deployment of wind energy over a large area can be achieved whilst simultaneously protecting vulnerable wildlife from inappropriate development. Strategic planning not only helps identifying the most appropriate locations and scales for expansion as regards wind energy capacity, grid access etc. but also helps to avoid and reduce the impacts on the natural and social environment at a very early stage in the planning process.

Evidence from Germany, Denmark, Spain and the UK illustrates that wind power does not have to threaten wildlife but appropriate siting is critical and is one of the first goals of the planning development process from a conservation perspective. Despite the range of concerns, most threats can be minimised by avoiding sites with sensitive habitats and key populations of vulnerable species. Good site location also helps developers avoid costly investments in inappropriate sites.

Drawn up by public authorities, these land use or sectorial plans usually cover a broad geographical area, be it at the level of a municipality, region or country. This scale, combined with the spatial nature of the plans, enables strategic decisions to be made about the capacity and location of wind developments over a broad area. They also provide an opportunity to explore various alternatives, and potentially less environmentally and socially damaging options, as well as to consult early on with industry and other interested bodies.

As regards offshore wind energy in particular, in 2008 the European Commission adopted the Communication "Roadmap for Maritime Spatial Planning (MSP): Achieving Common Principles in the EU[90]", which proposed a set of key principles for MSP. At the end of 2010, the EC launched another Communication[91] proposing further steps and actions and seeking to outline the current context of MSP in the EU.

Maritime Spatial Planning is considered a key instrument for the Integrated Maritime Policy in the EU. It helps public authorities and stakeholders to coordinate their action and optimises the use of marine space to benefit economic and social development and the marine environment. It can be understood as a process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that are usually specified through a political process. These two Communications aim to facilitate the development of MSP by Member States and encourage its implementation at national and EU level. They set out key principles for MSP and seek, by way of debate, to encourage the development of a common approach among Member States.

Along those lines, the European project Seaenergy 2020 also seeks to promote a more integrated and coordinated approach to MSP, extending beyond national borders. This is particularly important, since many human activities as well as ecological concerns at sea have a cross-border dimension. The geographical scope of the Seaenergy 2020 project includes the Atlantic Coast and the Irish Sea, the Baltic Sea, the Mediterranean Sea, and the North Sea.

The Seanergy 2020 project has centred its work on three main work packages or phases: firstly, analysis of existing national MSP practices and their impact on offshore renewable deployment, and identification of best practices; secondly, analysis of different international MSP instruments and their compatibility with offshore renewable deployment; and thirdly, analysis of the challenges and opportunities of moving from a national to a transnational MSP approach. Finally, it has compiled all findings and issued recommendations.

Lastly, some specific examples of good practices carried out in Europe are listed here below:

• Different practices addressed at reducing bird and bat fatalities include: siting power plants in areas with lower bird and bat population densities, placing turbines in areas with low prey density, and using different numbers, types and sizes of turbines.

• Concerns about the impacts of offshore wind energy on marine life (and bird populations) have led to national zoning efforts in some countries that exclude the most sensitive areas from development.
• Apart from the planning and sitting procedures mentioned previously, community involvement has been an important factor as far as environmental and social impacts are concerned.

Greenhouse gas (GHG) emissions: In sections 3.1 and 3.3 best practices have been analysed regarding forecasts' improvement, reducing short-term balancing reserves, start-ups, shut-downs, part-load operation and ramping of conventional power plants, etc., which increases the efficiency of those plants, thus diminishing their unit exhaust gas emissions.

Then, the EU ETS, which covers more than 11,000 power stations and manufacturing plants in the 27 EU Member States as well as Croatia, Iceland, Liechtenstein and Norway, is the cornerstone of the EU's drive to reduce its emissions of man-made greenhouse gases which are largely responsible for warming the planet and causing climate change. Aviation operators flying within and between most of these countries are also covered. In total, 45% of total EU emissions are limited by the EU ETS. However, because of the surplus of carbon allowances during the economic crisis, resulting in low carbon prices and thus, low scheme's effectiveness, the EC has taken the initiative to postpone the auctioning of some allowances as an immediate redressing measure, while also launching a debate on structural reform measures which could provide a sustainable solution to the surplus of allowances in the longer term.

Climate change impact on wind energy development: In section 2.5 it has been showed that these impacts are considered of little importance for wind energy deployment. Nevertheless, as far as wind power generation is concerned, some manufacturing companies, supported by wind power developers, might consider anticipating on possible impacts by changing the design of wind turbines that could be used when repowering or at the end of their economic lifetime.

Concerning electricity transmission and distribution facilities, despite the little priority given by TSOs in Europe, there are some adaptation measures that have other benefits too and are being introduced in European grids for those reasons. European electricity networks are therefore becoming more climate-proof already. These practices include:
• Burying underground parts of the network: reduces both visual and environmental impacts.

89. For example, in Spain, Law 9/2006 of 28 April on the assessment of the effects of certain plans and programmes on the environment transposes Directive 2001/42/EC. It introduces into the Spanish legislation the strategic environmental assessment of plans and programmes. As a recent example, the Spanish Renewable Energy Plan (PER) 2011-2020 has fully undergone this process for the development, among other technologies, of wind onshore and offshore power.
90. COM(2008) 791 final of 25.11.2008
91. COM(2010) 771 final of 17.12.2010

• Using flexible AC transmission systems: increases the controllability of networks.

• Installing monitoring equipment facilities: integrates variable supply more easily

• The UK government has started a programme for developing adaptation strategies throughout its economy[92], after adopting the Adaptation Reporting Power in the 2008 Climate Change Act. All major operators of electricity networks are required to assess the impacts of climate change on their business in detail, evaluating the costs and benefits of adaptation. OFGEM will report about the role of adaptation as part of the government programme. It will primarily consider its own activities, including potential changes in regulatory practice. For example, the calculation of network tariffs could be changed to allow network operators to invest in adaptation. Regulators in most other countries have only considered the vulnerability of the electricity sector in general.

Human activities and well-being

First of all, remind that best practices in this field mainly include the pieces of legislation and the spatial planning regulations and initiatives described above.

Additionally, though concerns about visibility cannot be fully mitigated, some Member States require an assessment of visual impacts as part of the siting process, including defining the geographic scope of impact and preparing photo and video montages depicting the area before and after wind energy development. Other practices to minimize visual intrusion include using turbines of similar size and shape, using light-coloured paints, choosing a smaller number of larger turbines over a larger number of smaller ones, burying connection cabling and ensuring that blades rotate in the same direction. More generally, a rethinking of traditional concepts of 'landscape' to include wind turbines has sometimes been recommended covering, for example, setting aside areas in advance where development can occur, especially when such planning allows for public involvement.

92. www.london.gov.uk/climatechange/strategy

Significant efforts have been made to reduce the sound levels emitted by wind turbines. As a result, mechanical sounds from modern turbines (e.g., gearboxes and generators) have been substantially reduced. Reducing aeroacoustic noise, which is now the dominant concern, can be most easily accomplished by reducing blade speed, but different tip shapes and airfoil designs have also been explored. In addition, the predictive models and environmental regulations used to manage these impacts have improved to some degree. Specifically, in some Member States, both the wind shear and maximum sound power levels under all operating conditions are taken into account when establishing regulations. In other countries, different provisions mandate a minimum distance between turbines and other structures. Also, wind energy technology certification standards are aimed at reducing accidents involving the shedding of parts or of whole blades. Finally, it has been observed that impacts on property value can fade at distances of 100 m.

Public attitude

Public attitude has been found to improve when the development process is perceived as being transparent. Further, experience suggests that local ownership of wind power plants and other benefit-sharing mechanisms can improve public attitudes towards wind energy development. In Denmark, about 150,000 families either own wind turbines or have shares in wind turbine co-operatives

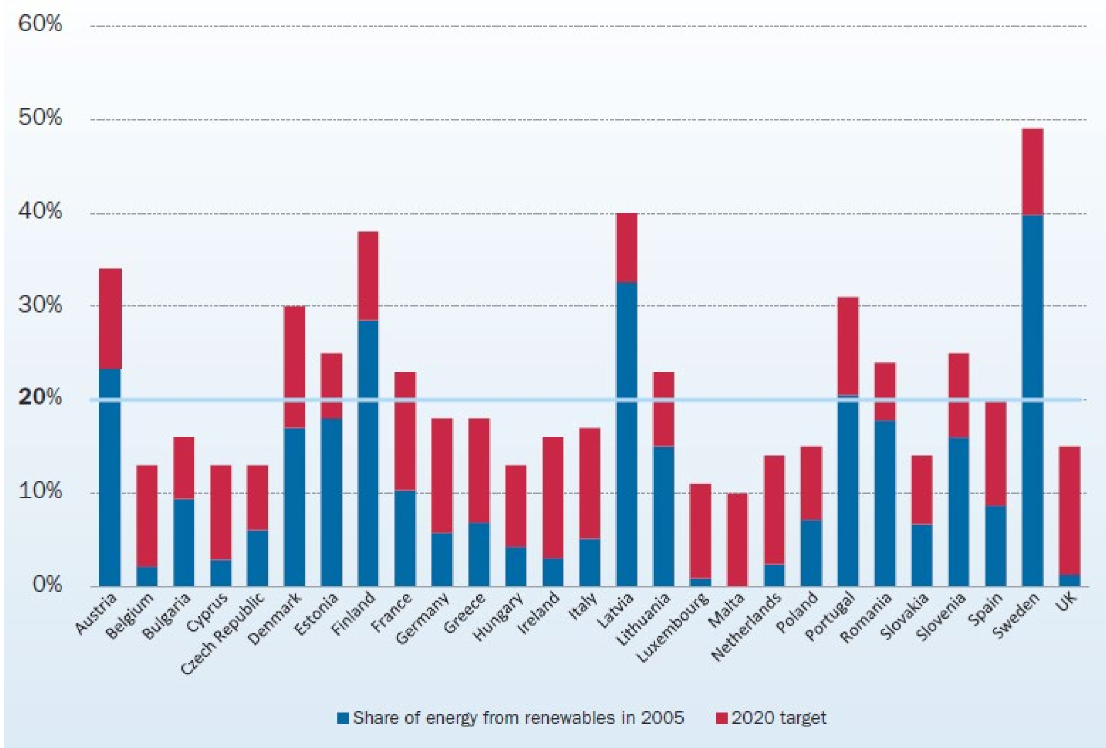
Moreover, available evidence suggests that the positive environmental and social benefits of wind energy generally outweigh the negative impacts that remain after careful planning and siting procedures are followed, which among other things will generally avoid placing wind turbines too close to dwellings, streets, railroad lines, airports, radar sites and shipping routes. In any case, one of the research strands of the EWI continues to address and analyse social acceptance of wind energy projects in order to further improve public attitude towards wind energy deployment.

4. PLANNING BY 2020 [2], [8], [10], [21], [41], [48], [49], [50]

The Directive 2009/28/EC of 23 April 2009 on renewable energy, nationally implemented by Member States by December 2010, sets global ambitious targets for the EU, i.e., reaching a 20% share of energy from renewable sources by 2020 and a 10% share of renewable energy specifically in the transport sector. The directive also sets binding national targets for the share of renewable energy in each of the 27 EU Member States in 2020 (see figure 4-1 and annex VI). According to the wind industry, it is by far the most significant legislative effort to promote renewable energy, including wind power, anywhere in the world.

It also improves the legal framework for promoting renewable electricity, requires national action plans that establish pathways for the development of renewable energy sources including bioenergy, creates cooperation mechanisms to help achieve the targets cost effectively and establishes the sustainability criteria for biofuels. On 31 January 2011, the European Commission (EC) presented its Communication showing that the 2020 renewable energy policy goals are likely to be met and exceeded if Member States fully implement their national renewable energy action plans and if financing instruments are improved. It also stresses the need for further cooperation between Member States and a better integration of renewable energy into the single European market. Estimates indicate that such measures could lead to 10 billion Euros savings each year.

Figure 4- : National targets - share of energy from RES in final consumption (2020)



Source: EWEA, European Commission directive 2009/28/EC

The 2009 Renewable Energy Directive also sets out indicative trajectories for renewable energy in each Member State corresponding to minimum average RES penetration for two year periods (2011-2012, 2013-2014, 2015-2016 and 2017-2018), so as to ensure that countries do not put off making an effort to the end of the target period (see annex VI).

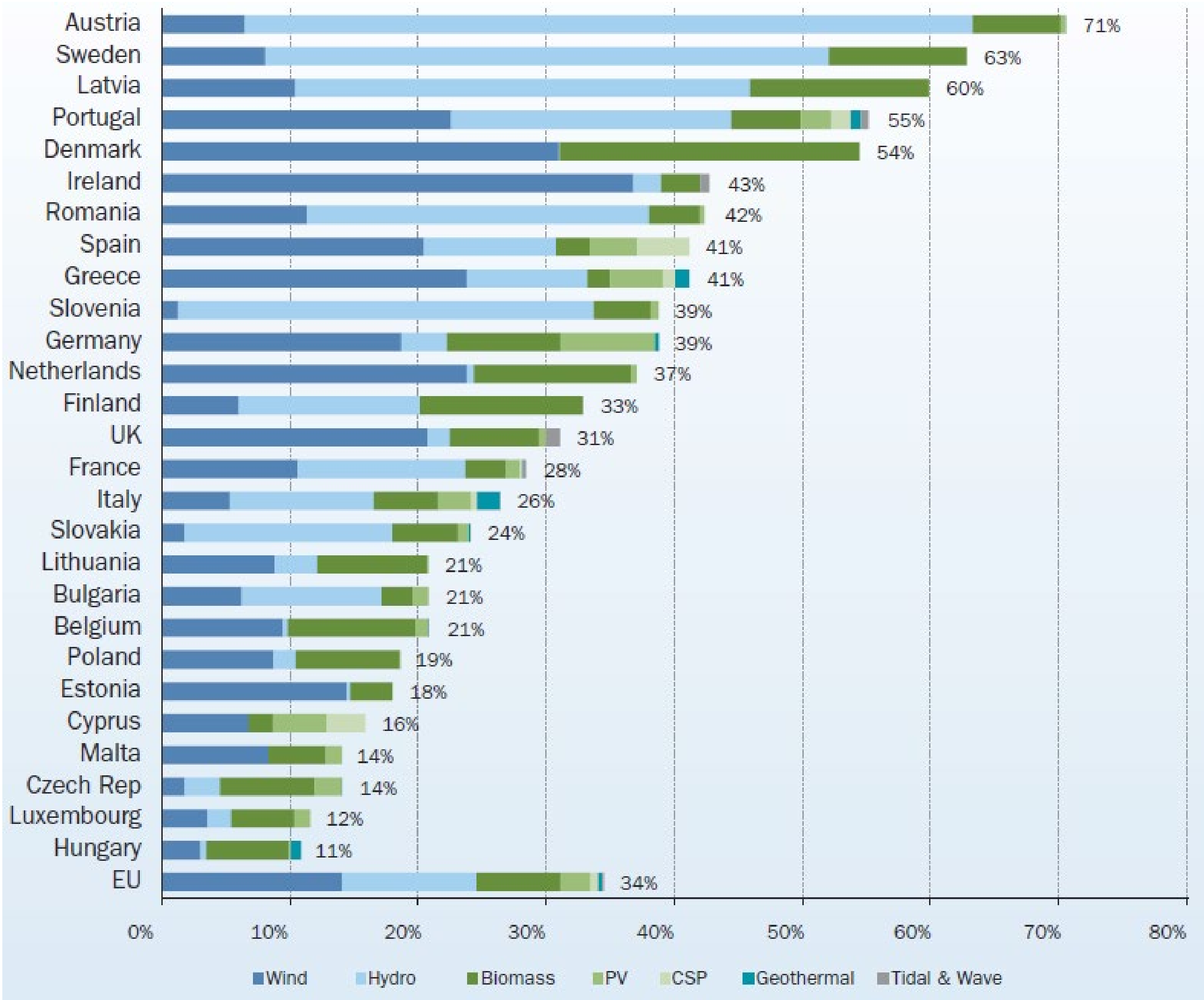
As required by the directive, the 27 Member States adopted their national renewable energy action plans (NREAPs), setting out their own national targets for the share of renewable energy consumed in electricity, heating and cooling and transport, and measures for achieving the national overall renewable energy targets and for supporting the growth of renewable energy in each of the energy consuming sectors. All Member States submitted their plans to the European Commission in 2010 and the Commission evaluated them, including the adequacy of measures envisaged by the Member States for reaching their national RES targets.

The assessment of the 27 NREAPs shows that the share of renewables in the EU final energy consumption would reach 20.6% in 2020. Renewable energy production is projected to increase from 99 million tonnes of oil equivalent (Mtoe) in 2005 to 245 Mtoe in 2020 (an average annual growth rate of 6% per year).

Based on Member State projections for renewable energy use and their sectoral targets, the combined EU renewable energy share in electricity will grow form 19,4% in 2010 to 34% in 2020, in heating and cooling respectively - from 12,5% to 21,5% and in transport from 5% to 11%. Renewable energy industry expectations for renewable energy shares in the three sectors are even higher – EU Industry roadmap estimates that 2020 renewable energy share in the electricity sector could reach even 42%, in the heating and cooling – 23,5% and in the transport 12%. According to NREAP analysis, in the next decade the strongest growth will occur in wind power (from 2% to 14.1% of the total electricity consumption) and solar electricity (from 0% to 3% of the total electricity consumption).

Therefore, as regards the electricity sector, according to NREAP technology projections by 2020 wind would become the most important renewable energy source providing 40% of all renewable electricity compared to 25% in 2010, the contribution of photovoltaic and solar thermal electricity would also grow from current 3% to 9%, the contribution of biomass is expected remain almost unchanged (18% in 2010 compared to 19% in 2020), while the role of hydro would decrease from 50% in 2010 to 30% in 2020. The role of geothermal and wave and tidal are still expected to remain marginal in 2020 with respectively 1% and 0.5%. Figure 4-2 shows the share of electricity consumption per Member State in 2020.

Figure 4- : RES share of electricity consumption per MS in 2020 according to the NREAPs



Source: EWEA, National Renewable Energy Action Plans

The EU Member States have a 213 GW target for wind power (see figure 4-4. For more detail see tables XII-1 and XII-3 in Annex XII), which will produce 495 TWh of electricity (see figure 4-3 for the distribution between onshore and offshore wind) (see figure 4-5. For more detail see tables XII-2 and XII-4 in Annex XII) –enough to meet 14.1% of the EU's electricity consumption. The remaining 20% of electricity consumption covered by renewable energy sources in 2020 consists of:

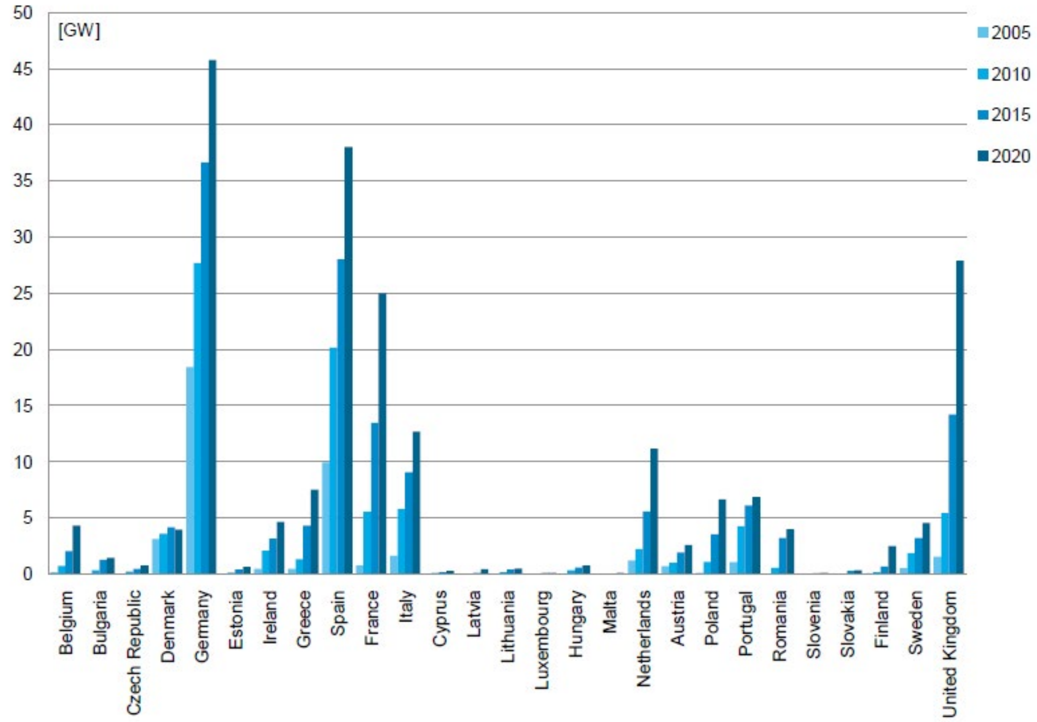
- Hydro – 10.5% (370 TWh from 136 GW of installed capacity);
- Biomass – 6.7% (232 TWh from 43 GW of installed capacity);
- Solar PV – 2.4% (83.3 TWh from 84 GW of installed capacity);
- Concentrated solar power – 0.5% (20 TWh from 7 GW of installed capacity);
- Geothermal – 0.3% (10.7 TWh from 1.6 GW of installed capacity);
- Tidal, wave and ocean – 0.2% (5.8 TWh from 2 GW of installed capacity).

The estimated capacity factor for each Member State is shown in figure 4-6 (for more detail see table XII-5 in Annex XII).

Figure 4- : Electricity production (onshore and offshore wind energy) according to NREAPs

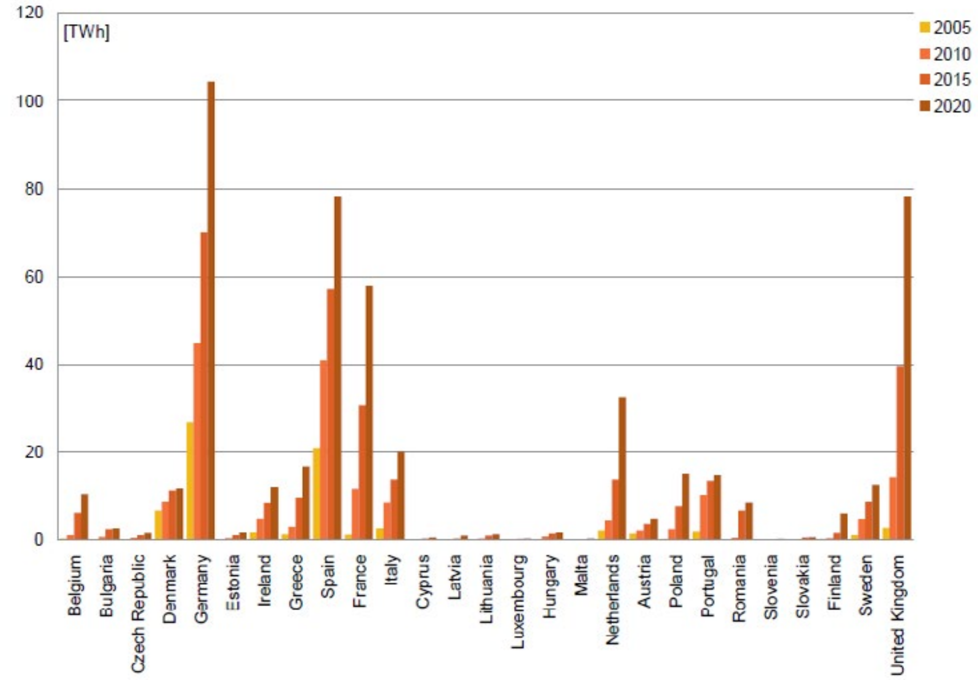
Source: EWEA, National Renewable Energy Action Plans

Figure 4- : Projected total wind power electric capacity (2005-20) (onshore and offshore)



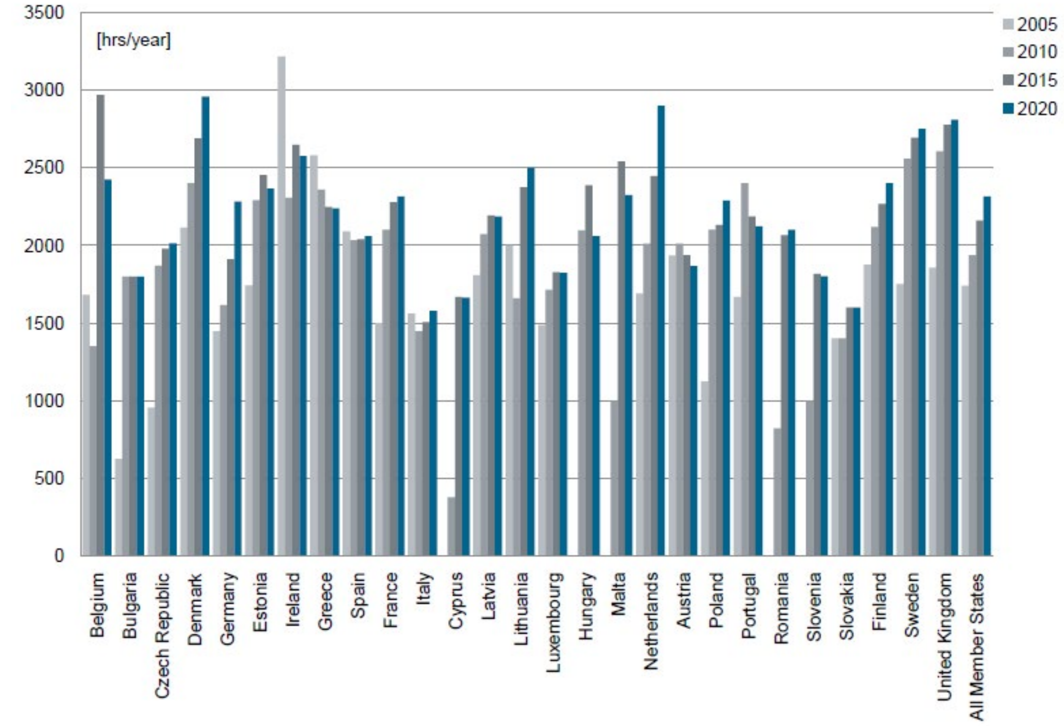
Source: ECN, National Renewable Energy Action Plans

Figure 4- : Wind power electricity generation (2005-20) (onshore and offshore)
(Projected total wind power electricity generation for the period 2005 - 2020, all capacity ranges excluding pumped storage, including onshore and offshore wind power)



Source: ECN, National Renewable Energy Action Plans

Figure 4- : Calculated average number of full load hours for total wind power (2005-20)



Source: ECN, National Renewable Energy Action Plans

However, despite the growth of annual wind energy installations in 2012 and its cumulative capacity reaching 106 GW, wind energy deployment is lagging behind the objectives the EU Member States set themselves in their National Renewable Energy Action Plans (NREAPs).

Interestingly, installations in 2012 were higher than EWEA's expectations. In 2009, the EWEA published a growth scenario that expected cumulative capacity in the EU to be 103 GW at the end of 2012. However, EWEA's scenario reaches 230 GW of installed wind energy capacity in 2020, whereas the sum of the Member State's NREAPs for that same year amounts to 213 GW. The latter suggests that whereas EWEA took a gradual approach with annual installations increasing slowly at the beginning and more rapidly towards 2020, the Member States, on the whole, "front-loaded" their trajectories.

Eighteen Member States are falling behind their wind power capacity trajectories (see table XII-6 in Annex XII). Of these, the furthest behind are Slovakia (-147 MW, -98%), Greece (-772 MW, -30.6%), Czech Republic (-83 MW, -24.2%), Hungary (-116 MW, -26.1%), Portugal (-1,075 MW, -19%) and France (-701 MW, -8.5%). The nine other Member States are, on the other hand, above their trajectory. Sweden is the most noteworthy with 1,336 MW more than forecast (+55%).

The EU overall is lagging by almost 1.6 GW (-1.5%). Table XII-6 in Annex XII also highlights that it is in offshore where there is the biggest discrepancy between the NREAPs and real installations. The Member States are trailing by 836 MW, -14%.

5. COUNTRY PROFILES[41]

[12], [39], [40], [46], [51], [52], [53], [54]

In previous chapters generic main barriers and best practices as regards wind energy deployment in Europe have been discussed, along with several country-specific examples to illustrate general cases through particular experiences. For the purpose of complementing these lessons learned, this chapter includes a selection of seven best practice countries, which provides an insight into the strengths of diverse policy design decisions across their particular markets.

Each of the country profiles here included intends to identify and review significant policy and regulatory measures that have contributed to the successful development of wind energy across each of the seven European markets over the last three decades. It highlights the major steps in the development of national policies that led to the creation of a large and successful wind power market. This chapter only summarises the detailed and chronologic information included in Annex XIII for each of the selected countries.

The choice of the Member States has been made on the grounds of their particular market deployment status concerning wind energy; their total wind power installed; wind energy penetration into their energy mix; and main policy support mechanism employed.

As can be observed in figure 1.2-3 in chapter 1, the countries showing the most advanced market deployment for wind onshore are Spain, Germany, Portugal, Denmark and Ireland. As regards wind offshore, even though market development is just starting, UK and Denmark are those countries paving the way. Also, from the table in Annex VIII, the countries with the highest wind power installed are Germany, Spain, UK and Italy and figure 1.1-12 shows the Member States enjoying the highest wind energy penetration, i.e., Denmark, Portugal, Spain, Ireland and Germany. Finally, UK and Italy's main support mechanism for wind energy development is a quota system, as opposed to the FIT/FIP used by Germany, Spain, Denmark, Portugal and Ireland (see figure XI-1 in Annex XI). Therefore, after combining this information, the seven Member States selected are (alphabetically listed): Denmark, Germany, Ireland, Italy, Portugal, Spain and UK, which provide a diverse selection of successful European countries as far as wind energy deployment is concerned.

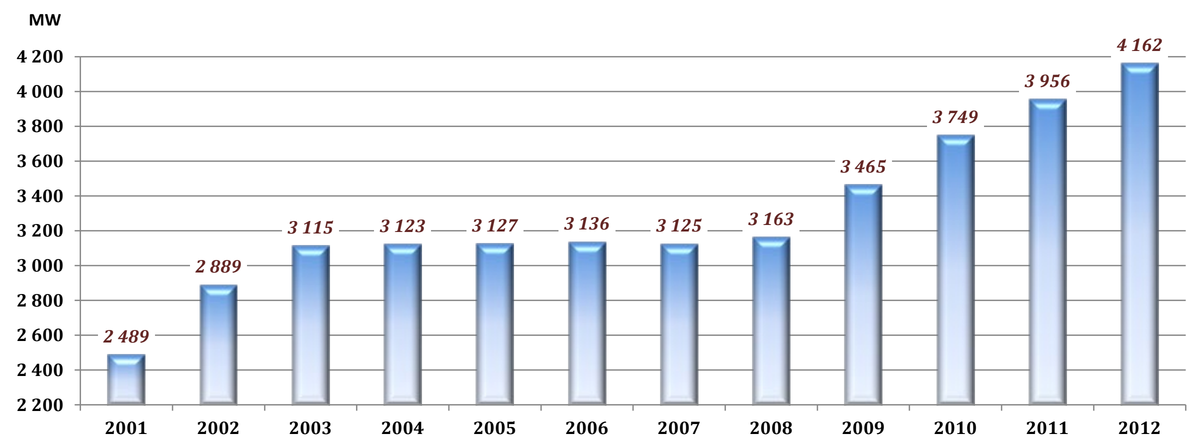
41. The country profiles have been mainly extracted from reference [39]. The rest of references used for this chapter have been consulted to check the agreement with specific pieces of information.

5.1. DENMARK (see Annex XIII for more detail)

By the end of 2012, Denmark had installed 4,162 MW of wind capacity. Wind power represented a share of 27% of the country's total electricity demand in 2012, by far the largest share of any country in the world. Figure 5-1 shows the evolution from year 2001 of installed wind power in Denmark.

For Denmark, the 2009 European Renewable Energy Directive targets a share of renewable energy in the country's final energy demand rising from 17% in 2005 to 30% in 2020. The government has set a target of 50% wind energy in electricity consumption by 2020 as part of its long-term strategy to achieve a 100% renewable energy mix in the electricity and heat sector by 2035, and in all sectors by 2050.

Figure 5- : Cumulative Wind Installation (MW) of Denmark



Source: GWEC, 2011 and EWEA, 2012

Renewable energy and the efficient use of energy have played a central role in Danish energy policy for more than three decades. The country is the pioneer of wind energy development in Europe, and its wind farms now provide on average more than a quarter of the country's electricity needs. Its wind industry is today among the most significant exporting industries of the national economy. Denmark has for a long time been a global centre for wind turbine manufacturing with Bonus, LM, Siemens and Vestas -some of the world's leading turbine manufacturing firms– based in the country. According to the Danish Energy Agency, close to 100% of the manufactured wind turbines in Denmark were exported during the years 2004-2008, and the trend has continued to date.

Under its energy plans, the Danish government was Europe's first country to bring in large subsidies for its nascent wind industry, including the feed-in-tariff system, which was successfully replicated in Germany. The industry also received significant subsidies for R&D in the late 1970s and the 1980s.

As a result of the Danish energy debate, the four energy plans, and the comprehensive reform of the electricity sector by the current Danish government, Denmark has, for several years now, been a net energy exporter. The country's electricity grid connects hundreds of small-scale "distributed" generators making use of wind resources and efficient use of a range of fuels.

The country is also a pioneer in the use of environmental taxation, with a range of primary energy taxes introduced since the 1980s. These taxes were designed inter alia to reduce air pollution and CO_2 emissions, encourage energy efficiency, and support renewable energy. They helped supporting development, with the revenue being used to promote a range of technologies.

Cooperatives have played an important role in the development of wind power by helping create public acceptance. Their engagement has ensured that communities directly benefitted from wind power development, especially in the form of profit-sharing from electricity generation from renewable energy sources and from lower energy taxes. The planning responsibility for offshore wind farms is currently managed at government level, while the planning of onshore wind farms is collaborative.

In the 1970s rising environmental awareness, the oil crisis and the anti-nuclear debate had a major impact on the reformulation of the Danish government's energy policy. In the 1980s the government focused its policy on reducing dependence on fossil fuels and subsidising clean energy sources. The large wind energy market in California was a major importer of wind turbines, and drove the Danish industry. However, with the reduced demand from overseas markets by the mid-80s, subsidies to the industry were curtailed and rationalised.

In the early 1990s, a new energy plan provided a feed-in tariff for wind, which led to rapid growth in the wind sector between 1994 and 2002. Coordinated government support mechanisms such as long-term R&D support, premium tariffs for wind electricity generation and ambitious national targets helped the domestic wind industry to mature. However, with a change in government in 2001, and the phasing out of the feed-in tariff there was stagnation in the wind sector till the end of 2008. In 2009 the market was revived due to the United Nations Climate Change Conference in Copenhagen 2009, and the setting of a long-term European target for promoting electricity generation from renewable energy sources.

Table 5-1 summarises the best practices for the achievement of enabling conditions for wind energy in Denmark.

Current challenges

In order for Denmark to reach its goal of 50% wind power penetration in 2020, industry developments will need to progress faster than currently. Connection to the electricity grid is a challenge. The Transmission System Operator (Energinet.dk) is supportive of the developments, and plans to supply 50% of the demand with wind power by 2025.

Over the last ten years some sections of the local communities have been protesting against any further building of onshore wind turbines across the country. This has made private sector development of wind farms very cumbersome in the last decade.

Table 5 - : Summary of enabling conditions for wind energy – Denmark

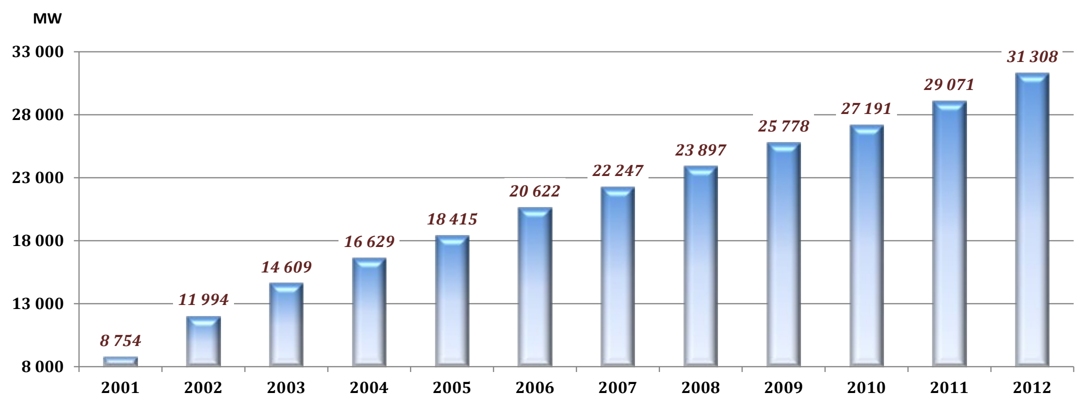
Effective rule of law; and transparency in administrative and permitting processes	A coherent and long-term policy framework has been in place since 1979. However, the wind sector experienced stagnation on the period 2001-2008, due to limited political support for the technology. There has been a strong revival of political support for wind energy post-2009.
A clear and effective pricing structure	Electricity production from renewable sources is supported through price premiums added to the market price, capped at a maximum amount, and tenders for offshore wind power. These instruments are drawn up and managed by the Danish Energy Agency. The combination of market price and premium ensures stable revenue to the producer. All subsidy costs are passed on to consumers as an equal Public Service Obligation.
Provisions for access to the grid (incentives & penalties for grid operators)	Priority access is guaranteed to renewable energy producers.
An industrial development strategy	Four energy plans – the outcome of which was that Denmark became a net exporter of energy.
A functioning finance sector	The investment for wind farms initially came from individuals through cooperatives. However, turbines became larger, the size of the projects increased, requiring private sector investment. Small individual developers have difficulties in investing in large projects (onshore), due to the amount of investment required. Offshore projects are mostly financed by utilities.
Expression of political commitment from government (e.g. targets)	The country aims to generate 50% of its electricity consumption from wind power by 2020, aiming at a full independence from coal, oil and gas by 2050.
A government and/or industry led strategy for public and community buy-in.	Stakeholder engagement and consumer awareness have played an important role in shaping the Danish energy sector. The country has a large number of cooperatives. The 1996 Energy Plan aimed at creating an energy sector rooted in a "democratic, consumer-oriented structure".
An employment development strategy	Subsidies have been available to the wind sector for R&D, and the government supported the initial phase of exports.
NOTE	Continuous government support has been in place since the 1980s, including support to long-term R&D, premium tariffs and the setting of ambitious national targets. All of these have helped the domestic wind industry to expand internationally.

Source: IRENA and GWEC, 2012

5.2. GERMANY (see Annex XIII for more detail)

Germany is the world's third-largest market for wind. In 2012, the country installed 2,415 MW of wind capacity, bringing its cumulative total to 31,308 MW. According to the National Renewable Energy Action Plan, the percentage of energy from renewable sources in the gross final energy consumption will rise from 6.5% in 2005 to 18% in 2020, and could even be surpassed to reach an aspirational target of 19.6%. By 2020, renewable energy will represent at least 35% of the gross electricity consumption of Germany. Figure 5-2 shows the evolution from year 2001 of installed wind power in Germany.

Figure 5- : Cumulative Wind Installation (MW) of Germany



Source: GWEC, 2011 and EWEA, 2012

The current position of Germany in the global wind market can be primarily attributed to decades of progressive and targeted legislation. By the early 1980s, a growing environmental movement influenced the energy debate in the German Parliament and the energy policy of the federal government.

Geographically dispersed wind farms, largely developed by small enterprises and cooperatives, have characterised wind development in the country. Historically, private citizens and mostly cooperative programmes owned the majority of the wind turbines. The involvement of a large number of small investors has contributed to a broad public support for wind energy projects, and has significantly reduced the "not in my backyard" problem that has been encountered in other large markets. Another supporting factor was the interest of farmers, who helped develop the financing market for early wind projects by providing their land as collateral for development costs. Most of the early jobs created by the wind energy sector were in small- and medium-sized enterprises and in regions that were rural or economically less developed. This helped to create a positive view of the technology and its socio-economic benefits.

Germany's renewable energy polices and wind energy market since the late 1990s had a positive impact on the global renewable energy debate. The rapid progress made in achieving the national renewable energy targets had a large impact on other national markets.

The policies in place translated the idea of a sustainable and clean energy supply into concrete developments. This development is emblematic, since it has been accomplished by the world's fifth-largest energy consumer.

Table 5-2 summarises the best practices for the achievement of enabling conditions for wind energy in Germany.

Current challenges

The Federal Building Code continues to be a key regulation impacting on wind power development. Under this law, wind energy plants are categorised as "privileged projects" and local authorities are required to designate specific priority or preferential zones for wind projects. The developments can also be restricted in specific areas (exclusion zones). In several regions, restrictions inhibit the turbines from installing at the best height for their operation, where they could yield the maximum amount of energy. In 2010, the Federal government and some states started to reconsider the authorisation conditions to allow continuous development onshore, and have entered into discussions with local and regional planning authorities.

Another key challenge for integrating renewable energy generation is the expansion of the grid, including underground cabling in critical areas in order to increase public acceptance. In 2010, the equivalent of 150 GWh of wind power was lost because grid operators had disconnected the wind turbines due to overproduction, which had increased by 69% compared to 2009.

The German Renewable Energy Act (EEG) specifies that grid operators have to pay for the power when wind turbines are disconnected from the grid (called curtailment). In the short- to medium-term, energy losses from curtailment are likely to increase. A difficult element will be to ensure the social acceptance of the projects for transmission and distribution lines that are required by the growing amount of wind energy.

The overall grid transport capacity in Germany can also be improved through soft measures such as temperature conductors, load flow management and other "smart grid" options. The upfront costs for integrating higher shares of wind energy may need to be considered in the broader perspective of the integration of the European electricity market. Additional storage capacities and HVDC interconnectors would need to be planned. In the current economic conditions these developments are likely to face financing constraints, thereby affecting the pace of integration plans for renewable energy.

Repowering will play a large role in the future, and is estimated to have the potential to double the amount of onshore wind capacity and to triple the country's energy yield with significantly fewer turbines deployed. By 2015, almost 6 GW of installed capacity will be older than 15 years and ready for repowering.

Table 5 - : Summary of enabling conditions for wind energy – Germany

Effective rule of law; and transparency in administrative and permitting processes	The legislation is clearly defined and has been enforced in a timely and targeted manner. Clear guidance is provided through the building codes, while siting and permitting laws are available for all landscapes.
A clear and effective pricing structure	A feed-in tariff has been available since 1991. Its subsequent revisions have allowed long-term certainty in the stability of the national market for both the local wind industry and its investors.
Provisions for access to the grid (incentives & penalties for grid operators)	Clear guidance is available to utilities, electricity generators and consumers on the role and duties of the grid operators. However, cooperation of regional grid companies in expanding the inland grid capacity and the offshore connections is not optimal. Issues related to grid integration are causing delays and adding risk to future projects.
An industrial development strategy	Focused and early support for R&D programmes was available for wind energy, as well as early support for demonstration projects both onshore and offshore. However the offshore development has run into delays.
A functioning finance sector	Wind projects have received long-term support from the National Development Bank (KfW) and the regional finance sector. Europe's current economic conditions and the impact of Basel 3 regulations62 could influence the ability of German lenders to finance large projects (especially offshore) in the short- to medium-term.
Expression of political commitment from government (e.g. targets)	According to the National Renewable Energy Action Plan, the percentage of energy from renewable sources in the gross final energy consumption will rise from 6.5% in 2005 to 18% in 2020, and could even be surpassed to reach an aspirational target of 19.6%. Targets up to 2030 would be welcome, in order to provide long-term certainty for both the offshore and onshore developments.
A government and/or industry led strategy for public and community buy-in.	As a result of the national commitment to renewable energy, the country has seen a tremendous increase in renewable energy production since the 1980s as well as job creation and industrial development.
An employment development strategy	At an early stage, the regional governments provided regulatory and financial support for small- and mediumsized enterprises to build and operate wind turbines and farms. By 2011, Germany had created more than 100 000 jobs in the wind industry.
NOTE	In Germany most of the early jobs created by the wind energy sector were in small- and medium-sized enterprises, often in rural or less developed regions. This helped create a positive view of the technology and highlighted its socio-economic benefits.

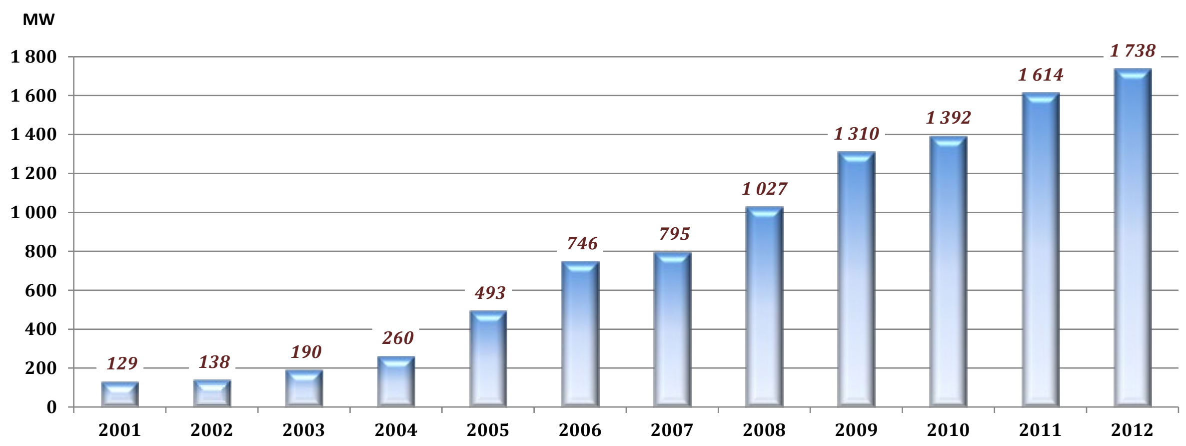
Source: IRENA and GWEC, 2012

5.3. IRELAND (see Annex XIII for more detail)

Ireland's installed wind capacity stood at 1,738 MW by the end of 2012. Wind power represented a share of 13% of the country's total electricity demand in 2012. Figure 5-3 shows the evolution from year 2001 of installed wind power in Ireland.

According to Ireland's National Renewable Energy Action Plan, the country would produce 16% of its final consumption from renewable sources in 2020. Renewable energy would represent 40% of the gross electricity consumption by 2020.

Figure 5- : Cumulative Wind Installation (MW) of Ireland



Source: GWEC, 2011 and EWEA, 2012

Ireland has one of the strongest wind regimes in Europe. However, its limited grid capacity and domestic demand is insufficient to absorb the large wind production, which is leading to curtailments. The first steps have been taken towards developing interconnections with Northern Ireland and the UK, and are expected to solve a large part of the curtailment problem.

In the past decade the energy policy has been driven by concerns about energy security, cost-competitiveness and environmental protection. The deployment of renewable energy sources in the electricity sector has been increasing steadily in recent years. The country has committed to increasing the share of renewable energy in electricity consumption to 40% by 2020.

Under the Alternative Energy Requirement (AER), a significant part of the capacity had not been built, and the scheme was replaced by a feed-in tariff system. The failure of the tendering system was due to the low price offers proposed, and the lack of profitability of the projects. This experience is similar to that of the UK with the Non-Fossil Fuel Obligation (NFFO) tenders.

The current renewable energy feed-in tariff (REFIT 1) scheme is capped at 1,450 MW, most of which will be provided by projects which have already received connection offers. Only a small part of the 3,000 MW, currently under process for connection offers, will be eligible to receive incentives under the scheme, creating considerable uncertainty for developers. The upcoming REFIT 2 might solve some of these issues. The final design of the support mechanisms and/or tariff bands that result from these discussions will be critical to the future of wind power development in the country. Furthermore, the outcome of ongoing discussions between developers and regulators on the latest policy guidelines for curtailment will be critical to future investments.

Table 5-3 summarises the best practices for the achievement of enabling conditions for wind energy in Ireland.

Current challenges

Ireland's banking crisis caused difficulties for the wind sector. The banks became extremely selective and would only lend to developers with a strong track record. The limited available credit created difficulties for small players who had approvals and grid-connection offers in place to proceed to the construction stage.

Although some efforts have been made to improve grid capacity, more efforts are required for Ireland to meet its 2020 targets. In 2006, the government requested that the Commission for Energy Regulation (CER) initiate the construction of an East-West Interconnector to Britain by 2012. The project led by EirGrid is part of the National Development Plan 2007-2013, and was completed in September 2012. Furthermore the "all-island grid" brings together the grids of the Republic of Ireland and Northern Ireland. In the beginning of 2011, more than 1.8 GW of wind had been installed on those territories, accounting for more than 10% of their cumulative installed capacity.

Until 2011, wind farms were regularly curtailed, and financially compensated. The regulators examined the effect of 4.6 GW of wind power capacity on the system operation. The curtailment rules for wind were then reviewed and in the last quarter of 2011 the regulators started to consider a new policy on curtailment. The rules favour established wind farms over new developments and have resulted in some projects being stalled.

Table 5 - : Summary of enabling conditions for wind energy – Ireland

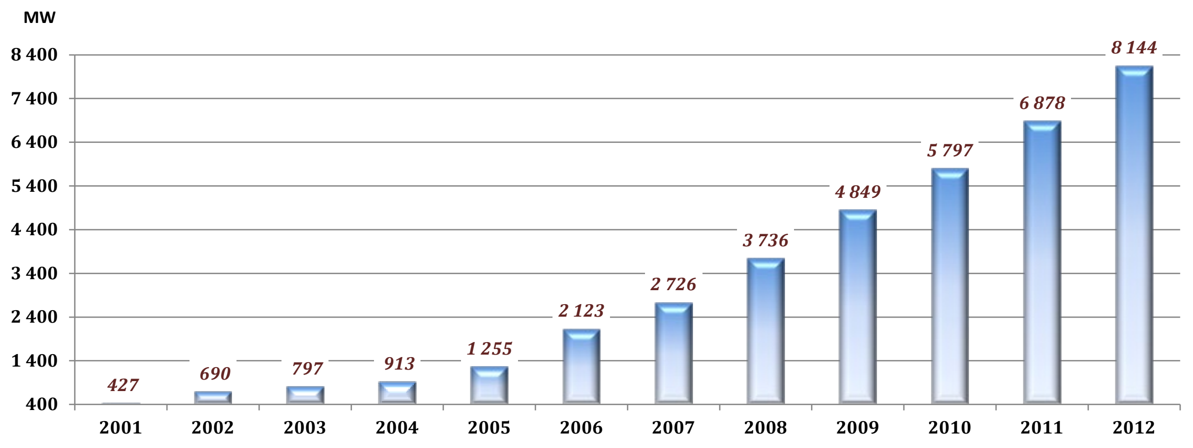
Effective rule of law; and transparency in administrative and permitting processes	Continuous support and a long-term policy framework were available from 1993 to 2010. The Sustainable Energy Authority of Ireland completed a series of surveys to assess the public attitude towards wind farms and future energy policy. The public is generally positively disposed to the introduction of wind farms. Detailed local planning guidelines and environmental guidelines are available.
A clear and effective pricing structure	The tariffs were first determined through auctioning under the AER programme, followed by a feed-in tariff system. A regulatory review after the financial crisis has had an adverse effect on the growth of, and confidence in, the wind industry. The sector now expects a review of the feed-in tariffs (REFIT 2).
Provisions for access to the grid (incentives & penalties for grid operators)	Electricity produced by renewable sources has priority over other energy production facilities. The national grid development strategy, Grid25, plans for the grid expansion until 2025. The share of electricity from renewable sources should reach 40% by 2020. At present planning regulations are not in phase with grid connection timelines. The standard planning permission granted to a wind farm development typically expires after five years, but it can take up to six years to process a grid connection application (Staudt, 2000).
An industrial development strategy	Regulatory and policy support were made available for the growth of a domestic wind industry.
A functioning finance sector	After the 2009 financial crisis, commercial lending was difficult to obtain, in particular for developers with limited track records.
Expression of political commitment from government (e.g. targets)	There is a long-term renewable energy target of 16% by 2020 under the 2009 European Renewable Energy Directive. However, regulatory support and secondary legislations are not in place, which causes significant delays to projects.
A government and/or industry led strategy for public and community buy-in.	EirGrid organises public engagement through public education efforts and outreach for specific transmission projects.
An employment development strategy	Not Applicable
NOTE	Despite a difficult economic atmosphere, the development of a green economy is set to be a key driver of the economic recovery and future growth of Ireland.

Source: IRENA and GWEC, 2012

5.4. ITALY (see Annex XIII for more detail)

By the end of 2012, Italy's total installed wind capacity reached 8,144 MW. The country has the fourth-largest installed wind capacity in the European Union. Figure 5-4 shows the evolution from year 2001 of installed wind power in Italy.

Figure 5- : Cumulative Wind Installation (MW) of Italy



Source: GWEC, 2011 and EWEA, 2012

Several policy elements are characteristic of the Italian case:
• The green certificate system was efficient in leading to strong growth in the wind energy market.
• However, Italy has the highest average expenditure for supporting wind power and small hydroelectric plants in the European Union. Although Italy's priority is to diversify its energy supply and to lower its dependency on imported gas in the electricity sector, the costs of the support policy might not be sustainable in the future.
• The country's generous support scheme has however attracted investors, despite long administrative procedures and grid constraints putting investments at risk.
• The regions play an important role in the deployment of renewable energy technology. Up until now developments have been mainly concentrated in the south of the country, causing grid overloads.

The national policy for renewables operates through a complex set of incentives which range from indirect regulatory support measures, such as feed-in tariffs and fiscal incentives, to market-based mechanisms, such as quota obligations and tradable green certificates.

The incentive schemes are not adjusted from the technology learning curve. The support for renewable energy is not within the range of production costs from other technologies. The high support levels have increased the number of investors involved in renewable energy production, and led to a successful growth of onshore wind power and solar PV.
Table 5-4 summarises the best practices for the achievement of enabling conditions for wind energy in Italy.

Current challenges

During the past decade the Italian electricity system suffered from inadequate grid infrastructure, which led to frequent curtailment of wind power to avoid congestions. The administrative processes to develop the grid are not centralised, which slows the authorisation process.

The grid problem affects projects in Campania, Apulia and Basilicata and some in Sardinia. Problems occur due to the high concentration of projects in pockets and the low capacity of the grid, especially on old 150 kV lines, which do not allow all the power produced by the wind farms to be dispatched. In 2009, a number of wind farms operated at 30% less than their normal capacity due to this issue. In some cases, wind farms were limited by over 70%, while others were shut down completely.

Integration to the grid is a source of concern for accommodating both the current installed wind energy capacity and the planned capacity. At present, some projects are under development to include storage (battery-based) systems for renewable energy-based electricity. In addition, Italy also suffers from administrative constraints such as complex authorisation procedures and high connection costs.

The quota system enables considerably higher profits for onshore wind than in most other European countries applying feed-in systems. In the light of economic concerns in Italy, the generous levels of support for renewable energy sources may be revised downwards, as seen in recent months in neighbouring countries like Spain, Portugal and Greece.

Table 5 - : Summary of enabling conditions for wind energy – Italy

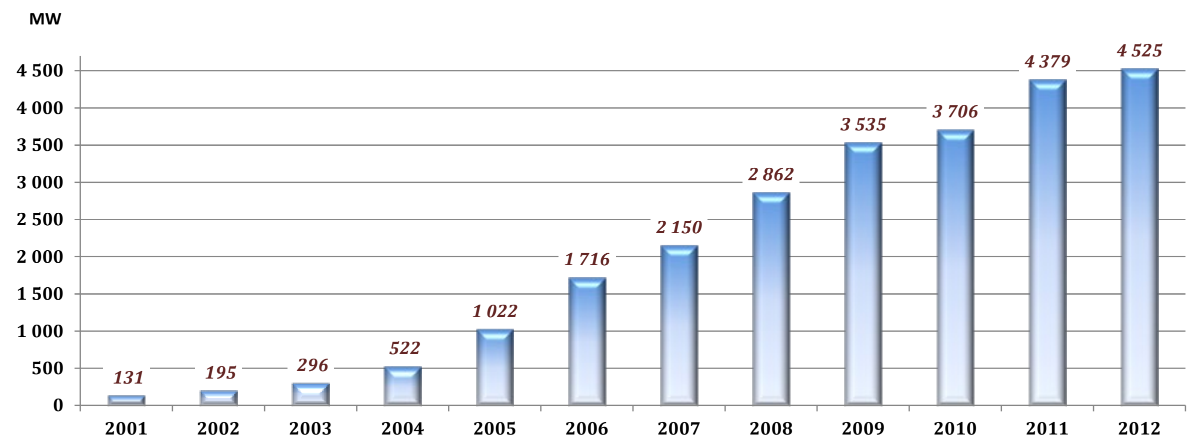
Effective rule of law; and transparency in administrative and permitting processes	A continuous and long-term policy framework has been in place since 1988. There is scope for improving regional permitting procedures to facilitate project development.
A clear and effective pricing structure	The tradable green certificates system under the quota obligations was an effective mechanism. The proposed shift to a feed-in system is likely to provide dependable support for wind power development.
Provisions for access to the grid (incentives & penalties for grid operators)	Electricity produced from renewable sources has priority for dispatch by the distribution companies and favourable connection procedures.
An industrial development strategy	The main driver developing renewable energy sources has been to promote energy security and reduce import dependency. No national industrial development strategy is in place. Some of the regions provide capital subsidies.
A functioning finance sector	Financing for wind projects has been available through the private sector.
Expression of political commitment from government (e.g. targets)	Long-term renewable energy target of 17% by 2020. Italy plans to produce 98 TWh from renewable sources by 2020, up from 27.5 TWh in 2010.
A government and/or industry led strategy for public and community buy-in.	Stakeholder engagement and consumer awareness have not been a specific activity undertaken by the government or industry.
An employment development strategy	Not Applicable
NOTE	Italy's national policy for renewables operates through a complex set of incentives which range from indirect regulatory support measures, such as feed-in tariffs and fiscal incentives, to marketbased mechanisms, such as quota obligations and tradable green certificates. According to a recent European study, Italy has the highest average expenditure for supporting wind power and small hydropower.

Source: IRENA and GWEC, 2012

5.5. PORTUGAL (see Annex XIII for more detail)

Portugal is one of the leading countries in Europe in terms of wind power penetration, with 17% of its electricity demand met by 4,525 MW of wind power capacity in 2012. Wind energy is the second most developed renewable source, after hydropower. The country adopted a target of achieving 20% of its energy consumption from renewables by 2020 under its National Renewable Energy Action Plan. Existing and planned wind farms are mainly concentrated in the northern part of the country[93]. Figure 5-5 shows the evolution from year 2001 of installed wind power in Portugal.

Figure 5- : Cumulative Wind Installation (MW) of Portugal



Source: GWEC, 2011 and EWEA, 2012

Portugal implemented a stable feed-in tariff for wind energy of EUR 74/MWh (USD 107.13/MWh). This tariff was valid for 15 years, and was adjusted for inflation. Taking into account the 2005 tenders, the country has one of the lowest feed-in tariffs in Europe. The use of a mixed tariff-based and tendering process has enabled the wind sector to benefit from a constant project pipeline. This system proved to be effective, and resulted in excellent growth, both in terms of installed capacity and electricity generation, between 2005 and 2010.

Strong government support over a long period of time, and a large and continuous pipeline of projects, provided long-term market viability to the industry. Local municipalities received a portion of the gross income generated by the wind projects, which increased public acceptance and facilitated a cooperative environment between the power producers and the municipalities.

From 1990 to 2010 electricity prices in Portugal decreased to below the European Union average, which confirms the positive effect of the domestic energy policy. However, consumers were not charged the full costs of electricity production, which led to a tariff deficit of over EUR 2 million (USD 2.9 million). This deficit was mistakenly attributed to the renewable energy sector. In addition, VAT has been increased from 6% to 23%. Electricity producers and the government therefore face challenges in justifying inevitable future electricity price increases.

By 2020, Portugal intends to be generating 60% of its electricity from renewable resources, in order to satisfy 31% of its final energy consumption. Grid integration will be a critical element for developing wind power. Interconnecting with the larger Spanish electricity market and the large hydropower system[94] enabled to integrate large amount of wind energy to the grid. However the interconnection capacity with Spain is already insufficient, since the wind regime is similar in both countries, and both countries have an overcapacity of gas and coal generation. Smart grids are now being promoted and deployed throughout Portugal as part of the National Energy Strategy. Their introduction is being combined with more efficient management of the existing networks.

Table 5-5 summarises the best practices for the achievement of enabling conditions for wind energy in Portugal.

Current challenges

As part of Portugal's broader economic restructuring under its bailout obligations to the EU, the European Central Bank and the IMF, the country must privatise a significant portion of its energy sector, and transpose the European legislation for the liberalisation of the energy sector. The government is required to revise, reduce and revoke several of its incentive mechanisms for renewables in 2012-13. The credit crisis also impacted on project financing in 2011-12. Therefore, Portugal's planned 2014 review of its 2020 renewable energy targets will take place at a time of national economic restructuring and tight government budgets.

To increase the penetration of renewable energy in the energy mix, the country would need to increase its grid and storage capacities. The increase in storage capacity could be mostly achieved through an increase of the hydropower capacity. IPPs are facing severe difficulties in connecting to the grid, due to the low capacity of the system, and issues in accommodating all connection requests.

93. Most wind farms located in Portugal are in the northern half of the country. The windier locations in Portugal are usually in coastal regions and on mountaintops. However, as the Portuguese coast is densely populated, wind farms in Portugal have mostly been built inland, on mountains, to make the most of the country's wind resource.

94. The implementation of the Large Hydro National Plan is expected to increase Portugal's pump storage capacity from 1,100 MW in 2011 to 4,850 MW in 2020, and thus reduce the limitations of wind production during off-peak hours, ensuring the economic feasibility of new capacity installations.

Table 5 - : Summary of enabling conditions for wind energy – Portugal

Effective rule of law; and transparency in administrative and permitting processes	Historically the regulatory framework has been stable. However, since 2010, there has been limited clarity on the future of the tariff and support schemes for renewables, due to the need for structural adjustments in the Portuguese economy. The short-term actions now being deployed to meet budgetary obligations may affect long-term investment priorities. According to the European Wind Energy Association, the average lead-time for project developments could now reach 58 months, when the EU average was 24 months in 2010.
A clear and effective pricing structure	Feed-in tariffs were available for almost all renewable energy producers. The tariff system is combined with tendering schemes, and has proven to be effective. The tariff system has led to a very steep growth of both installed capacity and electricity production over the last five to six years. Both the scheme and the tariffs have been continuously monitored against the level of market prices.
Provisions for access to the grid (incentives & penalties for grid operators)	Renewable energy projects have priority on access to the grid, as stated in the National Energy Strategy Plan. Sites for new wind and forestry biomass power plants are tendered and located where the grid can be efficiently and consistently developed.
An industrial development strategy	The government supported the development of industrial clusters, thus creating a local supply chain. Long-term targets for wind energy and a large pipeline of projects provided the necessary long-term visibility on market conditions to allow a local supply chain to be built.
A functioning finance sector	The stability of the support scheme, and of other fiscal incentives through the last decade, allowed for predictable returns on investments. Project financing was easily available until the economic crisis.
Expression of political commitment from government (e.g. targets)	Portugal intends to supply 60% of its electricity from renewable resources by 2020, in order to satisfy 31% of its final energy consumption.
A government and/or industry led strategy for public and community buy-in.	The 2.5% (of gross income from wind projects) taxbased contribution to municipalities helped to improve public acceptance and cooperation between project developers, power producers and the municipalities.
An employment development strategy	Small- and medium-size enterprises were supported to develop capacity and manpower for building and operating renewable energy projects and manufacturing equipment.
NOTE	Portugal has one of the most stable policy and regulatory regimes for wind. However, the ongoing financial and economic crisis will greatly affect the future of the sector.

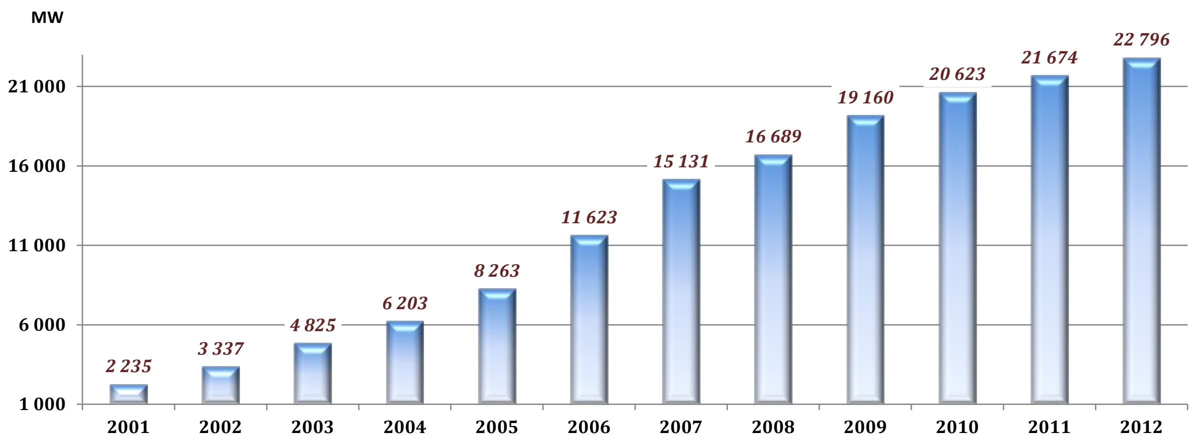
Source: IRENA and GWEC, 2012

5.6. SPAIN (see Annex XIII for more detail)

Spain is the second largest European wind energy market after Germany, and has the fourth largest installed capacity in the global market. The country installed 1,122 MW in 2012, for a total installed wind capacity of 22,796 MW, a growth of 5.2% over 2011. Figure 5-6 shows the evolution from year 2001 of installed wind power in Spain.

Spain has a target of producing 20% of its gross final energy consumption from renewable sources by 2020, which includes a total installed capacity of 35.75 GW of wind power.

Figure 5- : Cumulative Wind Installation (MW) of Spain



Source: GWEC, 2011 and EWEA, 2012

Before the 1990s, the Institute for Diversification and Saving of Energy (IDAE), which is the Spanish Renewable Energy Agency reporting to the Ministry of Industry, Energy and Tourism, played a significant role in the early stage of wind energy deployment in Spain, when an initial dynamic impulse was needed. In the late 80's IDAE appeared as an outstanding developer, sharing investment risks through shareholding and trade agreements with utilities, manufacturers and other public entities to implement wind farms, strongly stimulating wind power technological development and private investments until a critical mass was reached. IDAE's investments in the wind sector represented an important share (e.g., 60% of the total investment in wind energy in 1986 came from IDAE).

Through the 1990s and early 2000s, the rapid development of renewable energy in Spain was a direct outcome of national and regional industrial and energy policies. Since 2008, the policies were influenced by the implementation of the European Directives. Several elements are characteristic:

• The country's rapid emergence as a centre for wind manufacturing was due to its local content requirements and its stable feed-in tariff policy, which created opportunities for investment in technology development

• Government-led wind concessions were also widely used. Five wind concessions totalling 3,200 MW were granted to project developers through a tendering process. These projects helped support the development of new transmission capacity, since the financing of power lines was a requirement of the concessions.

• The support scheme provided stable long-term support for the projects. This, in turn, created a stable market environment, where investors could predict their returns, and generated a constant demand for turbines. This constant demand enabled the industry to predict market volumes, and invest in manufacturing facilities and technology development.

• The 17 autonomous communities which constitute Spain have had a significant role in the development of renewable energy. In particular, the regional authorities mostly develop administrative procedures and provisions related to the environment, as well as planning provisions. For example, the autonomous region of Navarre was one of the first regions to actively support local wind industry development, paving the way for other Spanish regions to replicate the approach.

• The electricity grid has shown sufficient flexibility to operate with high levels of wind penetration, even above 50%, and with lower than originally expected costs of support services and spinning reserve. The recent implementation of electricity exchanges agreements with Portugal, along with plans to reinforce the exchanges with France, would further increase the flexibility of the system.

• The contribution of the local industry to R&D was equivalent to EUR 189.5 million (USD 277 million) in 2008. The wind energy industry is a dynamic component of the national manufacturing industry.

• The growth of wind energy in the electricity generation sector has led to environmental benefits, reduction of energy dependence, development of an important technological and industrial base, and job creation.

According to the analysis undertaken by the European Wind Energy Association a key reason why Spain stood out from other European leaders in wind power, was that environmental issues were not the major driving force behind the sector's expansion. Spain's wind energy boom was much more about regional growth and economics.

Spain's initial success has been possible due to the existence of a strong policy regime at a time where very few similar initiatives existed. A solid industrial sector was created, and the Spanish manufacturers developed strong export capacity. However since 2010, the wind sector has almost come to a standstill and its future beyond 2012 remains unclear.

Table 5-6 summarises the best practices for the achievement of enabling conditions for wind energy in Spain.

Current challenges

In January 2012, the government passed a moratorium stopping subsidies to all new RE capacity not already approved. Wind projects already approved on the national pre-allocation register will not be affected by the moratorium.

The current uncertainties in the Spanish legislation are an example of the difficulties that a country can face in continuously adapting its legislative framework to broader economic constraints, while preserving a dynamic market.

The economic crisis and the Spanish tariff deficit has put limits on budgetary allocations for renewable energy. This is likely to further slow down development of Spain's wind industry in 2013.

Table 5 - : Summary of enabling conditions for wind energy – Spain

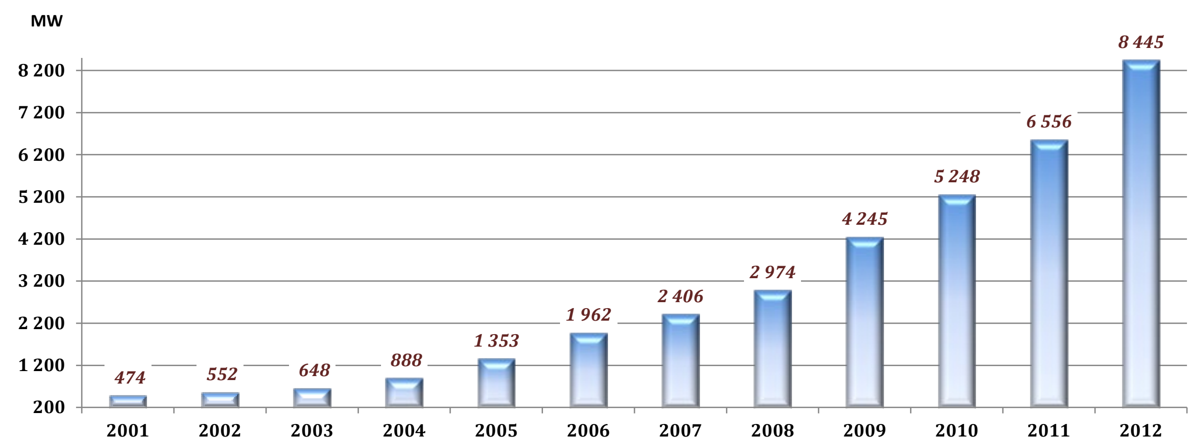
Effective rule of law; and transparency in administrative and permitting processes	A contiguous and long-term policy framework has been in place since 1985. Administrative and permitting processes are primarily the responsibility of regional governments. Detailed guidance is available to the industry.
A clear and effective pricing structure	Until 2009, there was strong support for renewable energy. Since 2010, revised legislation has slowed the growth of the wind sector. The revised legislation followed constraints on public expenditures caused by the financial crisis.
Provisions for access to the grid (incentives & penalties for grid operators)	Electricity produced from renewable energy sources has priority access. All electricity produced is purchased.
An industrial development strategy	The industry's growth has been largely due to the initial public support for wind turbine manufacturing. Two of the largest wind manufacturers are based in Navarre. The Navarran Hydroelectric Energy Company or EHN (presently called Acciona Energy) was created in 1989 under a public-private partnership. In 1994 GamesaEólica was created to manufacture wind turbines as a joint venture between the government of Navarre, GamesaEnergía and Vestas (with a 40% stake) .
A functioning finance sector	Spanish wind energy companies are among the largest in the global market. Financing was not a problem till 2010.
Expression of political commitment from government (e.g. targets)	There is a long-term renewable energy target of 20.8% by 2020.
A government and/or industry led strategy for public and community buy-in.	Early benefit-sharing among local populations (via rent for land use for wind farms, job creation, economic development in the community, etc.) has helped create positive support for the wind industry.
An employment development strategy	This was largely driven by the governments of the autonomous regions who provided additional support to both foreign and domestic investors in the 1990s to set up manufacturing units in Spain.
NOTE	Through the 1990s and early 2000s, the rapid development of renewable energy was the result of Spain's national industrial and energy policy. Since 2008, the legislation has been influenced by the implementation of the European Directives.

Source: IRENA and GWEC, 2012

5.7. UK (see Annex XIII for more detail)

The United Kingdom (UK) has one of the best wind regimes in Europe both onshore and offshore. As of 2012 the country had installed a cumulative capacity of 8,445 MW. It has the largest installed offshore wind capacity worldwide, with 2,948 MW installed capacity as of 31 December 2012. The majority of onshore wind farms in the UK are located in Scotland. The national renewable energy strategy has a target of generating 15% of all its energy from renewables by 2020[95]. Figure 5-7 shows the evolution from year 2001 of installed wind power in UK.

Figure 5- : Cumulative Wind Installation (MW) of UK



Source: GWEC, 2011 and EWEA, 2012

The key policy instruments for the support of renewables at the national level in the UK are the Renewables Obligation[96] (RO) and the recently introduced feed-in tariff for projects smaller than 5 MW. Prior to the RO, the wind sector was supported through the auctioning system (Non Fossil Fuel Obligation - NFFO).

In the UK, the support to renewable energy was mainly driven by the privatisation and the reform of the energy sector in the late 1970s and the 1980s[97].

The Renewables Obligation has only contributed modestly to the deployment of renewable energy sources since 2002. Although over 20,000 MW of onshore wind projects have been proposed, their actual development has been hindered by planning and grid delays. In April 2009, the regulators looked at addressing this concern by introducing technology "banding" in the RO.

The UK government is also considering revising banding levels for the period 2013-2017. It is also consulting on its proposal to discontinue the RO from 2017 and introduce an expanded feed-in tariff to cover all electricity generation from low-carbon sources, including renewables. By 2011 the UK secured 9.5% of its electricity from renewables, compared to less than 3% before the RO.

95. The UK has one of the highest offshore wind resources in the world with over 33% of the total European potential

96. The legislation is divided into the Renewables Obligation (for England and Wales), the Renewables Obligation Scotland (ROS), and the Northern Ireland Renewables Obligation (NIRO). These schemes are managed by the DECC, the Scottish government and the Department of Enterprise, Trade and Investment for Northern Ireland respectively. The UK electricity regulator, the Office of Gas and Electricity Markets (OFGEM) administers the scheme.

97. Mrs Margaret Thatcher was the Prime Minister of the UK between 1979 and 1990. By November 1990, more than 40 former state-owned companies had been privatised.

Each NFFO round took the form of capacity auctions, where developers were invited to submit competitive "bids" for NFFO contracts. However, the lack of planning and penalties for not building allocated capacity led to limited growth of the wind sector.

The UK Renewable Energy Strategy, as implemented under the EU Renewable Energy Directive, mentions a binding objective of 15% of final energy consumption from renewables by 2020, implying 30% of electricity produced from renewable sources. Wind energy would be the largest contributor, with up to 33 GW of capacity, delivering over GBP 60 billion (USD 96.8 billion) of investment and creating 160,000 jobs.

Each of the countries of the UK has its own distinct planning system; the responsibility for town and country planning is devolved to the Northern Ireland Assembly, the Scottish Parliament and the Welsh Assembly. Planning legislation varies across the countries of the UK, and must itself take into account the European Directives and International legislation (such as the Kyoto Protocol). However, improved access to the electricity transmission network would overcome a backlog of connections from renewable energy projects and encourage further investments. There are also opportunities for streamlining the planning and consenting process.

Table 5-7 summarises the best practices for the achievement of enabling conditions for wind energy in the UK.

Current challenges

The wind sector in the UK has faced several barriers over the past two decades, some of which have been persistent. The UK government has launched a number of recent initiatives to support the growth of the wind sector by confronting critical issues such as grid access (Transmission Access Review), national planning (Planning Bill), local planning (the Killian Pretty Review), and the supply chain (establishment of the Office for Renewable Energy Development) among others. However, despite these actions, the wind sector still faces considerable challenges, especially for onshore wind.

Grid capacity is limited in areas of high wind regimes, and site approval can be difficult to get. Building significant transmission capacity out to remote locations can take up to 10 years, which creates high uncertainty for investors[98].

Much of the UK, especially England and Wales, is densely populated, and the planning process is complex. The UK still is one of the most difficult places in Europe to get planning consent, which can take five times longer than the average for European countries. On a comparative basis the UK's offshore site approval process is less complex.

The UK does not have extensive domestic wind manufacturing capacity, though this is beginning to change slowly. A number of points in the supply chain are prone to shortages – the most important of which are wind turbines, vessels, cables, and offshore substations.

98. Historically, the grid operator, the National Grid, was granting access to the grid according to non-discriminative criteria. Renewables were thus not given priority (compared to conventional generators).The Department of Climate Change (DECC) undertook two public consultations on improving grid access for renewables in 2009 and 2010. This led to the introduction of the "Connect and Manage" (Socialised) regime for grid access in August 2010, which enabled new and existing renewable energy generation projects to connect to the network more rapidly.

Table 5 - : Summary of enabling conditions for wind energy – UK

Effective rule of law; and transparency in administrative and permitting processes	A long-term energy policy framework has been in place since 2010 although it was not specifically designed for promoting renewable energy sources. The UK is developing a large renewable energy capacity, but current projects do not generate high local benefits. Since the country is densely populated, there has been opposition to wind farms in many rural areas.
A clear and effective pricing structure	The auction system was not favourable to small, local investors. The RO created uncertainty for investors, since future ROC prices could collapse if excess renewable generation were built. Due to this risk element, the cost of capital was increased, which favoured large companies able to finance the developments on their balance sheet. Before the banding process, the ROCs were awarded per MWh regardless of the method of generation. This system favoured mature, lower-cost generation technologies, such as landfill gas, over less mature technologies like offshore wind and wave power.
Provisions for access to the grid (incentives & penalties for grid operators)	Until recently renewable energy did not have priority access to the grid, making the UK among the most difficult markets to secure a grid connection for wind projects.
An industrial development strategy	The UK did not create a domestic industrial base for onshore wind. However, this is changing with the upcoming development of the offshore wind market, especially in Scotland.
A functioning finance sector	Since the 2009 financial crisis, commercial lending has been difficult to access, and the finance sector is yet to recover completely, as of 2012.
Expression of political commitment from government (e.g. targets)	The 2008 Climate Change Act committed the UK to reducing its emissions by 80% by 2050. This required a rapid advance in the rate of growth of renewable energy. The Act further specified a reduction in emissions of at least 34% by 2020, on a 1990 baseline.
A government and/or industry led strategy for public and community buy-in.	The UK wind industry started working closely with other stakeholders to address the issue of local communities' hostility to onshore wind projects in the late 1990s. Today the UK has the most developed processes for public consultation and stakeholder engagement.
An employment development strategy	Not Applicable
NOTE	The UK has some of the best wind resources in Europe. Improved access to the electricity transmission network would overcome a backlog of connections from renewable energy projects and encourage further investments. There is still room for streamlining the planning and consenting process for both onshore and offshore projects.

Source: IRENA and GWEC, 2012

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ANNEX I - RESEARCH & DEVELOPMENT – MEMBERS of the EUROPEAN ENERGY RESEARCH ALLIANCE (EERA)

ANNEX I: R&D – MEMBERS of EERA

The Sub-programmes within the Joint Programme on Wind Energy of the European Energy Research Alliance (EERA) are listed next:

- Wind Conditions. Coordinated by Prof. Erik Lundtang Petersen, DTU Wind Energy (DK)
- Aerodynamics. Coordinated by Dr. Peter Eecen, ECN (NL)
- Offshore Wind Energy. Coordinated by Dr. John O. Tande, SINTEF (NO)
- Grid Integration. Coordinated by Dr. Kurt Rohrig, FhG IWES (DE)
- Research Facilities. Coordinated by Dr. Pablo Ayesa Pascual, CENER (ES)
- Structural design and materials. Coordinated by Dr. Denja Lekou, CRES (GR)

Table I - : EERA member institutions

Country	Name	Webpage
Iceland	Iceland GeoSurvey	www.geothermal.is
Ireland	Hydraulics and Maritime Research Centre	http://www.ucc.ie/en/hmrc/
UK	UK Energy Research Centre	www.ukerc.ac.uk
UK	British Geological Survey	www.bgs.ac.uk
UK	School of Electronic, Electrical and Systems Engineering	www.lboro.ac.uk
UK	Imperial College London	www3.imperial.ac.uk
UK	Scottish Carbon Capture and Storage	www.geos.ed.ac.uk
UK	SuperGen UK Centre for Marine Energy Research	www.supergen-marine.org.uk
UK	UK Carbon Capture and Storage Consortium	www.geos.ed.ac.uk
UK	University of Bristol	www.bris.ac.uk
UK	University of Nottingham	www.nottingham.ac.uk
UK	University of Oxford	www.ox.ac.uk
UK	University of Southampton	www.southampton.ac.uk
UK	University of Ulster	www.ulster.ac.uk
UK	University of Loughborough	www.lboro.ac.uk

Country	Name	Webpage
Belgium	Cenaero	www.cenaero.be
Belgium	University of Mons	portail.umons.ac.be
Belgium	Belgium Building Research Institute	www.bbri.be
Belgium	Institute for Broadband Technology	www.geysers.eu
France	French Alternative Energies and Atomic Energy Commission	www.cea.fr/english-portal
France	Bureau de Recherches Géologiques et Minières	www.brgm.fr
France	National Center for Scientific Research	www.cnrs.fr/index.php
France	French Oil Institute	www.ifpenergiesnouvelles.com
France	French Research Institute for Exploitation of the Sea	www.ifremer.fr
France	French National Institute for Agricultural Research	www.inra.fr
France	University of Lorraine	www.univ-lorraine.fr
Spain	Centre for Energy, Environment and Technology	www.ciemat.es
Spain	ALBA Synchrotron Light Facility	www.cells.es
Spain	National Renewable Energy Centre	www.cener.com
Spain	Renewable energy and energy efficiency	www.fcirce.es
Spain	Spanish National Research Council	www.icmm.csic.es
Spain	Institute of Materials Science of Barcelona	www.icmab.es
Spain	Institute of Materials Science of Madrid	www.icmm.csic.es
Spain	Madrid Institute for advanced studies	www.imdea.org
Spain	Center for Applied Research in RD&i	www.tecnalia.com
Spain	University of Zaragoza	www.unizar.es
Portugal	National Laboratory for Energy and Geology	www.lneg.pt
Portugal	Structure of Mission Extended Continental Shelf	www.emepc.pt
Portugal	University of Evora	www.ip.uevora.pt
Portugal	University of Porto	sigarra.up.pt/up/en
Portugal	Offshore Renewables	www.wavec.org
Germany	German Aerospace Center	www.dlr.de
Germany	Fraunhofer-Gesellschaft	www.fraunhofer.de
Germany	Dresden-Rossendorf Research Center	www.hzdr.de/FZD/
Germany	FZ Juelich (Institute of Energy and Climate Research)	www.fz-juelich.de
Germany	The national research centre for Earth Sciences in Germany	www.gfz-potsdam.de

Country	Name	Webpage
Germany	Helmholtz-Zentrum Berlin	www.helmholtz-berlin.de
Germany	Helmholtz-Zentrum Geesthacht	www.hzg.de
Germany	Karlsruhe Institute of Technology	www.kit.edu/english
Germany	Leibniz Institute for Applied Geophysics	www.liag-hannover.de
Germany	RWTH Aachen University	www.rwth-aachen.de
Germany	Zentrum für Sonnenenergie- und Wasserstoff-Forschung	www.zsw-bw.de
Germany	University of Münster	www.uni-muenster.de
Switzerland	The Paul Scherrer Institute	www.psi.ch
Switzerland	Centre for Hydrogeology and Geothermics	www.thinkgeoenergy.com
Switzerland	Research Institute of the ETH Domain	www.empa.ch
Switzerland	Ecole Polytechnique fédèrale de Lausanne	www.epfl.ch
Switzerland	As a University of Science and Technology	www.ethz.ch
Poland	Jagiellonian University	www.sthesca.eu
Poland	AGH-University of Science &Technologie (Krakow)	www.agh.edu.pl
Poland	Institute of Power Engineering	www.ien.com.pl
Poland	Warsaw University	www.uw.edu.pl
Czech Republic	Fyzikalni ustav Akademie ved Ceske republiky	www.fzu.cz/en
Czech Republic	The research organisation Centrum výzkumu Řež	www.cvrez.cz
Czech Republic	Institute of Plasma Physics	www.ipp.cas.cz
Austria	Austrian Institute of Technology	www.ait.ac.at
Austria	AEE – Institute for Sustainable Technologies	www.aee-intec.at
Slovenia	University of Ljubljana	www.uni-lj.si
Italy	Italian National Agency for New Technologies, Energy and Sustainable Economic Developmer	www.enea.it
Italy	Centro di Eccellenza per la Geotermia di Larderell	www.cegl.it
Italy	The National Research Council	www.cnr.it
Italy	Ricerca sul Sistema Energetico	www.rse-web.it
Italy	Istituto Nazionale di Geofisica e Vulcanologia	www.bo.ingv.it
Italy	Istituto Nazionale di Oceanografia e di Geofisica Sperimentale	www.ogs.trieste.it
Italy	Politecnico di Torino	www.polito.it
Italy	Politecnico di Milano	www.english.polimi.it

Country	Name	Webpage
Italy	University of Bologna	www.eng.unibo.it
Italy	University of Bari	www.uniba.it
Italy	University of Chieti	www.unich.it
Italy	University of Padova	www.unipd.it/
Italy	University of Parma	www.unipr.it
Italy	University of Bergamo	www.unibg.it
Italy	University of Milano-Biciocca	www.unimib.it/go/102/Home/English
Italy	University of Napoli	www.international.unina.it
Italy	University of Palermo	www.unipa.it
Italy	University of Pisa	www.unipi.it
Italy	University of Rome	www.uniroma1.it
Italy	University of Rome 3	www.uniroma3.it
Italy	University of Udine	www.uniroma1.it
Italy	University of Verona	www.univr.it
Italy	University of Sienna	www.unisi.it
Italy	Marche Politechnic University	www.univpm.it
Italy	Ente Nazionale per l'Energia eLettrica	www.enel.com
Italy	Telecommunications	www.ericsson.com
Italy	Telecommunications	www.telecomitalia.com
Italy	Loccioni	www.loccioni.com
Italy	Fondazione Ugo Bordoni	www.fub.it
Italy	Consorzio Università Industria – Laboratori di Radiocomunicazioni	www.radiolabs.it
Slovakia	Institute of Electrical Engineering	www.elu.sav.sk
Romania	Institute for Nuclear Research, Pitesti	www.nuclear.ro
Greece	Centre for Renewable Energy Sources and Saving	www.cres.gr/kape/default_uk.htm
Turkey	Technological Research Council of Turkey	www.tubitak.gov.tr

Source: European Energy Research Alliance (EERA)

ANNEX II: RD&D EU PROJECTS

Only projects fully in line with the EWI and not completed before June 2010 (when the EWI was launched) have been taken into consideration.

Table II - : RD&D EU projects.

Name	EU Instrument, budget and duration	Coordinator	Relevant EWI activity / activities (according to the classification used in the EWI 2010 – 2012 Implementation Plan)	
EEPR projects	EEPR - € 565m Duration not applicable (several projects)	N.A. (several organisations)	Activity 1.3.1: Large scale manufacturing and logistics, both size and numbers for in and out of factory and site erection Activity 2.2.1: Industry-wide initiative on mass-manufacturing of substructures Activity 3.1.1: Combined solutions for wind farm grid connection and interconnection of at least two Countries (this activity is now covered by the EEGI) Activity 3.1.2: Wind power plants requirements and solutions to wind farms supporting the system dynamics	http://ec.europa.eu/energy/eepr/index_en.htm
UPWIND	FP6 - € 14.5m 2006 - 2011	Risoe/DTU	Activity 1.1.1: Large scale turbines and innovative design for reliable turbines (10–20 MW)	www.upwind.eu
INNWIND	FP7 - € 13.8m 2012 - 2017	Risoe/DTU	Activity 1.1.1: Large scale turbines and innovative design for reliable turbines (10–20 MW)	www.innwind.eu
HYDROBOND	FP7 - € 2.9m 2013 - 2016	Barcelona University	Activity 1.1.1: Large scale turbines and innovative design for reliable turbines (10–20 MW)	http://hydro-bond.eu/
7MW-WEC-BY-11	FP7 - € 3.3m 2008 - 2012	WIP GMBH & CO PLANUNGSKG	Activity 1.1.1: Large scale turbines and innovative design for reliable turbines (10–20 MW)	www.7mw-wec-by-11.eu
WINGY-PRO	FP7 - € 2.5m 2009 - 2013	University of Bremen	Activity 1.1.1: Large scale turbines and innovative design for reliable turbines (10–20 MW)	www.wingypro.com
TOPFARM	FP6 - € 1.7m 2007 - 2010	Risoe/DTU	Activity 1.1.2: Improved reliability of large turbines and wind farms	http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=EN&PJ_RCN=10011136&pid=0&q=A23F06EAF5025A86E5064F1FCFCDA8B6&type=sim
RELIAWIND	FP7 - € 5.2m 2008 - 2011	Gamesa	Activity 1.1.2: Improved reliability of large turbines and wind farms	www.reliawind.eu
MARINET	FP7 - € 9m 2011 - 2015	University of Cork	Activity 1.2.2: Improvement of size and capabilities of system-lab testing facilities for 10 – 20 MW turbines Activity 1.2.3: Field testing facilities for 10 – 20 MW turbines aimed at increasing reliability	www.fp7-marinet.eu
ORECCA	FP7 - € 1.6m 2010 - 2011	Fraunhofer Institute	Activity 2.1.1: Deep offshore and site identification for demonstration of largescale substructures	www.orecca.eu
MARINA PLATFORM	FP7 - € 8.7m 2010 - 2014	Acciona	Activity 2.1.1: Deep offshore and site identification for demonstration of largescale substructures	www.marine.ie
DEEPWIND	FP7 - € 3m 2010 - 2014	Risoe/DTU	Activity 2.1.1: Deep offshore and site identification for demonstration of largescale substructures	http://www.risoe.dtu.dk/Research/sustainable_energy/wind_energy/projects/VEA_DeepWind.aspx?sc_lang=en
HIPRWIND	FP7 - € 11m 2010 - 2015	Fraunhofer Institute	Activity 2.1.1: Deep offshore and site identification for demonstration of largescale substructures	www.hyperwind.eu
H2OCEAN	FP7 - € 4.5m 2012 - 2014	Meteosim Truewind S.L.	Activity 2.1.1: Deep offshore and site identification for demonstration of largescale substructures	www.h2ocean-project.eu/
MERMAID	FP7 - € 5.5m 2012 - 2015	Risoe/DTU	Activity 2.1.1: Deep offshore and site identification for demonstration of largescale substructures	www.mermaidproject.eu
TROPOS	FP7 - € 4.9m 2012 - 2015	Consorcio plataforma oceanica de Canarias	Activity 2.1.1: Deep offshore and site identification for demonstration of largescale substructures	www.troposplatform.eu
SUPRAPOWER	FP7 - € 3.8m 2012 - 2016	Fundacion Tecnalia Research & Innovation	Activity 2.1.1: Deep offshore and site identification for demonstration of largescale substructures	http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=EN&PJ_RCN=13434037&pid=0&q=E36F9704B2ED5C761449F203DDE76F49&type=sim
OFFSHORE GRID	IEE - € 1.4m 2009 - 2011	3E	Activity 3.1.1: Combined solutions for wind farm grid connection and interconnection of at least two countries	www.offshoregrid.eu
RESERVICES	IEE - € 2.18m 2012 - 2014	EWEA	Activity 3.2.1: Wind power plants requirements and solutions to wind farms supporting the system dynamics	www.reservices-project.eu
CLUSTERDESIGN	FP7 - € 3.5m 2011 - 2016	3E	Activity 3.2.1: Wind power plants requirements and solutions to wind farms supporting the system dynamics	www.cluster-design.eu
EERA - DTOC	FP7 – 4m 2012 - 2015	Risoe/DTU	Activity 3.2.1 – Wind power plants requirements and solutions to wind farms supporting the system dynamics	www.eera-dtoc.eu
TWENTIES	FP7 - € 31.7m 2010 - 2013	Red Electrica	Activity 3.2.1: Wind power plants requirements and solutions to wind farms supporting the system dynamics Activity 3.3.1: Balancing technologies for large scale wind power penetration	www.twenties-project.eu
GRID+	FP7 - € 3.9m 2011 - 2014	RSE	Activity 3.3.2: Market integration	www.gridplus.eu
UMBRELLA	FP7 – € 5.25m 2012 - 2015	TENNET	Activity 3.3.2: Market integration	www.e-umbrella.eu
ITESLA	FP7 – € 19.38m 2012 - 2015	RTE EDF	Activity 3.3.2: Market integration	www.itesla-project.eu
SEEWIND	FP6- € 3.7m 2007 - 2013	EWS Consulting	Activity 4.1.1: Data sets for new models for wind energy	www.seewind.org/
SAFEWIND	FP7 - € 4m 2008 - 2012	ARMINES	Activity 4.1.1: Data sets for new models for wind energy	www.safewind.eu
NORSEWIND	FP7 - € 3.9m 2008 - 2012	Oldbaum Services Limited	Activity 4.1.1: Data sets for new models for wind energy	www.norsewind.eu
WIND BARRIERS	IEE - € 0.7m 2008 - 2010	EWEA	Activity 4.2.1: Coordination process for on and offshore spatial planning	www.windbarriers.eu/
WINDSPEED	IEE - € 1m 2008 - 2011	ECN	Activity 4.2.1: Coordination process for on and offshore spatial planning	www.windspeed.eu
SEANERGY 2020	IEE - € 1.2m 2010 - 2012	EWEA	Activity 4.2.1: Coordination process for on and offshore spatial planning	www.seanergy2020.eu
RESCOOP 20 20 20	IEE - € 1.5m 2012 - 2015	Ecopower	Activity 4.3.1: European wind study on the social economic value of wind energy in the EU	www.rescoop.eu/

Source: Wind European Industrial Initiative Team, TPWind

ANNEX II - EU RESEARCH & DEVELOPMENT – PROJECTS

ANNEX III: LIST of EnR MEMBER ENERGY AGENCIES

Table III - : EnR Member Energy Agencies

Country	Organisation		Address	Website
Austria	AEA	Österrechische Energieagentur / Austrian Energy Agency	Mariahilfer Straße 136, 1150 Vienna, AUSTRIA	www.energyagency.at
Bulgaria	SEDA	Sustainable Energy Development Agency	37 Ekzarh Yossif Str. 1000 Sofia. Bulgaria	www.seea.government.bg
Croatia	EIHP	Energetski institut Hrvoje Požar	EIHP, Savska cesta 163, 10001 Zagreb, Croatia	www.eihp.hr
Denmark	DEA	Danish Energy Authority	DEA, Amaliegade 44, DK-1256 Copenhagen K	www.ens.dk
Finland	MOTIVA	Motiva Oy	Motiva Oy, Urho Kekkosen katu 4-6 A, P.O. Box 489, FI-00101 Helsinki	www.motiva.fi
France	ADEME	Agence de l'Environnement et de la Maîtrise de l'Energie	ADEME, 27 rue Louis Vicat, FR-75737 Paris Cedex 15	www.ademe.fr
Germany	PTJ	Projektträger Jülich	PtJ, Forschungszentrum Jülich GmbH, D-52425 Jülich	www.fz-juelich.de/ptj
Germany	DENA	Deutsche Energie-Agentur GmbH	DENA GmbH, Chausseestrasse 128a, D-10115 Berlin	www.dena.de
Greece	CRES	Centre for Renewable Energy Sources & Saving	CRES, 19th km Marathonos Avenue, GR-19009 Pikermi, Attiki	www.cres.gr
Ireland	SEAI	Sustainable Energy Authority Ireland	Sustainable Energy Ireland, Wilton Park House, Wilton Park, Dublin 2, Ireland	www.seai.ie
Italy	ENEA	Ente per le Nuove Tecnologie l'Energia e l'Ambiente	ENEA, C.R. Casaccia, Via Anguillarese 301, IT-00060 Santa Maria di Galeria (Roma)	www.enea.it
Luxembourg	My Energy	My Energy GIE, Groupement d'intérêt Economique	28 rue Michel Rodange, L-2430 Luxembourg	www.myenergy.lu
Netherlands	NL Agency	NL Agency	NL Agency, PO-Box 8242, 3503 RE Utrecht, The Netherlands	www.agentschapNL.nl
Norway	ENOVA	ENOVA SF	Enova SF, Professor Brochs gate 2, N-7030 Trondheim	www.enova.no
Poland	KAPE	Krajowa Agencja Poszanowania Energii S.A.	Nowowiejska 21/25 00-665 Warszawa Poland	www.kape.gov.pl
Portugal	ADENE	Agência para a Energia (Portuguese Energy Agency)	Rua Dr. António Loureiro Borges, 5 - 6º, Miraflores – Arquiparque 1495-131 ALGÉS - Portugal	www.adene.pt
Romania	ANRE	Romanian Energy Regulatory Authority	Str. Constantin Nacu nr. 3, Bucuresti, Sector 2, Cod postal 020995, ROMANIA	www.anre.ro
Slovakia	SIEA	Slovak Innovation and Energy Agency	SEA, Bajkalská 27, SK-827 99 Bratislava , Slovakia	www.siea.gov.sk
Slovenia	AURE	Agency for Efficient Energy Use of the Republic of Slovenia	Ministry of the Economy, Energy Directorate Kotnikova 5,SI-1000 Ljubljana	www.aure.si
Spain	IDAE	Instituto para la Diversificación y Ahorro de la Energía	IDAE, Calle de la Madera 8, 28004 Madrid - SPAIN	www.idae.es
Sweden	STEM	Swedish Energy Agency	Box 310, 631 04 Eskilstuna, Sweden	www.energimyndigheten.se
Switzerland	BFE	Swiss Federal Office of Energy	SwissEnergy, Bundesamt fuer Energie BFE, CH-3003 Bern, Switzerland	www.swiss-energy.ch
Turkey	EIE	General Directorate of Renewable Energy	Eskisehir Yolu 7. km No:166 Zip code: 06520 Cankaya - ANKARA/TURKEY	www.eie.gov.tr
UK	EST	The Energy Saving Trust	EST, 21 Dartmouth Street, London SW1H 9BP, United Kingdom	www.est.co.uk

Members of the Renewable Energy Working Group:

The Renewables Working Group is currently chaired by Alexandra Lermen lermen@dena.

Austria - AEA – Herbert Tretter, herbert.tretter@energyagency.at
Croatia - EIHP – Branka Jelavic, BJelavic@eihp.hr
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Germany - dena - Alexandra Lermen (Chair) - lermen@dena.de
Greece - CRES – ggian@cres.gr
Ireland - SEI – Katrina Polaski, katrina.polaski2@seai.ie
Italy - ENEA – Luca Castellazzi, luca.castellazzi@casaccia.enea.it
Netherlands - SenterNovem – Kees Kwant, kees.kwant@agentschapnl.nl
Norway - Enova – Helle Gronli, Helle.Gronli@ENOVA.NO
Poland - KAPE – Ryszard Wnuk, rwnuk@kape.gov.pl
Portugal - ADENE – Alberto Tavares, alberto.tavares@adene.pt
Romania - ARCE - Mrs. Irina Nicolau - nicolau@arceonline.ro
Spain - IDAE – Silvia Vera Garcia, svera@idae.es
Sweden - STEM – Lena Ofverbeck, Lena.Ofverbeck@stem.se
UK - EST – Rob Lewis, rob.lewis@est.org.uk
Vito as an observer for the Flemish Energy Agency – Ruben Guisson, ruben.guisson@vito.be

ANNEX III - LIST OF EUROPEAN ENERGY NETWORK (EnR) MEMBER ENERGY AGENCIES

Continental and Regional Environmental & Conservation Organisations in Europe

- BELLONA - www.bellona.org
- CARPATHIAN ECOREGION INITIATIVE (CERI) - www.carpates.org
- CEDAR – THE CENTRAL EUROPEAN ENVIRONMENTAL DATA REQUEST FACILITY - www.cedar.at
- CLIMATE ALLIANCE (Climate Alliance of European Cities with Indigenous Rainforest Peoples) - www.climatealliance.org
- COALITION CLEAN BALTIC (CCB) - www.ccb.se
- COASTAL AND MARINE UNION (EUCC) - www.eucc.net
- CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION (LRTAP), UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE (UNECE) - www.unece.org/env/lrtap/
- ECO–ETHICS INTERNATIONAL UNION (EEIU) - www.eeiu.org
- ENVIRONMENT, HOUSING AND LAND MANAGEMENT DIVISION, UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE (UNECE) - www.unece.org/env/welcome.html
- EURAQUA - www.euraqua.org
- EUROBATS - www.eurobats.org
- EUROGROUP FOR ANIMALS - www.eurogroupforanimals.org
- EUROPARC FEDERATION - www.europarc.org
- EUROPEAN ACADEMY OF THE URBAN ENVIRONMENT (EA.UE) - www.eaue.de
- EUROPEAN ASSOCIATION OF GEOGRAPHERS (EUROGEO) - www.eurogeography.eu
- EUROPEAN ASSOCIATION FOR POPULATION STUDIES (EAPS) - www.eaps.nl
- EUROPEAN ASSOCIATION OF ZOOS AND AQUARIA (EAZA) - www.eaza.net
- EUROPEAN BUSINESS COUNCIL FOR A SUSTAINABLE ENERGY FUTURE (e5) - www.e5.org
- EUROPEAN CENTRE FOR NATURE CONSERVATION (ECNC) - www.ecnc.nl
- EUROPEAN CETACEAN BYCATCH CAMPAIGN (ECBC) - www.eurocbc.org
- EUROPEAN CHAPTER OF THE INTERNATIONAL SOCIETY FOR ECOLOGICAL MODELLING (ISEM EUROPE) - http://dino.wiz.uni-kassel.de/isem-eu
- EUROPEAN CHRISTIAN ENVIRONMENTAL NETWORK (ECEN) - www.ecen.org
- EUROPEAN COALITION TO END ANIMAL EXPERIMENTS (ECEAE) - www.eceae.org
- EUROPEAN COUNCIL FOR AN ENERGY EFFICIENT ECONOMY (ECEEE) - www.eceee.org
- EUROPEAN ENVIRONMENTAL BUREAU (EEB) - www.eeb.org
- EUROPEAN ENVIRONMENTAL LAW NETWORK - www.eel.nl
- EUROPEAN FEDERATION FOR LANDSCAPE ARCHITECTURE (EFLA) - http://europe.iflaonline.org
- EUROPEAN FORUM FOR RENEWABLE ENERGY SOURCES (EUFORES) - www.eufores.org
- EUROPEAN FOREST INSTITUTE (EFI) - www.efi.fi
- EUROPEAN GEOGRAPHY ASSOCIATION FOR STUDENTS AND YOUNG GEOGRAPHERS (EGEA) - www.egea.eu
- EUROPEAN GREEN PARTY - http://europeangreens.eu
- EUROPEAN FOUNDATION FOR LANDSCAPE ARCHITECTURE (EFLA) - www.efla.org
- EUROPEAN HYDROGEN ASSOCIATION (EHA) - www.h2euro.org
- EUROPEAN METEOROLOGICAL SOCIETY (EMS) - www.emetsoc.org
- EUROPEAN NETWORK OF EDUCATION AND TRAINING IN OCCUPATIONAL SAFETY AND HEALTH (ENETOSH) - www.enetosh.net
- EUROPEAN PARTNERS FOR THE ENVIRONMENT (EPE) - www.epe.be
- EUROPEAN RADON WEBSITE - http://european.radon.ntua.gr

- EUROPEAN RENEWABLE ENERGY CENTRES AGENCY (EUREC Agency) - www.eurec.be
- EUROPEAN RENEWABLE ENERGY COUNCIL (EREC) - www.erec-renewables.org
- EUROPEAN RIVERS NETWORK (ERN) - www.rivernet.org/ern.htm
- EUROPEAN SEA LEVEL SERVICE (ESEAS) - www.eseas.org
- EUROPEAN SOCIETY FOR ENVIRONMENTAL HISTORY (ESEH) - http://eseh.org
- EUROPEAN SOLAR THERMAL INDUSTRY FEDERATION (ESTIF) - www.estif.org
- EUROPEAN WATER ASSOCIATION (EWA) - www.ewaonline.de
- EUROPEAN WIND ENERGY ASSOCIATION (EWEA) - www.ewea.org
- EUROTURTLE - www.euroturtle.org
- FOOD & WATER EUROPE - www.foodandwaterwatch.org/world/europe
- FOUNDATION FOR ENVIRONMENTAL EDUCATION (FEE) - www.fee-international.org
- FRIENDS OF THE EARTH EUROPE (FoEE) - http://www.foeeurope.org
- GENEVA INTERNATIONAL CENTRE FOR HUMANITARIAN DEMINING (GICHD) - www.gichd.ch
- GEOGRAPHICAL INFORMATION SYSTEMS INTERNATIONAL GROUP (GISIG) - www.gisig.it
- GREENPEACE EUROPEAN UNIT - http://eu.greenpeace.org
- THE GREENS / EUROPEAN FREE ALLIANCE IN THE EUROPEAN PARLIAMENT - www.greens-efa.org
- HEALTH CARE WITHOUT HARM, EUROPE - www.noharm.org/europe
- ICP FORESTS - www.icp-forests.org
- ITDP EUROPE - www.itdp-europe.org
- INFORSE – EUROPE - www.inforse.org/europe/
- INSTITUTE FOR EUROPEAN ENVIRONMENTAL POLICY (IEEP) - www.ieep.eu
- INSTITUTE FOR WATER EDUCATION, UNESCO–IHE - www.unesco-ihe.org
- INSTITUTION OF OCCUPATIONAL SAFETY & HEALTH (IOSH) - www.iosh.co.uk
- JUSTICE AND ENVIRONMENT - www.justiceandenvironment.org
- LONG TERM ECOSYSTEM RESEARCH AND MONITORING IN EUROPE (LTER-EUROPE) - www.lter-europe.ceh.ac.uk
- MEDITERRANEAN ASSOCIATION TO SAVE THE SEA TURTLE (MEDASSET) - www.medasset.org
- THE NETWORK OF EUROPEAN METEOROLOGICAL SERVICES (EUMETNET) - www.eumetnet.eu.org
- OSPAR COMMISSION - www.ospar.org
- PAN–EUROPE , IUCN - http://cms.iucn.org/about/union/secretariat/offices/europe/index.cfm
- PARTNERSHIP FOR EUROPEAN ENVIRONMENTAL RESEARCH (PEER) - www.peer.eu
- PLANTA EUROPA - www.plantaeuropa.org
- REGIONAL ENVIRONMENTAL CENTER FOR CENTRAL AND EASTERN EUROPE (REC) - www.rec.org
- REGIONAL OFFICE FOR EUROPE, UNITED NATIONS ENVIRONMENT PROGRAMME - www.unep.ch/roe/
- SAVE FOUNDATION (Safeguard for Agricultural Varieties in Europe) - www.save-foundation.net
- SEAS AT RISK - www.seas-at-risk.org
- STOCKHOLM INTERNATIONAL WATER INSTITUTE (SIWI) - www.siwi.org
- TWENTE WATER CENTRE, UNIVERSITY OF TWENTE [The Netherlands] - www.water.utwente.nl
- WATER FOOTPRINT NETWORK (WFN) - www.waterfootprint.org
- WWF – EUROPE - www.wwf.eu

ANNEX IV: EUROPEAN ENVIRONMENTAL AGENCIES

Continental and National European Government Environmental & Conservation Agencies European Union

• Primary Environmental Agency of the European Union:
EUROPEAN ENVIRONMENT AGENCY (EEA), EUROPEAN UNION - www.eea.europa.eu

• Primary Environmental Directorate of the European Commission: ENVIRONMENT DIRECTORATE-GENERAL (DG Environment), EUROPEAN COMMISSION - http://ec.europa.eu/dgs/environment/index_en.htm

• Primary Environmental Department of the European Council: DEPARTMENT OF CULTURE, HERITAGE AND DIVERSITY, COUNCIL OF EUROPE - www.coe.int/t/dg4/cultureheritage/default_EN.asp

• Primary Environmental Council of the Council of the European Union: ENVIRONMENT COUNCIL, COUNCIL OF THE EUROPEAN UNION - www.consilium.europa.eu/policies/council-configurations/environment?lang=en

• Primary Environmental Committee of the European Parliament: ENVIRONMENT, PUBLIC HEALTH AND FOOD SAFETY COMMITTEE, EUROPEAN PARLIAMENT - www.europarl.europa.eu/committees/en/ENVI/home.html

• CHEMICAL LEGISLATION EUROPEAN ENFORCEMENT NETWORK (CLEEN) - www.cleen-europe.eu

• CLIMATE ACTION, EUROPEAN COMMISSION - http://ec.europa.eu/clima/news/index_en.htm

• DIRECTORATE-GENERAL FOR AGRICULTURE AND RURAL DEVELOPMENT, EUROPEAN COMMISSION - http://ec.europa.eu/dgs/agriculture/index_en.htm

• DIRECTORATE-GENERAL FOR CLIMATE ACTION, EUROPEAN COMMISSION - http://ec.europa.eu/dgs/clima/mission/index_en.htm

• DIRECTORATE-GENERAL FOR HEALTH & CONSUMERS, EUROPEAN COMMISSION - http://ec.europa.eu/dgs/health_consumer/index_en.htm

• ENVIRONMENT, EUROPEAN COMMISSION - http://ec.europa.eu/environment/index_en.htm

• ENVIRONMENT, EUROPEAN UNION - http://europa.eu/pol/env/index_en.htm

• EUROPEAN AGENCY FOR SAFETY AND HEALTH AT WORK (EU-OSHA) - http://osha.eu.int

• EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS (ECMWF) - www.ecmwf.int

• EUROPEAN ENVIRONMENT INFORMATION AND OBSERVATION NETWORK (EIONET) - www.eionet.europa.eu

• EUROPEAN FOOD SAFETY AUTHORITY (EFSA) - www.efsa.europa.eu

• EUROPEAN LONG-TERM ECOSYSTEM RESEARCH NETWORK (LTER-Europe) - www.lter-europe.ceh.ac.uk

• EUROPEAN UNION NETWORK FOR THE IMPLEMENTATION AND ENFORCEMENT OF ENVIRONMENTAL LAW (IMPEL) - http://impel.eu

• GLOBAL MONITORING FOR ENVIRONMENT AND SECURITY (GMES), EUROPEAN COMMISSION - www.gmes.info

• INSTITUTE FOR ENVIRONMENT AND SUSTAINABILITY (IES), EUROPEAN COMMISSION - http://ies.jrc.ec.europa.eu

• INSTITUTE FOR HEALTH AND CONSUMER PROTECTION (IHCP), EUROPEAN COMMISSION - http://ihcp.jrc.ec.europa.eu

• LIFE [FINANCIAL INSTRUMENT FOR THE ENVIRONMENT], EUROPEAN COMMISSION - http://ec.europa.eu/environment/life/home.htm

• MAJOR ACCIDENT HAZARDS BUREAU (MAHB), EUROPEAN COMMISSION - http://mahb.jrc.it

• SPACE ENVIRONMENT INFORMATION SYSTEM (SPENVIS), EUROPEAN SPACE AGENCY (ESA) - www.spenvis.oma.be

• SUSTAINABLE DEVELOPMENT, COUNCIL OF EUROPE www.coe.int/t/dc/files/themes/developpement_durable/default_en.asp

• SUSTAINBLE ENERGY EUROPE CAMPAIGN, EUROPEAN COMMISSION - www.sustenergy.org

National Government Environmental Agencies in Europe

DIRECTORIES OF NATIONAL GOVERNMENT ENVIRONMENTAL AGENCIES

• EUROPE, DIRECTORY OF WEB SITES OF ENVIRONMENTAL AGENCIES OF THE WORLD, INTERNATIONAL NETWORK FOR ENVIRONMENTAL COMPLIANCE AND ENFORCEMENT (INECE) - www.inece.org/links_pages/onlineresourcesEnvironmentalagencies.html#europe
• MINISTRIES OF ENVIRONMENT IN EUROPE, ENVIROWINDOWS - www.ewindows.eu.org/Agriculture/government/environment/Ministries_of_the_Environment

ALBANIA

• ALBANIAN NATIONAL ENVIRONMENT HOMEPAGE, NATIONAL ENVIRONMENTAL AGENCY [1998] - www.grida.no/prog/cee/enrin/htmls/albania/soe/htmls
• MINISTRY OF ENVIRONMENT, FORESTS AND WATER ADMINISTRATION (MoEFWA) - www.moe.gov.al
• STATE OF THE ENVIRONMENT IN ALBANIA 2000 - www.grida.no/enrin/htmls/albania/soe1998/eng/backgr/ecat.htm

ALDERNEY

[Crown Dependency of the United Kingdom]
• ALDERNEY COMMISSION FOR RENEWABLE ENERGY - www.acre.gov.gg
• WASTE AND RECYCLING - www.alderney.gov.gg/Waste-and-Recycling
• WATER BOARD - www.alderney.gov.gg/Water-Board

ANDORRA

• DEPARTMENT OF ENVIRONMENT - www.mediambient.ad

AUSTRIA

• UMWELTBUNDESAMT - ENVIRONMENT AGENCY AUSTRIA - www.umweltbundesamt.at
• UMWELTNET - www.umweltnet.at

BELARUS

• MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT - www.minpriroda.by

BELGIUM

• ENVIRONMENT, BELGIAN GOVERNMENT - www.belgium.be/en/environment
• FEDERAL COUNCIL FOR SUSTAINABLE DEVELOPMENT (FRDO-CFDD) - www.belspo.be/frdocfdd
• HEALTH, FOOD CHAIN SAFETY AND ENVIRONMENT FEDERAL PUBLIC SERVICE - www.health.belgium.be/eportal

REGIONS OF BELGIUM

• ENVIRONMENT, CITY OF BRUSSELS [Brussels Capital Region] - www.brussels.be/artdet.cfm/4103/Environment
• FLEMISH ENVIRONMENT AGENCY (VMM) [Flemish Region] - www.vmm.be
• ENVIRONMENT PORTAL, GENERAL DIRECTORATE OF NATURAL RESOURCES & ENVIRONMENT [Walloon Region] - http://environnement.wallonie.be
• RESEARCH INSTITUTE FOR NATURE AND FOREST (INBO) [Flemish Region] - www.inbo.be
• PUBLIC WASTE AGENCY OF FLANDERS (OVAM) [Flemish Region] - www.ovam.be

BOSNIA AND HERZEGOVINA

• FEDERAL HYDROMETEOROLOGICAL INSTITUTE - www.fhmzbih.gov.ba
• MINISTRY OF ENVIRONMENT AND TOURISM - www.fbihvlada.gov.ba/english/ministarstva/okolis_turizam.php

BULGARIA

• EXECUTIVE ENVIRONMENT AGENCY (EEA) - http://eea.government.bg/eng
• MINISTRY OF ENVIRONMENT AND WATER - www.moew.government.bg

CROATIA

• CROATIAN ENVIRONMENTAL AGENCY - www.azo.hr
• MINISTRY OF AGRICULTURE - www.mps.hr
• MINISTRY OF ENVIRONMENT AND NATURE PROTECTION - www.mzoip.hr

CYPRUS

(Republic of Cyprus)
• MINISTRY OF AGRICULTURE, NATURAL RESOURCES AND ENVIRONMENT - www.moa.gov.cy or www.cyprus.gov.cy/moa/agriculture.nsf/

CZECH REPUBLIC

• CZECH ENVIRONMENTAL INSPECTORATE (CIZP) - www.cizp.cz
• FOREST MANAGEMENT INSTITUTE (UHUL) - www.uhul.cz
• MINISTRY OF THE ENVIRONMENT OF THE CZECH REPUBLIC - www.env.cz
• NATURE CONSERVATION AGENCY - www.nature.cz

DENMARK

• DANISH ENVIRONMENTAL PROTECTION AGENCY - www.mst.dk
• DANISH NATURE AGENCY - www.sns.dk
• MINISTRY OF THE ENVIRONMENT - www.mim.dk
• NATIONAL ENVIRONMENTAL RESEARCH INSTITUTE (DMU) - www.dmu.dk/international/

ESTONIA

• ESTONIAN LAND BOARD - www.maaamet.ee
• ESTONIAN MARINE INSTITUTE - www.sea.ee
• MINISTRY OF THE ENVIRONMENT - www.envir.ee

FAROE ISLANDS

[Dependency of Denmark]
• FOOD AND VETERINARY AGENCY - www.hfs.fo
• MINISTRY OF FISHERIES - www.fisk.fo

FINLAND

• FINLAND'S ENVIRONMENTAL ADMINISTRATION, MINISTRY OF THE ENVIRONMENT - www.environment.fi
• MINISTRY OF THE ENVIRONMENT - www.environment.fi/ym

FRANCE

• ADMINISTRATION ECO-RESPONSABLE, MINISTERE DE L'ECOLOGIE ET DU DEVELOPPEMENT DURABLE - www.ecoresponsabilite.environnement.gouv.fr
• INSTITUT FRANCAIS DE L'ENVIRONNEMENT (IFEN) - www.ifen.fr
• MINISTRY OF ECOLOGY, SUSTAINABLE DEVELOPMENT, TRANSPORT AND HOUSING - www.developpement-durable.gouv.fr
• THE NATIONAL INSTITUTE OF INDUSTRIAL ENVIRONMENT AND RISKS (INERIS) - www.ineris.fr

GERMANY

• FEDERAL ENVIRONMENTAL AGENCY (UBA) - www.umweltbundesamt.de
• FEDERAL MINISTRY FOR THE ENVIRONMENT, NATURE CONSERVATION AND NUCLEAR SAFETY - www.bmu.de
• GEIN (German Environmental Information Network) – THE PORTAL FOR ENVIRONMENTAL ISSUES - www.gein.de
• GERMAN ADVISORY COUNCIL ON THE ENVIRONMENT (SRU) - www.umweltrat.de
• GERMAN ADVISORY COUNCIL ON GLOBAL CHANGE (WBGU) - www.wbgu.de
• GERMAN FEDERAL AGENCY FOR NATURE CONSERVATION (BfN) - www.bfn.de
• GLOBAL RUNOFF DATA CENTER (GRDC), FEDERAL INSTITUTE OF HYDROLOGY - http://grdc.bafg.de

GIBRALTAR

[Overseas Territory of the United Kingdom]
• DEPARTMENT OF THE ENVIRONMENT - www.gibraltar.gov.gi/environment/environment
• ENVIRONMENTAL AGENCY - www.environmental-agency.gi
• MINISTRY OF ENVIRONMENT AND TOURISM (METT) - www.gibraltar.gov.gi/environment

GREECE

• CENTRE FOR RENEWABLE ENERGY SOURCES (CRES) - www.cres.gr/kape/index.htm
• CHAMBER FOR ENVIRONMENT & SUSTAINABILITY - www.environ-sustain.gr
• MINISTRY OF ENVIRONMENT, ENERGY & CLIMATE [new site for environmental ministry] - www.ypeka.gr
• MINISTRY FOR THE ENVIRONMENT, PHYSICAL PLANNING & PUBLIC WORKS (MEPPPW) [old site for environmental ministry] - www.minenv.gr/welcome_gr.html or www.minenv.gr/4/41/e4100.html

GUERNSEY

[Crown Dependency of the United Kingdom]
• ENVIRONMENT DEPARTMENT, GUERNSEY GOVERNMENT - www.gov.gg/article/1711/Environment

HUNGARY

• CENTRAL AGRICULTURE OFFICE (CAO) - www.mgszh.gov.hu

• MINISTRY OF RURAL DEVELOPMENT [includes environmental protection for Hungary] - www.kormany.hu/en/ministry-of-rural-development/ and www.vm.gov.hu

ICELAND

• ENVIRONMENT AND FOOD AGENCY OF ICELAND (UST) - www.ust.is
• MINISTRY FOR THE ENVIRONMENT - www.stjr.is/umh

IRELAND

• DEPARTMENT OF THE ENVIRONMENT, HERITAGE AND LOCAL GOVERNMENT - www.environ.ie
• ENVIRONMENTAL PROTECTION AGENCY (EPA) - www.epa.ie
• NATIONAL PARKS & WILDLIFE SERVICE (NPWS) - www.npws.ie

ISLE OF MAN

[Crown Dependency of the United Kingdom]
• DEPARTMENT OF LOCAL GOVERNMENT AND THE ENVIRONMENT - www.gov.im/dlge
ITALY
• AGRICULTURAL RESEARCH COUNCIL (CRA) - www.entecra.it
• MINISTRY FOR THE ENVIRONMENT, TERRITORY AND SEA - www.minambiente.it
• MINISTRY OF AGRICULTURE AND FORESTRY POLICIES - www.politicheagricole.it
• NATIONAL AGENCY FOR NEW TECHNOLOGIES, ENERGY AND ENVIRONMENT (ENEA) - www.enea.it
• PARKS IN ITALY - www.parks.it
• UFFICIO CENTRALE DI ECOLOGIA AGRARIA (UCEA) - www.ucea.it

JERSEY

[Crown Dependency of the United Kingdom]
• DEPARTMENT OF ENVIRONMENT - www.gov.je/Government/Departments/PlanningEnvironment/Pages/index.aspx
• ENVIRONMENT AND GREENER LIVING - www.gov.je/Environment/Pages/default.aspx

LATVIA

• MINISTRY OF ENVIRONMENT - www.varam.gov.lv

LIECHTENSTEIN

• MINISTRY OF ENVIRONMENTAL AFFAIRS, LAND USE PLANNING, AGRICULTURE AND FORESTRY - http://www.liechtenstein.li/en/eliechtenstein_main_sites/portal_fuerstentum_liechtenstein/fl-staat-staat/fl-staat-regierung/fl-staat-regierung-verteilung/fl-staat-regierung-verteilung-umwelt.htm

LITHUANIA

• ENVIRONMENTAL PROJECTS MANAGEMENT AGENCY (APVA) - www.apva.lt/en/
• MINISTRY OF ENVIRONMENT - www.am.lt/VI/
• STATE PLANT PROTECTION SERVICE - www.vaat.lt

LUXEMBOURG

• PORTAIL DE L'ENVIRONNEMENT, MINISTERE DE L'ENVIRONNEMENT - www.environnement.public.lu
Additional web site address for the same site - www.emwelt.lu
• RESOURCE CENTRE FOR ENVIRONMENTAL TECHNOLOGIES (CRTE) - www.crte.lu

MACEDONIA

• GALICICA NATIONAL PARK AUTHORITY - www.galicica.org.mk
• MACEDONIA METEOROLOGICAL SERVICE - www.meteo.gov.mk
• MAVROVO NATIONAL PARK AUTHORITY - www.npmavrovo.org.mk
• MINISTRY OF AGRICULTURE, FORESTRY AND WATER MANAGEMENT - www.mzsv.gov.mk
• MINISTRY OF ENVIRONMENT AND PHYSICAL PLANNING - www.moepp.gov.mk

MALTA

• MALTA ENVIRONMENT & PLANNING AUTHORITY (MEPA) - www.mepa.org.mt
• MINISTRY FOR RESOURCES AND RURAL AFFAIRS (MRRA) - http://mrra.gov.mt
• WEATHER, MET OFFICE, MALTA AIRPORT - www.maltairport.com/weather/

MOLDOVA

• MINISTRY OF ECOLOGY AND NATURAL RESOURCES - www.utm.md/master/en/parteneri/m_ecol.html

MONACO

• DEPARTEMENT DE L'EQUIPEMENT, DE L'ENVIRONNEMENT ET DE L'URBANISME - www.gouv.mc/Gouvernement-et-Institutions/Le-Gouvernement/Departement-de-l-Equipement-de-l-Environnement-et-de-l-Urbanisme

MONTENEGRO

• ENVIRONMENTAL PROTECTION AGENCY OF MONTENEGRO - www.epa.org.me
• HYDROLOGICAL AND METEOROLOGICAL SERVICE OF MONTENEGRO (HMZCG) - www.meteo.co.me
• MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT - www.mpr.gov.me/en/ministry
• MINISTRY OF SUSTAINABLE DEVELOPMENT AND TOURISM - www.mrt.gov.me/en/ministry

NETHERLANDS

• GOVERNMENT SERVICE FOR LAND AND WATER MANAGEMENT (DLG) - www.dienstlandelijkgebied.nl/en
• MINISTRY OF ECONOMIC AFFAIRS, AGRICULTURE AND INNOVATION - www.government.nl/ministries/eleni
• MINISTRY OF INFRASTRUCTURE AND THE ENVIRONMENT - www.government.nl/ministries/ienm
• NATIONAL INSTITUTE FOR PUBLIC HEALTH AND THE ENVIRONMENT (RIVM) - www.rivm.nl
• NETHERLANDS FOOD AND CONSUMER PRODUCT SAFETY AUTHORITY (VWA) - www.vwa.nl/english
• PBL NETHERLANDS ENVIRONMENTAL ASSESSMENT AGENCY (PBL) - www.pbl.nl/en

NORWAY

• DIRECTORATE FOR NATURE MANAGEMENT (DN) - www.naturforvaltning.no
• MINISTRY OF THE ENVIRONMENT - http://odin.dep.no/md
• NORWEGIAN POLLUTION CONTROL AUTHORITY (SFT) - www.sft.no
• STATE OF THE ENVIRONMENT NORWAY - www.environment.no

POLAND

• INSTITUTE OF ENVIRONMENTAL PROTECTION (IOS) - www.ios.edu.pl
• MINISTRY OF THE ENVIRONMENT - www.mos.gov.pl

PORTUGAL

• INSTITUTE OF NATURE CONSERVATION (ICN) - www.icn.pt
• INSTITUTO DO AMBIENTE - www.iambiente.pt

ROMANIA

• MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT (MADR) - www.mapam.ro
• MINISTRY OF ENVIRONMENT AND FORESTS - www.mmediu.ro
Russian Federation
• MINISTRY OF NATURAL RESOURCES AND THE ENVIRONMENT OF THE RUSSIAN FEDERATION - www.mnr.gov.ru/english

SAN MARINO

• NATIONAL CENTER OF METEOROLOGY AND CLIMATOLOGY (METEOSANMARINO) - www.meteosanmarino.com

SARK [Crown Dependency of the United Kingdom]

• BAYS & HEADLANDS - www.sark.info/index.cfm?fuseaction=attractions.content&cmid=465
• CAVES & POOLS - www.sark.info/index.cfm?fuseaction=attractions.content&cmid=471
• INTRODUCTION - www.sark.info/index.cfm?fuseaction=attractions.content&cmid=462
• NATURAL BEAUTY - www.sark.info/index.cfm?fuseaction=attractions.content&cmid=463

SERBIA

• MINISTRY OF AGRICULTURE, TRADE, FORESTRY AND WATER MANAGEMENT - www.mpt.gov.rs
• MINISTRY OF ENVIRONMENT, MINING AND SPATIAL PLANNING - www.ekoplan.gov.rs/en/index.php
• REPUBLIC HYDROMETEOROLOGICAL SERVICE OF SERBIA - www.hidmet.gov.rs/index.php

SLOVAK REPUBLIC

• MINISTRY OF ENVIRONMENT - www.minzp.sk/en/
• SLOVAK ENVIRONMENTAL AGENCY (SAZP) - www.sazp.sk

SLOVENIA

• MINISTRY OF THE ENVIRONMENT AND SPATIAL PLANNING - www.mop.gov.si

SPAIN

• MINISTRY OF AGRICULTURE, FOOD AND ENVIRONMENT - www.magrama.gob.es
• SPANISH OFFICE OF CLIMATE CHANGE http://www.magrama.gob.es/ca/ceneam/recursos/quien-es-quien/oficina_cc.aspx
• NATIONAL PARKS NETWORK - http://reddeparquesnacionales.mma.es
• RESEARCH CENTRE FOR ENERGY, ENVIRONMENT AND TECHNOLOGY (CIEMAT) - www.ciemat.es

SWEDEN

• MINISTRY FOR RURAL AFFAIRS - www.sweden.gov.se/sb/d/2064/
• MINISTRY OF SUSTAINABLE DEVELOPMENT - www.regeringen.se/sb/d/1471
• SWEDISH ENVIRONMENTAL PROTECTION AGENCY - www.naturvardsverket.se
• SWEDISH ENVIRONMENTAL RESEARCH INSTITUTE (IVL) - www.ivl.se
• SWEDISH INSTITUTE FOR ECOLOGICAL SUSTAINABILITY - www.ieh.se/english/
• SWEDISH RESEARCH COUNCIL FOR ENVIRONMENT, AGRICULTURAL SCIENCES AND SPATIAL PLANNING (FORMAS) - www.formas.se

SWITZERLAND

• FEDERAL DEPARTMENT OF ENVIRONMENT, TRANSPORT, ENERGY AND COMMUNICATIONS (UVEK) - www.uvek.admin.ch
• FEDERAL OFFICE FOR THE ENVIRONMENT (FOEN) - www.umwelt-schweiz.ch

TURKEY

• MINISTRY OF ENVIRONMENT AND FORESTRY - www.cevreorman.gov.tr

UKRAINE

• INSTITUTE OF HYGIENE AND MEDICAL ECOLOGY (IHME) - www.health.gov.ua
• MINISTRY OF EMERGENCIES AND AFFAIRS OF POPULATION PROTECTION FROM THE CONSEQUENCES OF CHORNOBYL CATASTROPHE - www.mns.gov.ua
• MINISTRY FOR ENVIRONMENTAL PROTECTION OF UKRAINE - www.menr.gov.ua
• MINISTRY FOR ENVIRONMENTAL PROTECTION OF UKRAINE – INFORMATION CARD - www.kmu.gov.ua/control/en/publish/article?art_id=91651&cat_id=73007

UNITED KINGDOM

Home Pages of Primary Environmental Agencies:
• DEPARTMENT FOR ENVIRONMENT AND SUSTAINABLE DEVELOPMENT, WELSH ASSEMBLY GOVERNMENT - http://wales.gov.uk/about/civilservice/directorates/sustainablefutures/environmentsustainabledev/?lang=en
• ENVIRONMENT AGENCY [ENGLAND & WALES] - www.environment-agency.gov.uk
• ENVIRONMENT AND HERITAGE SERVICE [NORTHERN IRELAND] - www.ehsni.gov.uk
• SCOTTISH ENVIRONMENT PROTECTION AGENCY (SEPA) - www.sepa.org.uk
• COUNTRYSIDE COUNCIL FOR WALES (CCW) - www.ccw.gov.uk
• DEPARTMENT FOR ENVIRONMENT, FOOD & RURAL AFFAIRS (DEFRA) - www.defra.gov.uk
• ENVIRONMENT, SCOTTISH EXECUTIVE - www.scotland.gov.uk/Topics/Environment
• JOINT NATURE CONSERVATION COMMITTEE (JNCC) - www.jncc.gov.uk
• NATURAL ENGLAND - www.naturalengland.org.uk
• NATURAL ENVIRONMENT RESEARCH COUNCIL (NERC) - www.nerc.ac.uk
• ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION - www.rcep.org.uk
• SCOTTISH NATURAL HERITAGE (SNH) - www.snh.org.uk
Source: EIONET

ANNEX V: ENVIRONMENTAL PROCEDURES UNDER AA, EIA and SEA

Table V - : Procedures under AA, EIA and SEA

	AA	EIA	SEA
Which type of developments are targeted ?	Any plan or project which - either individually or in combination with other plans/projects - is likely to have an adverse effect on a Natura 2000 site (excluding plans or projects directly connected to the management of the site)	All projects listed in Annex I. For projects listed in Annex II the need for an EIA shall be determined on a case by case basis and depending on thresholds or criteria set by Member states (taking into account criteria in Annex III)	Any Plans and Programmes or amendments thereof which are (a) prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning or land use and which set the framework for future development consent of projects listed in Annexes I and II to Directive 85/337/EEC, or (b) which, in view of the likely effect on sites, have been determined to require an assessment pursuant to Article 6 or 7 of Directive 92/43/EEC.
What impacts need to be asssessed relevant to nature?	The Assessment should be made in view of the site's conservation objectives (which are set in function of the species/ habitat types for which the site was designated.) The impacts (direct, indirect, cumulative..) should be assessed to determine whether or not they will adversely affect the integrity of the site concerned.	Direct and indirect, secondary, cumulative, short, medium and longterm, permanent and temporary, positive and negative significant effects on ...'fauna and flora'	Likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors;
Who carries out the Assessment?	It is the responsibility of the competent authority to ensure that the AA is carried out. In that context the developer may be required to carry out all necessary studies and to provide all necessary information to the competent authority in order to enable the latter to take a fully informed decision. In so doing the competent authority may also collect relevant information from other sources as appropriate.	The developer	The competent planning authority

	AA	EIA	SEA
Are the public/Other authorities consulted?	Not obligatory but encouraged 'if appropriate'	Compulsory –consultation to be done before adoption of the development proposal Member States shall take the measures necessary to ensure that the authorities likely to be concerned by the project by reason of their specific environmental responsibilities are given an opportunity to express their opinion on the request for development consent. Ditto for the public.	Compulsory –consultation to be done before adoption of the plan or programme. The authorities and the public shall be given an early and effective opportunity within appropriate time frames to express their opinion on the draft plan or programme and the accompanying environmental report before the adoption of the plan or programme or its submission to the legislative procedure Member States must designate the authorities to be consulted which, by reason of their specific environmental responsibilities, are likely to be concerned.
How binding are the outcomes ?	Binding. The competent authorities can agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site.	The results of consultations and the information gathered as part of the EIA must be taken into consideration in the development consent procedure.The results of consultations and the information gathered as part of the EIA must be taken into consideration in the development consent procedure.	The environmental report, as well as the opinions expressed shall be taken into account during the preparation of the plan or programme and before its adoption or submission to the legislative procedure.

Source: European Commission

ANNEX VI: RENEWABLE ENERGY SHARES FROM ANNEX I OF THE Directive 2009/28/EC

ANNEX VI: RE TARGETS for EU-27

Table VI - : EU renewable energy targets and indicative trajectory up to 2020

	Reference	Indicative trajectory				Target
	2005 [%]	2011-2012 [%]	2013-2014 [%]	2015-2016 [%]	2017-2018 [%]	2020 [%]
Belgium	2.2	4.4	5.4	7.1	9.2	13
Bulgaria	9.4	10.7	11.4	12.4	13.7	16
Czech Republic	6.1	7.5	8.2	9.2	10.6	13
Denmark	17.0	19.6	20.9	22.9	25.5	30
Germany	5.8	8.2	9.5	11.3	13.7	18
Estonia	18.0	19.4	20.1	21.2	22.6	25
Ireland	3.1	5.7	7.0	8.9	11.5	16
Greece	6.9	9.1	10.2	11.9	14.1	18
Spain	8.7	11.0	12.1	13.8	16.0	20
France	10.3	12.8	14.1	16.0	18.6	23
Italy	5.2	7.6	8.7	10.5	12.9	17
Cyprus	2.9	4.9	5.9	7.4	9.5	13
Latvia	32.6	34.1	34.8	35.9	37.4	40
Lithuania	15.0	16.6	17.4	18.6	20.2	23
Luxembourg	0.9	2.9	3.9	5.4	7.5	11
Hungary	4.3	6.0	6.9	8.2	10.0	13
Malta	0.0	2.0	3.0	4.5	6.5	10
Netherlands	2.4	4.7	5.9	7.6	9.9	14
Austria	23.3	25.4	26.5	28.1	30.3	34
Poland	7.2	8.8	9.5	10.7	12.3	15
Portugal	20.5	22.6	23.7	25.2	27.3	31
Romania	17.8	19.0	19.7	20.6	21.8	24
Slovenia	16.0	17.8	18.7	20.1	21.9	25
Slovakia	6.7	8.2	8.9	10.0	11.4	14
Finland	28.5	30.4	31.4	32.8	34.7	38
Sweden	39.8	41.6	42.6	43.9	45.8	49
United Kingdom	1.3	4.0	5.4	7.5	10.2	15

Source: ECN, 28 November 2011

All percentages originate from Annex I of Directive 2009/28/EC.
The indicative trajectory has been calculated from Part B of the Annex

ANNEX VII - Global installed wind power capacity (MW) – Regional Distribution (2011 and 2012) and evolution from 2004 to 2012

ANNEX VII: GLOBAL INSTALLED WIND POWER

Table VII - : Regional distribution of global installed wind capacity (2011-2012)

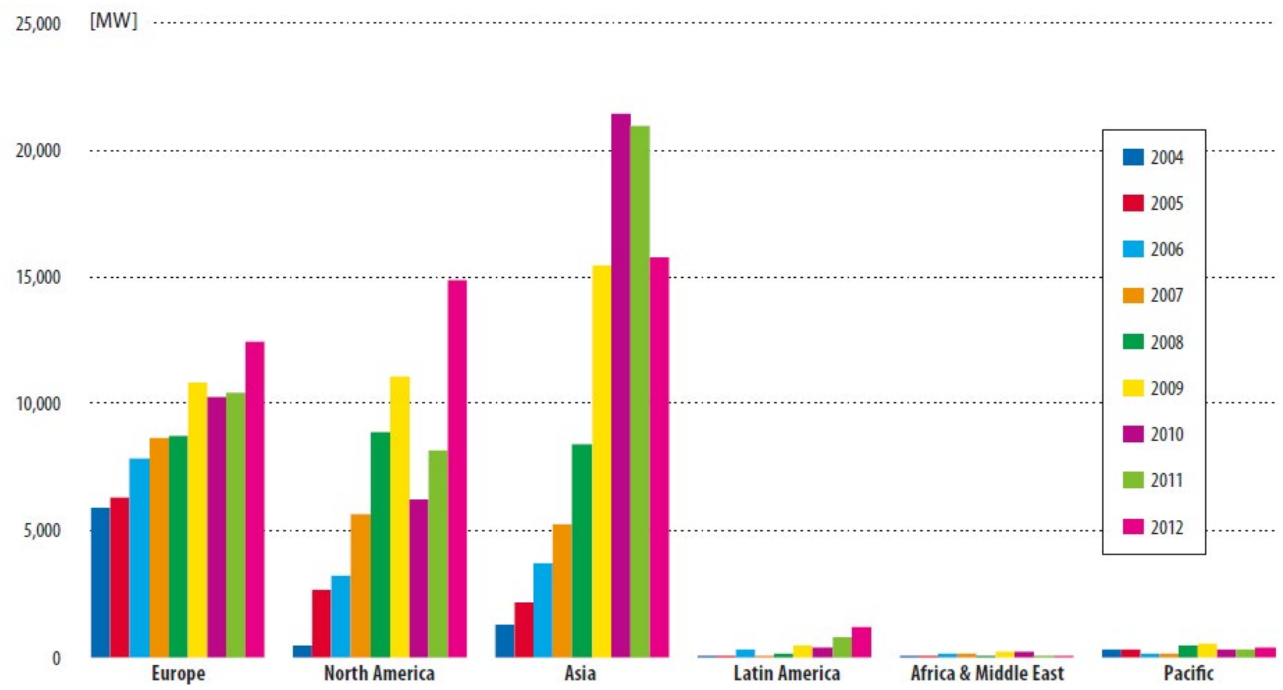
	End 2011	New 2012	Total (End of 2012)
AFRICA & MIDDLE EAST			
Tunisia	54	50	104
Ethiopia	-	52	52
Egypt	550	-	550
Morocco	291	-	291
Iran	91	-	91
Cape Verde	24	-	24
Other [1]	23	-	23
Total	**1,033**	**102**	**1,135**
ASIA			
PR China**	62,364	13,200	75,564
India	16,084	2,336	18,421
Japan	2,536	88	2,614
Taiwan	564	-	564
South Korea	407	76	483
Pakistan	6	50	56
Other [2]	109	-	108
Total	**82,070**	**15,750**	**97,810**
EUROPE			
Germany	29,071	2,439	31,332
Spain	21,674	1,122	22,796
UK	6,556	1,897	8,445
Italy	6,878	1,273	8,144
France**	6,792	404	7,196
Portugal	4,379	145	4,525
Denmark	3,956	217	4,162
Sweden	2,899	846	3,745
Poland	1,616	880	2,497
Netherlands	2,272	119	2,391
Turkey	1,806	506	2,312
Romania	982	923	1,905
Greece	1,634	117	1,749
Ireland	1,614	125	1,738
Austria	1,084	296	1,378
Rest of Europe [3]	3,815	1,106	4,922
Total Europe	**97,028**	**12,416**	**109,237**
of which EU-27 [4]	94,337	11,566	105,696
LATIN AMERICA & CARIBBEAN			
Brazil	1,431	1,077	2,508
Argentina	113	54	167
Costa Rica	132	15	147
Nicaragua	62	40	102
Venezuela	-	30	30
Uruguay	43	9	52
Caribbean [5]	271	-	271
Others [6]	229	-	229
Total	**2,280**	**1,225**	**3,505**
NORTH AMERICA			
USA	46,929	13,124	60,007
Canada	5,265	935	6,200
Mexico	569	801	1,370
Total	**52,763**	**14,860**	**67,576**
PACIFIC REGION			
Australia	2,226	358	2,584
New Zealand	623	-	623
Pacific Islands	12	-	12
Total	**2,861**	**358**	**3,219**
World total	**238,035**	**44,711**	**282,482**

Source: GWEC

** Provisional Figure
1 Israel, Jordan, Kenya, Libya, Nigeria, South Africa
2 Bangladesh, Indonesia, Philippines, Sri Lanka, Thailand, Vietnam
3 Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Finland, Faroe Islands, FYROM, Hungary, Iceland, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Norway, Romania, Russia, Switzerland, Slovakia, Slovenia, Ukraine.
4 Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, UK
5 Caribbean: Aruba, Bonaire, Curacao, Cuba, Dominica, Dominican Republic, Guadalupe, Honduras, Jamaica, Martinique
6 Colombia, Chile, Ecuador, Peru

Please note: Project decommissioning of approximately 263 MW and rounding affect the final sums

Figure VII - : Regional distribution of global installed wind capacity (2004-2012)



Source: GWEC, 2013

ANNEX VIII - Wind power installed in Europe by end of 2012 (cumulative)

ANNEX VIII: WIND POWER INSTALLED in EUROPE

Table VIII - : Wind power installed in Europe in 2012

	Installed 2011	End 2011	Installed 2012	End 2012
EU Capacity (MW)				
Austria	73	1084	296	1,378
Belgium	191	1,078	297	1,375
Bulgaria	28	516	168	684
Cyprus	52	134	13	147
Czech Republic	2	217	44	260
Denmark	211	3,956	217	4,162
Estonia	35	184	86	269
Finland	2	199	89	288
France	830	6,807	757	7,564
Germany	2,100	29,071	2,415	31,308
Greece	316	1,634	117	1,749
Hungary	34	329	0	329
Ireland	208	1,614	125	1,738
Italy	1,090	6,878	1,273	8,144
Latvia	17	48	21	68
Lithuania*	16	179	46	225
Luxembourg*	1	45	0	45
Malta	0	0	0	0
Netherlands	59	2,272	119	2,391
Poland	436	1,616	880	2,497
Portugal	341	4,379	145	4,525
Romania	520	982	923	1,905
Slovakia	0	3	0	3
Slovenia	0	0	0	0
Spain	1,050	21,674	1,122	22,796
Sweden	754	2,899	846	3,745
United Kingdom	1,298	6,556	1,897	8,445
Total EU-27	**9,664**	**94,352**	**11,895**	**106,040**
Total EU-15	**8,524**	**90,145**	**9,714**	**99,652**
Total EU-12	**1,140**	**4,207**	**2,181**	**6,388**

European Union: 105,040 MW
Candidate Countries: 2,492 MW
EFTA: 753 MW
Total Europe: 109,581 MW

	Installed 2011	End 2011	Installed 2012	End 2012
Candidate Countries (MW)				
Croatia	52	131	48	180
FYROM**	0	0	0	0
Serbia	0	0	0	0
Turkey	477	1,806	506	2,312
Total	**529**	**1,937**	**554**	**2,492**
EFTA (MW)				
Iceland	0	0	0	0
Liechtenstein	0	0	0	0
Norway	99	537	166	703
Switzerland	3	46	4	50
Total	**88**	**583**	**170**	**753**
Other (MW)				
Faroe Islands*	0	4	0	4
Ukraine	66	151	125	276
Russia*	0	15	0	15
Total	**66**	**171**	**125**	**296**
Total Europe	**10,361**	**97,043**	**12,744**	**109,581**

* Provisional data or estimate.
** Former Yugoslav Republic of Macedonia
Note: due to previous year adjustments, 207 MW of project de-commissioning, re-powering and rounding of figures, the total 2012 end-of-year cumulative capacity is not exactly equivalent to the sum of the 2011 end-of-year total plus the 2012 additions.

Source: EWEA, 2013

ANNEX IX - EUROPEAN ELECTRICITY MARKETS

ANNEX IX: EUROPEAN ELECTRICITY MARKETS

Table IX - : Electricity generation, flows and consumption – 2010

	DEMAND (CONSUMPTION) (TWh)	IMPORT LOAD FLOWS/ CONSUMPTION (%)	EXPORT LOAD FLOWS/ CONSUMPTION (%)	NATIONAL ANNUAL MAX. LOAD (GW)	MAXIMUM GENERATION CAPACITY (GW)
BELGIUM	95.67	13.0%	12.4%	14.17	18.69
BULGARIA	38.21	3.1%	25.2%	7.27	12.07
CZECH REPUBLIC	70.96	9.4%	30.4%	10.38	18.94
DENMARK	37.65	28.2%	31.2%	6.35	13.38
GERMANY	612.96	7.0%	9.4%	79.90	152.20
ESTONIA	9.71	11.3%	44.8%	1.59	2.48
IRELAND	29.08	2.6%	1.0%	5.09	8.47
GREECE	63.10	13.5%	4.5%	9.79	13.93
SPAIN	294.76	1.8%	4.6%	44.49	96.31
FRANCE	538.25	3.6%	9.3%	96.71	123.51
ITALY	346.22	13.3%	0.5%	56.43	106.49
CYPRUS	5.35	0.0%	0.0%	1.15	1.47
LATVIA	7.50	53.0%	41.3%	1.32	2.46
LITHUANIA	11.74	69.6%	18.6%	1.71	3.61
LUXEMBOURG	8.66	84.1%	37.2%	1.11	1.73
HUNGARY	42.57	23.3%	11.0%	6.06	8.75
MALTA	2.11	0.0%	0.0%	0.71	0.87
NETHERLANDS	120.92	12.9%	10.6%	17.73	25.47
AUSTRIA	73.46	27.1%	23.9%	10.76	21.09
POLAND	156.30	4.0%	4.9%	23.58	33.31
PORTUGAL	56.71	10.3%	5.6%	9.40	17.91
ROMANIA	58.35	1.3%	5.2%	8.46	17.05
SLOVENIA	14.31	56.0%	70.8%	1.97	3.04
SLOVAKIA	28.88	25.4%	21.8%	4.34	7.78
FINLAND	91.17	17.2%	5.7%	14.59	17.08
SWEDEN	150.69	9.9%	8.5%	26.69	35.70
UNITED KINGDOM	383.79	1.9%	1.2%	60.10	79.71

Source: Eurostat, ENTSO-E

Table IX - : Annual average day-ahead wholesale electricity prices (€/MWh)

	2009	2010	2011
BRITISH ISLES AND IRELAND			
United Kingdom – APX	59.4	56.6	56.9
Ireland – SEMO	N/A	55.0	62.3
CENTRAL WESTERN EUROPE			
Germany – EPEX	38.9	44.5	51.1
Belgium – BPX	39.4	46.3	49.4
Netherlands – APX	39.2	45.4	52.0
France – EPEX	43.1	47.6	48.9
Austria – EXAA	39.2	44.9	51.9
NORDIC MARKETS			
Nord Pool Spot system price	35.1	53.0	46.8
Norway system – NP	36.6	55.8	45.7
Sweden – NP	37.1	58.5	48.4
Finland – NP	36.9	56.6	49.3
Denmark – NP	37.7	52.4	49.4
Estonia – NP	N/A	47.2	43.4
IBERIAN PENINSULA			
Spain – OMEL	37.8	40.4	50.8
Portugal – OMEL	37.6	37.3	45.5
APPENNINE PENINSULA			
Italy – IPEX	63.7	64.1	72.2
CENTRAL AND EASTERN EUROPE			
Poland – TGE	39.1	48.0	52.2
Czech Republic – OTE	37.8	43.7	50.6
Slovakia – OTE	39.2	43.8	50.9
Hungary – OTE	N/A	53.2	55.8
Romania – OPCOM	34.3	36.4	52.1
Slovenia – BSP	N/A	46.2	57.2
SOUTH EAST EUROPE			
Greece – DESMIE	43.4	45.7	59.4

Source: Platts, European power trading platforms

Table IX - : Structure of the electricity market in 2010

	NUMBER OF COMPANIES REPRESENTING AT LEAST 95% OF NET ELECTRICITY GENERATION	NUMBER OF MAIN ELECTRICITY COMPANIES (1)	MARKET SHARE OF THE LARGEST GENERATOR IN THE ELECTRICITY MARKET	TOTAL NUMBER OF ELECTRICITY RETAILERS TO FINAL CONSUMERS	NUMBER OF MAIN ELECTRICITY RETAILERS (2)
BELGIUM	4	3	79.1%	37	3
BULGARIA	22	5	N/A	36	5
CZECH REPUBLIC	24	1	73.0%	324	3
DENMARK	> 1000	2	46.0%	33	
GERMANY	> 450	4	28.4%	> 1000	3
ESTONIA	6	1	89.0%	41	1
IRELAND	8	6	34.0%	8	5
GREECE	4	1	85.1%	11	1
SPAIN	N/A	4	24.0%	202	4
FRANCE	> 5	1	86.5%	177	1
ITALY	217	5	28.0%	342	3
CYPRUS	1	1	100.0%	1	1
LATVIA	45	1	88.0%	4	1
LITHUANIA	17	5	35.4%	15	3
LUXEMBOURG	3	2	85.4%	11	4
HUNGARY	68	3	42.1%	38	5
MALTA	1	1	100.0%	1	1
NETHERLANDS	7	5	N/A	36	3
AUSTRIA	126	4	N/A	129	6
POLAND	68	5	17.4%	146	7
PORTUGAL	107	2	47.2%	10	4
ROMANIA	10	6	35.6%	56	8
SLOVENIA	3	2	56.3%	16	7
SLOVAKIA	8	1	80.9%	77	5
FINLAND	29	4	26.6%	72	3
SWEDEN	24	5	42.0%	134	5
UNITED KINGDOM	19	9	20.0%	22	6

Source: Sources: Eurostat, 2010 data and National Regulators

(1) Companies are considered as 'main' if they produce at least 5% of the national net electricity generation.
(2) Retailers are considered as 'main' if they sell at least 5% of the total national electricity consumption.

Table IX - : Unbundling of transmission system operators (TSOs) in electricity - 2010

	NUMBER OF TSOs IN THE COUNTRY	NUMBER OF TSOs THAT ARE OWNERSHIP UNBUNDLED	% OF PUBLIC OWNERSHIP	% OF PRIVATE OWNERSHIP	TSOs WITH NETWORK ASSETS	TSOs WITHOUT NETWORK ASSETS
BELGIUM	1	1	47.9	52.1	1	0
BULGARIA	1	0	100.0	0.0	0	1
CZECH REPUBLIC	1	1	100.0	0.0	1	0
DENMARK	1	1	100.0	0.0	1	0
GERMANY	4	2	0.0	100.0	2	0
ESTONIA	1	1	100.0	0.0	1	0
IRELAND	N/A	N/A	N/A	N/A	N/A	N/A
GREECE	N/A	N/A	N/A	N/A	N/A	N/A
SPAIN	1	1	20.0	80.0	1	0
FRANCE	1	0	84.5	15.5	1	0
ITALY	11	1	30.0	70.0	11	0
CYPRUS	N/A	N/A	N/A	N/A	N/A	N/A
LATVIA	N/A	N/A	N/A	N/A	N/A	N/A
LITHUANIA	1	0	97.5	2.5	0	1
LUXEMBOURG	1	0	42.5	57.5	1	0
HUNGARY	1	0	0.0	100.0	1	0
MALTA	0	0	0.0	0.0	0	0
NETHERLANDS	2	2	100.0	0.0	N/A	N/A
AUSTRIA	3	0	75.6	24.4	2	1
POLAND	1	1	100.0	0.0	1	0
PORTUGAL	3	1	51.0	49.0	1	0
ROMANIA	1	1	73.7	26.3	1	0
SLOVENIA	1	1	100.0	0.0	1	0
SLOVAKIA	1	1	100.0	0.0	1	0
FINLAND	1	1	12.0	88.0	1	0
SWEDEN	1	1	100.0	0.0	1	0
UNITED KINGDOM	3	1	0.0	100.0	3	0

Source: Sources: CEER database

ANNEX X- CAPITAL AND O&M COSTS OF WIND ENERGY

ANNEX X: COSTS of WIND ENERGY

Table X - : Installed capital costs (onshore wind) (2003-2010)

	Onshore wind power system installed cost 2010 USD/kW							
	2003	2004	2005	2006	2007	2008	2009	2010
Australia							2 566	1 991 - 3 318
Austria							2 477	2 256 - 2 654
Canada	865	785	1 367	1 855	2 268	1 749	2 336	1 975 - 2 468
China	0	0	0	0	1 472	1 463	1 392	1 287 - 1354
Denmark	790	725	886	1 331	1 503	1 759	1 840	1 367
Finland	922	836	924	0	1 893	2 126	2 134	2 100
Germany	1 044	956	1 084	1 750	1 979	2 174	2 122	1 773 - 2 330
Greece	959	862	952	1426	1 586	1 639	2 265	1 460 - 1 858
India	0	0	0	0	1 075	1 152	1 194	1 460
Ireland	1 034	973	0	0	2 883	2 533	2 268	2 419
Italy	846	853	943	1 629	2 595	2 682	2 463	2 339
Japan	818	734	943	1 643	1 856	2 980	3 185	3 024
Mexico				1 477		1 466	1 982	2 016
Netherlands	1 044	956	1 037	1 494	1 637	1 788	1 876	1 781
Norway	1 175	853	971	1 652	1 977	2 227	2 196	1 830
Portugal	1 063	939	1 094	1 589	1 874	1 932	1 982	1 327 - 1 858
Spain	903	802	896	1 657	1 802	2 086	1 770	1 882
Sweden	969	853	0	0	1 893	2 239	2 598	2 123
Switzerland				1 688		2 808	2 669	2 533
United Kingdom	0	879	1 433	1 714	1 981	1 955	1 858	1 734
United States	752	683	849	1 522	1 840	2 124	2 144	2 154

Source: IEA 2007-2011 and WWEA/CWEC, 2011

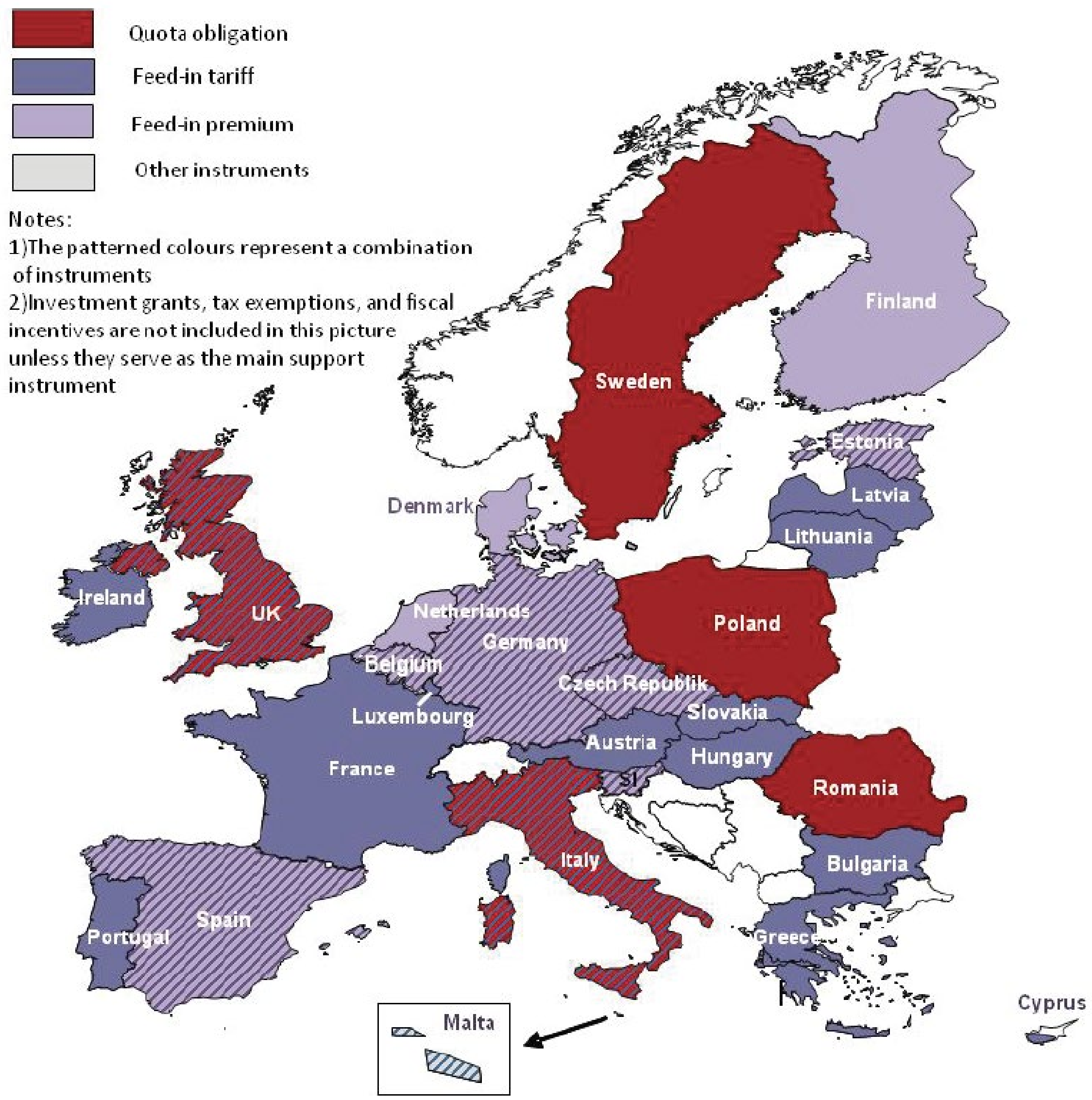
Table X - : O&M costs for onshore wind projects. Source: IEA, 2011

	Variable, USD/kWh	Fixed, USD/kW/year
Austria	0.038	
Denmark	0.0144 - 0.018	
Finland		35 - 38
Germany		64
Italy		47
Japan		71
The Netherlands	0.013 – 0.017	35
Norway	0.020 – 0.037	
Spain	0.027	
Sweden	0.010 – 0.033	
Switzerland	0.043	
United States	0.010	

ANNEX XI - EUROPEAN SUPPORT MECHANISMS

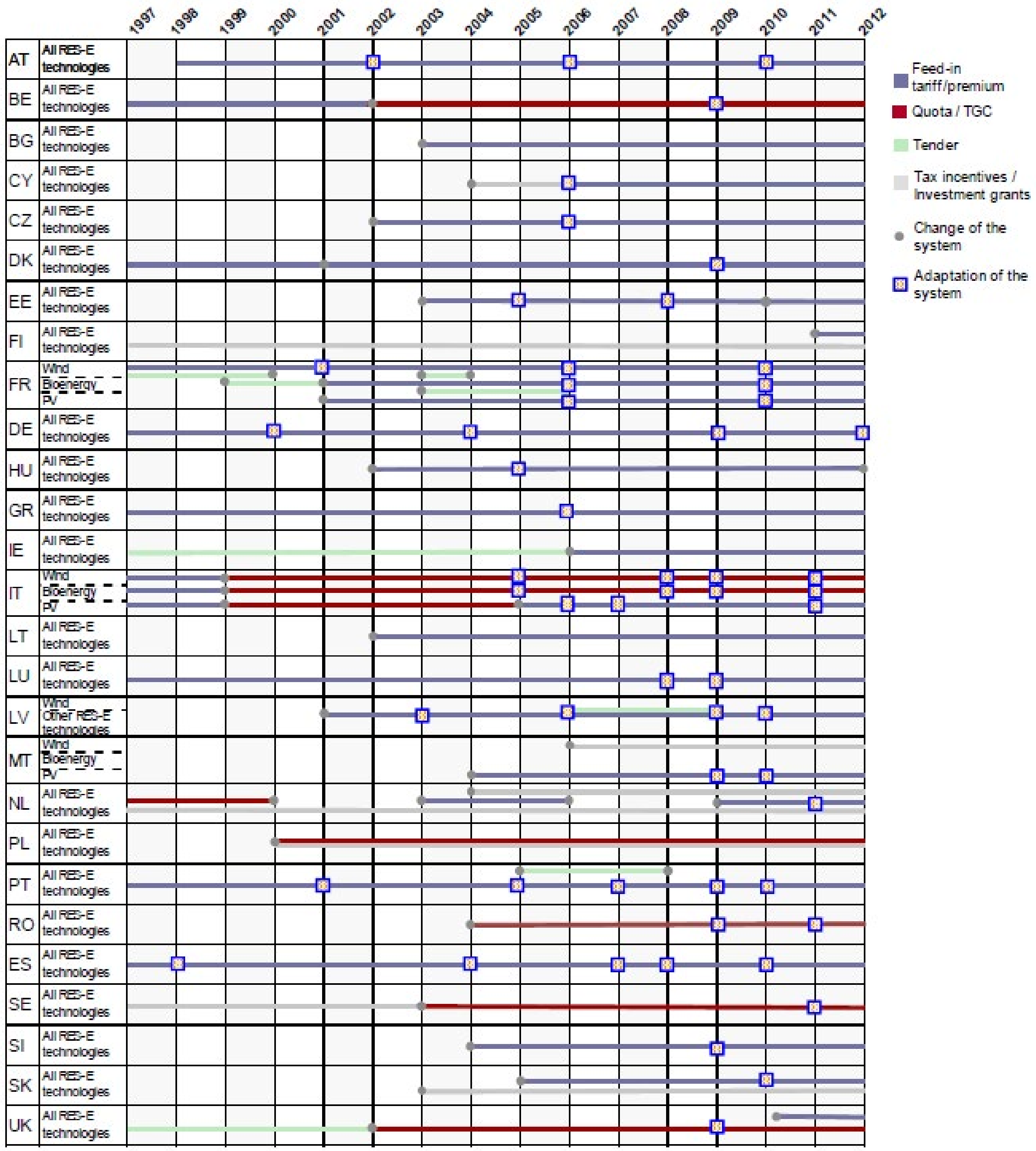
ANNEX XI: EUROPEAN SUPPORT MECHANISMS

Figure XI - : RES support instruments in the EU



Source: Mario Ragwitz, et al. (RE-Shaping project), 2012

Table XI - : Evolution of the main support instruments in EU27 Member States



Source: Simone Steinhilber, et al. (RE-Shaping project), 2011

ANNEX XII - WIND ENERGY PLANNING TO 2020 BY EU MEMBER STATES

ANNEX XII: EU WIND ENERGY PLANNING to 2020

Table XII - : Projected total wind power capacity (2005–20) (onshore and offshore)

	2005 [MW]	2010 [MW]	2015 [MW]	2020 [MW]	2020 [%]
Belgium	190	733	2049	4320	2
Bulgaria	8	336	1274	1440	1
Czech Republic	22	243	493	743	0
Denmark	3129	3584	4180	3960	2
Germany	18415	27676	36647	45750	21
Estonia	31	147	400	650	0
Ireland	494	2088	3151	4649	2
Greece	491	1327	4303	7500	4
Spain	9918	20155	27997	38000	18
France	752	5542	13445	25000	12
Italy	1639	5800	9068	12680	6
Cyprus	0	82	180	300	0
Latvia	26	28	104	416	0
Lithuania	1	179	389	500	0
Luxembourg	35	35	105	131	0
Hungary	n.a.	330	577	750	0
Malta	0	0	7	110	0
Netherlands	1224	2221	5578	11178	5
Austria	694	1011	1951	2578	1
Poland	121	1100	3540	6650	3
Portugal	1063	4256	6125	6875	3
Romania	1	560	3200	4000	2
Slovenia	0	2	60	106	0
Slovakia	5	5	300	350	0
Finland	80	170	670	2500	1
Sweden	536	1873	3210	4547	2
United Kingdom	1565	5430	14210	27880	13
All Member States (total)	40440	84913	143212	213563	**100**

Source: ECN, National Renewable Energy Action Plans

Table XII - : Projected total wind power generation (2005–20) (onshore and offshore)

	2005 [GWh]	2010 [GWh]	2015 [GWh]	2020 [GWh]	2020 [%]
Belgium	320	991	6084	10474	2
Bulgaria	5	605	2293	2592	1
Czech Republic	21	454	975	1496	0
Denmark	6614	8606	11242	11713	2
Germany	26658	44668	69994	104435	21
Estonia	54	337	981	1537	0
Ireland	1588	4817	8339	11970	2
Greece	1267	3129	9674	16797	3
Spain	20729	40978	57086	78254	16
France	1128	11638	30634	57900	12
Italy	2558	8398	13652	20000	4
Cyprus	0	31	300	499	0
Latvia	47	58	228	910	0
Lithuania	2	297	924	1250	0
Luxembourg	52	60	192	239	0
Hungary	n.a.	692	1377	1545	0
Malta	0	0	17	255	0
Netherlands	2067	4470	13655	32408	7
Austria	1343	2034	3780	4811	1
Poland	136	2310	7541	15210	3
Portugal	1773	10214	13400	14596	3
Romania	0	460	6614	8400	2
Slovenia	0	2	109	191	0
Slovakia	7	7	480	560	0
Finland	150	360	1520	6000	1
Sweden	939	4793	8646	12500	3
United Kingdom	2904	14150	39430	78270	16
All Member States (total)	70362	164559	309168	494812	**100**

Source: ECN, National Renewable Energy Action Plans

Table XII - : Projected wind power capacity (2005-20) (onshore and offshore)

	Onshore wind				Offshore wind				Total wind power			
	2005 [MW]	2010 [MW]	2015 [MW]	2020 [MW]	2005 [MW]	2010 [MW]	2015 [MW]	2020 [MW]	2005 [MW]	2010 [MW]	2015 [MW]	2020 [MW]
Belgium	190	684	764	2320	0	49	1285	2000	190	733	2049	4320
Bulgaria	8	336	1274	1440	0	0	0	0	8	336	1274	1440
Czech Republic	22	243	493	743	n.a.	n.a.	n.a.	n.a.	22	243	493	743
Denmark	2706	2923	2929	2621	423	661	1251	1339	3129	3584	4180	3960
Germany	18415	27526	33647	35750	0	150	3000	10000	18415	27676	36647	45750
Estonia	31	147	400	400	n.a.	n.a.	n.a.	250	31	147	400	650
Ireland	469	2052	2899	4094	25	36	252	555	494	2088	3151	4649
Greece	491	1327	4303	7200	n.a.	n.a.	n.a.	300	491	1327	4303	7500
Spain	9918	20155	27847	35000	0	0	150	3000	9918	20155	27997	38000
France	752	5542	10778	19000	0	0	2667	6000	752	5542	13445	25000
Italy	1639	5800	8900	17000	0	0	168	680	1639	5800	9068	17680
Cyprus	0	82	180	300	n.a.	n.a.	n.a.	n.a.	0	82	180	300
Latvia	26	28	104	236	n.a.	n.a.	n.a.	180	26	28	104	416
Lithuania	1	179	389	500	0	0	0	0	1	179	389	500
Luxembourg	35	35	105	131	0	0	0	0	35	35	105	131
Hungary	n.a.	330	577	750	n.a.	0	0	0	n.a.	330	577	750
Malta	n.a.	0	7	15	n.a.	0	0	95	0	0	7	110
Netherlands	1224	1993	4400	6000	0	228	1178	5178	1224	2221	5578	11178
Austria	694	1011	1951	2578	0	0	0	0	694	1011	1951	2578
Poland	121	1100	3350	5600	0	0	0	500	121	1100	3540	6650
Portugal	1063	4256	6100	6800	0	0	25	75	1063	4256	6125	6875
Romania	1	560	3200	4000	0	0	0	0	1	560	3200	4000
Slovenia	0	2	60	106	0	0	0	0	0	2	60	106
Slovakia	5	5	300	350	0	0	0	0	5	5	300	350
Finland	80	n.a.	n.a.	1600	0	n.a.	n.a.	900	80	170	670	2500
Sweden	513	1797	3081	4365	23	76	129	182	536	1873	3210	4547
United Kingdom	1351	4040	8710	14890	214	1390	5500	12990	1565	5430	14210	27880
All Member States (total)	39755	82153	126747	168789	685	2590	15605	44224	40440	84913	143212	213563

Source: ECN, National Renewable Energy Action Plans

Table XII - : Projected wind power generation (2005-20) (onshore and offshore)

	Onshore wind				Offshore wind				Total wind power			
	2005 [GWh]	2010 [GWh]	2015 [GWh]	2020 [GWh]	2005 [GWh]	2010 [GWh]	2015 [GWh]	2020 [GWh]	2005 [GWh]	2010 [GWh]	2015 [GWh]	2020 [GWh]
Belgium	320	840	2100	4274	0	151	3984	6200	320	991	6084	10474
Bulgaria	5	605	2293	2592	0	0	0	0	5	605	2293	2592
Czech Republic	21	454	975	1496	n.a.	n.a.	n.a.	n.a.	21	454	975	1496
Denmark	5158	6121	6322	6391	1456	2485	4920	5322	6614	8606	11242	11713
Germany	26658	44397	61990	72664	0	271	8004	31771	26658	44668	69994	104435
Estonia	54	337	981	974	n.a.	n.a.	n.a.	563	54	337	981	1537
Ireland	n.a.	4701	7525	10228	n.a.	116	814	1742	1588	4817	8339	11970
Greece	1267	3129	9674	16125	n.a.	n.a.	n.a.	672	1267	3129	9674	16797
Spain	20729	40978	56786	70502	0	0	300	7753	20729	40978	57086	78254
France	1178	11638	22634	39900	0	0	8000	18000	1178	11638	30634	57900
Italy	2558	8398	13199	18000	0	0	453	2000	2558	8398	13652	20000
Cyprus	0	31	300	499	n.a.	n.a.	n.a.	n.a.	0	31	300	499
Latvia	47	58	228	519	n.a.	n.a.	n.a.	391	47	58	228	910
Lithuania	2	297	924	1250	0	0	0	0	2	297	924	1250
Luxembourg	52	60	192	239	0	0	0	0	52	60	192	239
Hungary	n.a.	692	1377	1545	n.a.	0	0	0	n.a.	692	1377	1545
Malta	n.a.	0	17	38	n.a.	0	0	216	0	0	17	255
Netherlands	2067	3667	9508	13372	0	803	4147	19036	2067	4470	13655	32408
Austria	1343	2034	3780	4811	0	0	0	0	1343	2034	3780	4811
Poland	136	2310	7370	13160	0	0	0	1500	136	2310	7541	15210
Portugal	1773	10214	13420	14416	0	0	60	180	1773	10214	13400	14596
Romania	0	460	6614	8400	0	0	0	0	0	460	6614	8400
Slovenia	0	2	109	191	0	0	0	0	0	2	109	191
Slovakia	7	7	480	560	0	0	0	0	7	7	480	560
Finland	150	n.a.	n.a.	3500	0	n.a.	n.a.	2500	150	360	1520	6000
Sweden	877	4585	8292	17000	62	208	354	500	939	4793	8646	17500
United Kingdom	2501	9520	20610	34150	403	4630	18820	44120	2904	14150	39430	78270
All Member States (total)	66853	155535	257701	351796	1921	8664	49856	142466	70362	164559	309168	494812

Source: ECN, National Renewable Energy Action Plans

Table XII - : Calculated average number of full load hours for total wind power (2005-20)

	2005 [hrs/year]	2010 [hrs/year]	2015 [hrs/year]	2020 [hrs/year]
Belgium	1680	1351	2970	2425
Bulgaria	625	1801	1800	1800
Czech Republic	955	1868	1978	2013
Denmark	2114	2401	2689	2958
Germany	1448	1614	1910	2283
Estonia	1742	2293	2453	2365
Ireland	3215	2307	2646	2575
Greece	2580	2358	2248	2240
Spain	2090	2033	2039	2059
France	1500	2100	2278	2316
Italy	1561	1448	1506	1577
Cyprus	n.a.	378	1667	1663
Latvia	1808	2071	2192	2188
Lithuania	2000	1659	2375	2500
Luxembourg	1486	1714	1829	1824
Hungary	n.a.	2097	2386	2060
Malta	n.a.	1000	2539	2324
Netherlands	1689	2013	2448	2899
Austria	1935	2012	1937	1866
Poland	1124	2100	2130	2287
Portugal	1668	2400	2188	2123
Romania	0	821	2067	2100
Slovenia	n.a.	1000	1817	1802
Slovakia	1400	1400	1600	1600
Finland	1875	2118	2269	2400
Sweden	1752	2559	2693	2749
United Kingdom	1856	2606	2775	2807
All Member States (average)	1740	1938	2159	2317

Source: ECN, National Renewable Energy Action Plans

Table XII - : wind power capacity targets, NREAPs and real (MW)

	Onshore 2012		Offshore 2012		Total 2012		Difference 2012			
	NREAP	Real	NREAP	Real	NREAP	Real	Onshore	Offshore	Total	
Austria	1,435	1,378	0	0	1,435	1,378	-57	0	-57	-4%
Belgium	720	996	503	380	1,223	1,375	276	-124	152	12.5%
Bulgaria	451	684	0	0	451	684	233	0	233	51.7%
Cyprus	114	147	0	0	114	147	33	0	33	28.9%
Czech Rep	343	260	0	0	343	260	-83	0	-83	-24.2%
Denmark	2,985	3,241	856	921	3,841	4,162	256	65	321	8.4%
Estonia	311	269	0	0	311	269	- 42	0	-42	-13.5%
Finland	380	262	0	26	380	288	-118	26	-92	-24.2%
France	7,598	7,564	667	0	8,265	7,564	-34	-667	-701	-8.5%
Germany	30,566	31,027	792	280	31,358	31,307	461	-512	-51	-0.2%
Greece	2,521	1,749	0	0	2,521	1,749	-772	0	-772	-30.6%
Hungary	445	329	0	0	445	329	-116	0	- 116	-26.1%
Ireland	2,334	1,713	36	25	2,370	1,738	-621	-11	-632	-26.7%
Italy	7,040	8,144	0	0	7,040	8,144	1,104	0	1,104	15.7%
Latvia	49	68	0	0	49	68	19	0	19	38.8%
Lithuania	250	225	0	0	250	225	-25	0	-25	-10%
Luxembourg	54	45	0	0	54	45	-9	0	-9	-16.7%
Malta	2	0	0	0	2	0	-2	0	-2	-100%
Netherlands	2,727	2,144	228	247	2,955	2,391	-583	19	-564	-19.1%
Poland	2,010	2,497	0	0	2,010	2,497	487	0	487	24.2%
Portugal	5,600	4,523	0	2	5,600	4,525	-1,077	2	- 1,075	-19.2%
Romania	1,850	1,905	0	0	1,850	1,905	55	0	55	3%
Slovakia	150	3	0	0	150	3	-147	0	-147	-98%
Slovenia	2	0	0	0	2	0	-2	0	- 2	-100%
Spain	23,555	22,796	0	0	23,555	22,796	-707	0	-707	-3.2%
Sweden	2,311	3,582	97	164	2,408	3,745	1,269	67	1,336	55.6%
UK	5,970	5,497	2,650	2,948	8,620	8,445	-473	298	- 175	-2%
EU-27	**101,773**	**101,048**	**5,829**	**4,993**	**107,602**	**106,041**	**-725**	**-836**	**-1,561**	**-1.5%**
EWEA 2009 EU		**98,000**		**5,300**		**103,300**				
Difference EWEA 2009 and real		**3,048**		**-307**		**2,741**				

Source: EWEA, 2013

ANNEX XIII - DETAILED COUNTRY PROFILES

DENMARK

The history of wind energy in Denmark goes back hundreds of years although real commercialisation of the technology started only after the oil crises of the 1970s. In 1973 Denmark had an exceptionally high dependency on oil in its energy mix with more than 90% of its energy supply based on imported oil. This situation led to significant economic difficulties triggered by the 1973 and 1979 oil crises. It stimulated Denmark to shift from oil to coal for electricity production and propose the use of nuclear power to ensure security of supply. These decisions became part of a proactive energy policy promoted through four energy plans over the following two decades.

First Energy Plan, (Dansk Energipolitik): 1976

This plan was developed to safeguard the country against energy supply crises and reduce dependence on imported oil. Its focus was on energy savings and converting Danish power plants from oil to coal and nuclear power. At that time, renewable energy only had a marginal role in the country's energy supply.

Energy taxes on electricity prices were imposed in the mid-70s, and used to support R&D for renewable energy. This provided financial support for public research, while spreading the costs of that research among all electricity customers. In 1979, Denmark created its Ministry of Energy.

In 1973 the electricity companies announced their intention to build nuclear power plants and by the following year 16 possible locations had been identified. However an antinuclear movement (OOA) soon started in the country and over the next 11 years took the lead in a broad public campaign ending in March 1985, when a majority of the members of the Danish parliament decided to exclude nuclear power from future energy planning. This development had major help from two alternative energy plans published by independent groups of energy experts: "Sketch for an energy plan in Denmark" published in 1976 and "Energy for the future: alternative energy plan" published in 1983. Wind power was included in these plans as one of the key alternatives to nuclear power. Together with the antinuclear movement, the plans were significant drivers for the introduction of wind and other renewables which, together with energy efficiency and natural gas in decentralised cogeneration plants, offered an alternative to nuclear power.

By the early 1980s several manufacturers were producing wind turbines with a capacity larger than 55 kW. However, since these turbines were too costly for most individual owners, the concept of local wind cooperatives – where groups of people invest jointly in shared wind turbines – developed. Many individual owners invested in wind turbines to meet their own energy consumption needs with the option of selling excess electricity generation to the grid.

Second Energy Plan (Energiplan81): 1981

This plan laid the ground for rapidly growing indigenous energy production and nuclear power. It included oil and gas recovery in the North Sea, the development of a nationwide grid for natural gas, and the introduction of subsidies for the construction and operation of wind turbines and biomass plants.

The support brought by the Energy Plan helped establish a strong home market for renewable energy and a local industry associated to it, while taxes imposed on oil and coal helped increase the competitiveness of renewable energy plants. Furthermore, during the 1980s Danish families were offered tax incentives for generating power for their community. As a result, more and more wind turbine cooperatives started to invest in community-owned wind turbines.

Another important parallel development during the 1980s was the large renewable energy market in California, which created an export opportunity for Danish wind turbine manufacturers until the California wind market came to a halt in 1985.

In 1985, a parliamentary majority rejected nuclear power. An agreement between the Ministry of Energy and the utilities, "100 MW Agreement", was reached to develop 100 MW of wind power between 1986 and 1990. This agreement supported the local wind industry's growth at a time when its overseas sales had fallen. The government set ambitious targets for utilities to install wind power, with two orders of 100 MW issued in 1985 and 1990, and a further order of 200 MW for completion in 2000.

The Danish government initially provided capital grants of up to 30% of the installation costs, progressively reduced to 20%, and then 10%. With sound growth in reliability and improved cost-effectiveness of the turbines, the subsidy for wind power was repealed in 1988. Denmark reduced the capital subsidy and required utilities to interconnect and purchase power from wind projects. Utilities were also required to provide a fair price. The total installed wind power capacity increased to approximately 300 MW, mostly based on 100 kW wind turbines. Some subsidies introduced under this plan continued to be available through research funds into the mid-2000s. Grants were also made available for replacing old wind turbines.

Third Energy Plan (Energi 2000), Feed-in tariff: 1990

The third plan was one of the first energy plans in the world without nuclear power. It set a target of reducing Danish CO_2 emissions by 20% between 1988 and 2005. Specific targets included providing 10% of electricity from wind turbines by 2005.

By 1992, the "fair price" for wind power was set at 85% of the retail electricity rate. The rules provided guaranteed interconnection and power purchase of wind-based electricity. Noticeably, the price was set relative to retail rates, and not relative to the cost of production for wind generators.

By 1992 systematic planning procedures, which included directives for local planners, were developed and implemented at the national level. At the same time an executive order from the Minister of Environment and Energy ordered municipalities to find suitable sites for wind turbines throughout the country. The planning directives included provisions for public hearings prior to any actual applications for siting of turbines, which was a significant help in getting public acceptance for their installation.

A fixed feed-in tariff for electricity production was introduced in 1993 and decoupled the power purchase price from existing electricity rates. The price paid for electricity generated from wind turbines was set at 85% of the utility's production and distribution costs. In addition, wind projects received a refund from the Danish carbon tax and a partial refund on the energy tax. These refunds effectively doubled the payment to wind projects for the first five years of their operation.

This support was provided equally across the country, irrespective of the wind conditions, which prompted wind farm developers to establish wind turbines at the best onshore locations. The outcome of the "Energi 2000" plan was that 10% of Danish electricity consumption would be supplied by wind energy by 2005.

Fourth Energy Plan (Energi 21): 1996

In the fourth plan, it was envisaged that renewable energy would provide 12-14% of total energy consumption in 2005, and 35% by 2030. By 1997 a further set of planning regulations had been developed for offshore wind farms, with the creation of a central national authority. The Danish Energy Agency was in charge of implementing the renewable energy policies. This solution provided a dedicated agency for supervising planning permissions.

By 1996, there were around 2,100 cooperatives throughout the country, which created the basis for continuing popular support for wind power in Denmark. By 2001, wind turbine cooperatives, including more than 100,000 families, had installed 86% of all turbines in Denmark. In 1998 the Danish government ordered an additional 750 MW of offshore wind power to be installed across five parks. By the turn of the century Denmark had become a net exporter of energy. In the following years, rising oil prices and an increased awareness of climate change influenced new energy policy guidelines, with higher ambitions for renewable energy.

Electricity market liberalisation and Renewable Purchase Specification introduced (1999-2008)

In 1999, the new government passed a resolution to liberalise Denmark's electricity market by 2002. The electricity reform set the target for electricity from renewable sources at 20% of the Danish electricity consumption by 2003, largely from wind and biomass.

In 1999, Denmark decided to abandon its feed-in tariff and to support renewable energy through a renewable portfolio standard (RPS) mechanism with a system of tradable green certificates. Although a new tradable green certificate system was introduced, the supporting legislation failed to be passed by parliament. Under the new policy guidelines, the Danish government emphasised the need to increase competition in the energy sector, and to encourage greater competitiveness of the renewable energy plants. As part of the new governmental policy, two of the planned five offshore parks were cancelled and the feed-in tariffs were changed substantially in 2002.

By 2003, all wind generators were connected to the grid under the new renewable portfolio standard. The remuneration was made up of the market price plus a premium. This premium was capped, setting a maximum price that the wind producers could receive. However, the new scheme no longer guaranteed interconnection.

Additions to wind power capacity declined rapidly, and the wind energy market stalled until 2008, when a new support framework was introduced. From 1993 to 2004, Danish wind power grew from 500 MW to over 3,000 MW but once the feed-in tariff was abandoned in 2004, the wind power development stagnated. Between 2001 and 2008, the energy policy developments in Denmark were considered very unambitious. The period 2004 to 2008 saw an addition of only 129 MW of wind capacity.

In 2004 there was considerable restructuring of Denmark's power supply sector. The power companies were privatised, and power distribution, transmission and production became independent sectors each with distinctive frameworks.

- Power distribution became the responsibility of local not-for-profit cooperatives, municipalities, or companies with a concession.

- Power transmission (> 60 kV) became the responsibility of Energinet, a new, wholly state-owned company.

- Power generation was divided as follows: (a) central power plants owned by DONG Energy (76% owned by the Danish state); (b) Plants owned by Vattenfall (a Swedish state-owned company) and E.ON (a German company); (c) municipal and local consumer-owned combined heat and power plants; and (d) wind power with 85% ownership by Independent Power Producers and the rest by the central power companies.

In 2008, the government developed an energy agreement valid until end 2012, which included the installation of two offshore parks of 200 MW each (installed in 2009 and 2010), and gave responsibility to the municipalities to plan for 75 MW onshore wind power in 2010 and 75 MW onshore in 2011.

In its energy policy statement of 2008 the Danish government committed itself to address climate change at minimal economic costs and without risking security of energy supply. This included making improvements in the nation's energy efficiency, increasing renewable energy and technological development. The government specifically committed to:

- Reducing total energy consumption by 2% by 2011 and by 4% by 2020, based on 2006 figures; and

- Increasing the use of renewable energy to 20% of gross energy consumption by 2011.

To help meet these ambitious targets, the government committed to increasing funding for R&D and demonstration of energy technology to EUR 135 million (USD 201 million) per year.

Rejuvenation and strengthening of the wind sector: 2009-2012

In 2009, Denmark saw a significant rise in installations with 116 MW of new capacity being erected onshore and 238 MW in national waters, bringing the total installed wind capacity up to 3,482 MW. In 2009, the main policy support mechanism for wind energy in Denmark was an environmental premium of DKK 0.25/kWh (USD

0.05/kWh) for 22,000 full load hours (equivalent to some 10 years of operation) added to the market price. An additional compensation of DKK 0.023/kWh (USD 0.004/kWh) was provided for balancing costs. The grid connection costs for offshore wind farms were financed by the electricity consumers, and special tariffs were defined based on competitive tenders.

The support scheme for electricity from renewable energy sources was based on price premiums added to the market price, and tenders for offshore wind power. The financing instruments were conceived and managed by the Danish Energy Agency. The combination of market price and premium ensured stable revenues for the producer. All subsidies costs were passed on to consumers as an equal Public Service Obligation tariff on their total electricity consumption.

During that period of time, many of the wind turbines installed in the 1980s and 1990s were reaching the end of their lifespan. The repowering of old turbines was likely to become an important part of the national market.

In February 2011, the government published its Energy Strategy 2050. The government's goal under this strategy was to achieve independence from coal, oil and gas by 2050, with an interim objective of 30% of the final energy demand supplied by renewable energy by 2020.

In 2011, a new government was elected. The winning party's manifesto had, among other things, proposed the following actions under its plan on energy and climate:

• All energy needs shall be covered by renewable energy in 2050.

• The electricity and heat sector shall be 100% supplied by renewable energy in 2035.

• Coal will be phased out from power plants and private oil boilers will be phased out by 2030 at the latest.
• The government will adopt a target of reducing the greenhouse gas emissions by 40% compared to 1990 levels.

• Half of the traditional electricity consumption shall come from wind by 2020.

• A comprehensive new strategy will be developed for creating smart grids.

In March 2012, a broad energy agreement was reached for the period up to 2020 (Danish Ministry of Climate, Energy and Building, 2012). According to this agreement, wind energy in 2020 would cover 50% of electricity consumption, and the greenhouse gas emissions from the Danish energy sector would be reduced by 34% in 2020 compared to 1990 levels. The remaining six percentage points to meet the 40% reduction of domestic carbon emissions by 2020 would be addressed through efforts in the transport and agriculture sectors in line with the forthcoming climate change plan.

It was also decided to build a total of 3,300 MW of new wind power capacity. The Danish wind sector is expected to expand under this agreement. Offshore, the wind parks of Horns Rev III (400 MW) and Kriegers Flak (600 MW) will be tendered over 2013-2015 and are due to be commissioned over 2017-2020. Furthermore, 500 MW near-coast wind and 1,800 MW new onshore wind are foreseen, from which 1,300 MW will be achieved through repowering.

The expansion of the electricity grids will be financed through a Public Service Obligation (PSO) scheme via the Energy Bill under the new agreement. In the first half of 2013 the possibility of further reduction in surcharge (price-adder) for onshore wind where the full surcharge is not needed will be discussed and agreed to.

GERMANY

The discussions on sustainable electricity generation started with the two oil crises of 1973 and 1979, which stressed the need to reduce the dependence on energy imports. The initial discussions however focused on using more coal and nuclear.

Support for technological demonstration and limited market growth (1979-1990)

A tariff for renewable electricity was introduced in 1979 to stimulate the market demand. It encouraged distribution companies to purchase locally produced renewable electricity at a price equivalent to the avoided costs. The system was similar to the Public Utility Regulatory Policies Act (PURPA) rules in the US. Since the estimated avoided costs were low, the proposed price was also low and this initiative had no significant impact.

Until the end of the 1980s, Germany's electricity supply system was dominated by very large utilities relying on coal and nuclear generation. Small and decentralised forms of generation were at a disadvantage. However, during the late 1980s a series of events shaped the future regulatory framework for renewables. In 1986, the Chernobyl accident had a profound impact on public opinion and subsequently on energy policies. Between 1987 and 1990, a series of proposals for institutional change were formulated, which included a feed-in law for the electricity produced from renewable sources. These proposals were supported by several government-funded R&D projects.

Market creation and introduction of the Electricity Feed-In Act (1991-1999)

The first Electricity Feed-In Act (EFL), which came into effect in 1991, regulated the purchase and price of electricity generated by hydropower, wind energy, solar energy, landfill gas, sewage gas, and biomass. The EFL guaranteed connection to the grid and proposed a Renewable Energy Feed-In Tariff (REFIT) to renewable energy generators. It also helped develop a national wind industrial base. For wind energy, the feed-in tariff was set at 90% of the average electricity utility rate per kWh. Together with the 100/250 MW programme and subsidies from various state programmes, the EFL provided considerable financial incentives to investors in renewable energy projects.

The rapid penetration of wind energy by the turn of the century can be attributed to the Electricity Feed-In Act (EFL), as can the obligation for power companies to purchase renewable energy from producers at fixed rates.

In addition, the government encouraged rural development by changing the Building Code in 1996. The code distinguishes between urban and non-urban areas and gives certain buildings in non-urban areas a special status. For these buildings, a construction permit should be granted, unless it infringes public interest. Since January 1997, wind power plants have been considered as having this special status.

In 1997, the Electricity Feed-In Act (EFL) was incorporated into the Act on the Reform of the Energy Sector, which transposed the European Renewable Energy Directive into national law. In 1999, when EFL reform started, Germany's national wind turbine industry had grown to be the second-largest in the world.

Market consolidation and Renewable Energy Sources Act (2000 -2012)

The seminal Renewable Energy Sources Act (Das Erneuerbare-Energien-Gesetz or EEG) came into force in 2000. This Act, which provided the main stimulus for the national wind market, established a feed-in tariff for each kWh produced, and awarded priority of connection to the grid for power generation based on renewable energy.

A two-component tariff was designed for wind energy, with an initial fixed tariff for a period of five years, and a second period of 15 years with a tariff level modulated by the local wind conditions. A strong element of the Renewable Energy Sources Act (EEG) was the obligation for power utility companies to purchase renewable energy at set tariffs over a period of 20 years.
From 2002 onwards, new installations received lower tariffs. Different elements such as technology learning were considered to set an annual tariff degression. The degression rate for new wind contracts was fixed at 2% per year, and later revised to 1%. This provided wind turbine manufacturers with an incentive to systematically reduce production costs and offer more efficient products each year. By defining the tariffs for different technologies based on the yield/generation costs of each plant, the stepped tariffs mirrored the learning curve of the technology. They capped the producer's profits, and lowered costs to consumers.

In 2002 the government published a strategy paper on offshore wind energy, which marked the beginning of the development of the national offshore wind sector. Its objective was to establish large-scale wind power capacities offshore to increase the share of renewable electricity in the energy mix. The renewable energy targets of the European Renewable Energy Directive reflected the German offshore policy.

Due to existing environmental protection laws for Germany's coastal regions, the offshore developments were limited to the Exclusive Economic Zone. The offshore sites were situated at least 12 nautical miles from the coast, which required putting up structures in deeper waters than the Danish projects for example (20-30 m depth instead of 5-10 m). This challenge to locate deeper sites further from the coast than as the state-of-the-art projects of that time did inspire the German wind industry to develop turbines that could withstand more difficult environmental conditions.

At the same time the government established and financed R&D programmes for offshore wind. After the 2008 financial crisis, concerns regarding finance and insurance, as well as technical challenges, contributed to a lower expansion rate of the offshore installations than initially planned.

The Renewable Energy Sources Act (EEG) was amended in January 2009. It included an increased initial tariff for both onshore and offshore wind energy. The tariff system was designed to respond to market dynamics and the level of technology maturity. The new EEG required grid operators not only to expand the grid, but also to optimise its management. Failure to comply with these requirements could lead to claims for damages by any renewable power producer willing, but unable to connect to the grid.

In September of 2010, the government adopted the "Energy Concept", which includes long-term climate and energy targets. As a response to the nuclear disaster in Fukushima in 2011, Germany decided on the gradual phasing-out of nuclear power by 2022, greater energy efficiency and an accelerated growth of renewable energies. These decisions supplemented and accelerated the implementation of the measures set out in the "Energy Concept".

The continued and rapid expansion of renewable energies will be a central element for the future national electricity market. Greater coordination will be needed between renewable energy generation and conventional power plants, both for market and system integration.

The Renewable Energy Sources Act (EEG) was subsequently amended in January 2012. The main amendments included an increase in the tariff degression rate from 1% to 1.5% for onshore wind and a "repowering bonus", which improves the economic conditions of the repowering projects.

For offshore wind, several elements were revised:

• Integration of a "sprinter premium" (EUR 0.02/kWh: USD 0.03/kWh), added to the initial tariff, increasing it from EUR 0.13/kWh to EUR 0.15/kWh (USD 0.18kWh to USD 0.2/kWh)

• A tariff degression delayed from 2015 to 2018, as the offshore expansion has been delayed. In return, the tariff degression rate is increased from 5% to 7%.

• Launch of a EUR 5 billion (USD 6.8 billion) credit programme by the national development bank (KfW) in order to secure financing for about 10 wind farms at market interest rates.

• Development of a master plan for offshore grid connection, preferably by the Federal Maritime and Hydrographic Agency.

The offshore wind energy capacity increased to 108 MW in 2011, and is expected to reach 3 GW by 2015. To date, the national maritime authority and the federal states have licensed 24 projects, bringing the overall capacity close to 7 GW. The costs for connecting offshore wind farms to the mainland grid are supported by the transmission system operators, which started to plan for connection lines to clusters of offshore projects. Three 400 MW high-voltage direct current (HVDC) lines have been completed.

Support for R&D and technology demonstration

The initial development of the German wind industry relied strongly on the government-funded R&D programme. In the period from 1977 to 1989, about 40 R&D projects were granted to industrial firms and academic organisations for the development or testing of small (e.g., 10 kW) to medium-sized (e.g., 200–400 kW) wind turbines.

In the 1980s, a set of demonstration programmes became part of the national R&D policy. Some 14 wind turbine suppliers were funded to produce 124 wind turbines between 1983 and 1991. This programme represented an important part of the national market for small wind turbines at that time. The total installed capacity reached 20 MW by the end of 1989.

In 1989, the Ministry of Research initiated a demonstration and market creation programme for wind power. Initially, it aimed at installing 100 MW of wind power capacity. Due to the success of the first programme, the Ministry expanded the objective to 250 MW in 1991.

The programme mainly involved a guaranteed payment of EUR 0.04/kWh (USD 0.08/kWh) for the electricity produced, which was subsequently reduced to EUR 0.03/kWh (USD 0.06/kWh).

Long-term R&D support has been continuously available for the wind power sector in the country. Recent highlights include:

• The 2010 opening of the Alpha Ventus offshore test site, complementing the research initiative called "Research at Alpha Ventus" (RAVE). This offshore test site aims to acquire fundamental technical and environmental information for the future expansion of offshore wind energy.

• Continued funding for the operation of three research platforms – FINO 1, 2 and 3 – in the North and the Baltic seas. These platforms provide data to industry and research institutions.

• Fraunhofer Institute for Wind Energy and Energy System Technology (IWES) coordinates 45 research institutions and companies, which are involved in wind energy research. Currently an important topic of research is the foundations and support structures for an offshore wind turbine, which account for about a third of its capital costs.

• In 2011, the BMU approved 74 projects with a total funding amount of EUR 77 million (USD 99.9 million). In 2010, the BMU approved 37 projects with a total funding of EUR 53 million (USD 75.3 million).

IRELAND

Demonstration projects

In the early 1980s several demonstration wind turbines were installed in Ireland. The first detailed investigation of the wind resource and the first significant wind energy installation were done under the VALOREN programme funded by the European Commission (EC).

In 1990, Ireland was a heavily import-dependent energy economy. The dominant energy source was oil, which accounted for 46% of the energy mix in 1990, followed by gas. The government initiated significant reforms of the energy sector in the 1990s. Up until then the energy sector was essentially a monopoly of the Electricity Supply Board (ESB), the state-owned electricity utility.

Competitive tender, targets and market reform (1993-2005)

In 1993, the government initiated the Alternative Energy Requirement (AER) programme, to install 75 MW of renewable energy capacity by 1997. A competitive bidding process was launched in 1994, complying with European procurement rules and State Aid guidelines. The projects had to qualify technically before submitting their offers for a grant amount. The lowest bids in each category were offered contracts up to the available capacity. The successful applicants were granted a Power Purchase Agreement (PPA) of up to 15 years, not extending beyond 2010. The national utility company (ESB) had to purchase the produced electricity, and was compensated for the net additional costs incurred from a Public Service Obligation (PSO) levy funded by electricity consumers.

The 1996 national strategy "Renewable Energy – A

Strategy for the Future" stated wind connection targets of 31 MW per year between 2000 and 2010. The document addressed the access of third parties to the electricity grid, and promoted small-scale renewable energy projects to enhance energy self-sufficiency.

The initial phase of the AER programme was successful in terms of proposed projects, but less so in terms of actual deployment:

• For the first round of the AER programme (1995), the initial target was set at 75 MW. A total volume of 300 MW was proposed, and 111 MW were accepted. Wind represented 73 MW of that total, of which only 45.8 MW was commissioned.

• The third Alternative Energy Requirement (AER 3) competition was launched in 1997, with an objective of 100 MW of new generation capacity. The final result awarded almost 160 MW, from which 137 MW is of wind capacity.

Unlike AER 1, the AER 3 awarded projects on the basis of price support per kWh, not a grant level. A grant from the European Regional Development Fund was made available to the successful bidders, and was discounted from the proposed kWh price.

The initial commissioning deadline for all projects under AER 3 was extended from 1999 to 2000. Several projects failed to receive planning permission or failed to proceed for other reasons, such as problems related to site access. Only six wind energy projects were developed under AER 3, totalling 37.51 MW.

A revised strategy for sustainable energy was proposed in 1999. The 1999 "Green Paper on Sustainable Energy" set a target to install 500 MW of renewable energy capacity between 2000 and 2005, later revised to 500 MW by 2007 under AER 5 and AER 6. The strategy included concrete proposals on the liberalisation of the electricity market, planning processes and grid connection. The Green Paper became a central feature in the national greenhouse gas abatement strategy.

The AER 5 competition was launched in 2001, with an initial target of 255 MW of which 363 MW were awarded. AER 6 (2003) awarded 365 MW of capacity, including two 25 MW offshore wind demonstration projects.

Liberalisation of the electricity market

The Electricity Regulation Act 1999 (ERA 1999) established the Commission for Energy Regulation (CER), to regulate the electricity and natural gas sectors. It also created the regulatory framework for introducing competition into the production and distribution of electricity.

An independent Transmission System Operator (TSO) was created for operating, developing and ensuring maintenance of the transmission network. The TSO does not own the lines, and the transmission owner (now called EirGrid) was to carry out the construction and maintenance. Renewable electricity suppliers could sell their electricity directly to the final customers. However, the grid planning and connection permission process became an issue. The TSO faced difficulties in handling the large amount of requests received in the years 2003-2004.

Up until 2004, the applications for connecting to the grid were processed on a case-by-case basis. In October 2004, a joint system operator was proposed, based on a centralised approach. Applications were grouped based on their geographic locations and the level of electrical interaction with the grid. The installed wind power capacity increased rapidly from 169 MW in 2003 to 744 MW at the end of 2006.

In addition, it was essential to reinforce the grid capacity to integrate large amounts of variable electricity supply. In 2003, the Republic of Ireland and Northern Ireland decided to create an all-island energy market. In 2007, the Single Electricity Market (SEM) became a cross-border wholesale electricity market.

Feed-in tariff programme (2006-2010)

Ireland's first renewable energy feed-in tariff (REFIT) programme was launched in May 2006 and approved by the European Commission State Aid regulations in September 2007. The programme aimed to more than double the contribution of renewable energy technologies from 5.2% in 2005 to 13.2% in 2010 (initial target under Directive 2001/77/EC).

The bidding process under the AER was replaced by a feed-in tariff scheme. Due to low bidding prices and lack of profitability for many projects, a significant amount of the wind capacity awarded had not been built.

The feed-in tariff scheme was funded through the Public Service Obligation (PSO[99]) levy charged to all electricity consumers. This levy is revised every year by the regulator, based on the amount of projects eligible for the payment of the feed-in tariff. The power purchase agreements (PPAs) were valid for 15 years.

Under the terms of the REFIT scheme, each generator entered into a PPA of 15 years with a licensed supplier. In the first version of the feed-in tariff (REFIT 1), similar to the AER scheme, the energy suppliers were compensated for the net additional costs they incurred.

The balance was funded through a PSO levy on the consumers. At its launch the scheme was limited to 400 MW which was later revised to 1,450 MW. The rules of REFIT 1 allowed the government to extend the capacity limitation by public notice.

Under the REFIT 1 scheme, 1,242 MW of renewable energy capacity were added to the system. Detailed rules for the second version of the feed-in scheme (REFIT 2) were to be announced in 2012.

In 2010, Ireland produced almost 15% of its electricity from renewable sources, exceeding its target of 13.2%. Due to the country's high wind resources (average capacity factor of 34%), the feed-in tariff was significantly lower than in other OECD countries. However, since 2009 broader economic concerns have affected the rate of new wind installation, with just 153 MW completed in 2010, down from 221 MW installed in 2009.

99. Details of the Public Service Obligation (PSO): (a) the legal basis for the PSO was set out in Section 39 of the 1999 Electricity Regulation Act. Statutory Instrument No. 217 of 2002 under Section 39 required that the Commission for Energy Regulation (CER) calculates and certifies the costs associated with the PSO, and set the associated levy for the required period. (b) The PSO levy took into account the estimated and actual costs incurred in undertaking generation activities, which were covered in the relevant PSO legislation. (c) The PSO levy year ran from 1 October to 30 September. The CER collated information from all licensed electricity suppliers to calculate the levy for the upcoming year. The feed-in tariff was eligible to suppliers notified to CER for the next PSO period.

ITALY

National Energy Plans and Feed-in tariff system (1981-1998)

The first National Energy Plan was elaborated in 1981, setting objectives and targets for the development of renewable energy across the country. In 1982, Law 308/82 established the basis of the future regulations, institutional rules and financial incentives for energy efficiency and renewable energy.

The second National Energy Plan was put forward in 1988 with objectives for 2000. This plan included implementation guidelines for energy saving, the rational use of energy, protection of the environment and human health, development of national energy sources and improvement of industry competitiveness.

In 1991, as part of electricity sector reforms, Law 9/91 allowed for producing energy from renewable sources through simplified authorisation procedures. The regional governments were obligated to propose energy plans (Law 10/91), with renewables as a policy priority.

In 1992, the CIP6/92 regulation established the first fixed feed-in tariff, covering the first eight years of energy production. The tariff was based on avoided investment and production costs for ENEL, the state-owned power company in charge of the national electricity system (including production, transmission and distribution).

The tariff enabled investors to see a predictable return on their investment. The initiatives that received support under CIP6/92 were chosen according to a procedure approved by the Ministry of Economic Development and consistent with ENEL's national electricity programme.

Both Laws 9/91 and CIP6/92 were successful in establishing new rules for the electricity sector, liberalising electricity generation and moving towards a free electricity market. Independent power producers (IPPs) could produce electricity from renewable sources without any capacity limit. CIP6/92 created certainty on the financial flows, as ENEL was obligated to buy all electricity produced, simplified the remuneration to IPPs (on the basis of kWh produced) and provided a clear definition of the remuneration for each type of technology.

The permitting procedures were lengthy due to complex and inconsistent rules across the country. The permitting procedures for small and large wind farm developers were identical, and disadvantaged smaller producers. The developers faced a lack of grid connectivity in rural areas.

Some of the local governments in southern regions provided capital cost subsidies under the regional support programme (POP programme) funded by the European Structural Funds. The POP programme covered a given percentage of the capital costs and could be combined with the CIP6/92 feed-in tariff. This initial tariff regime was implemented between 1992 and June 1995 for the proposed projects.

Liberalisation of the electricity market and the introduction of the green certificate system (1999)

The 1999 Legislative Decree 79/99 (widely known as the Bersani Decree) addressed the restructuring and gradual liberalisation of the Italian electricity market, in line with the European Directives for the liberalisation of energy markets. It encouraged electricity production from renewable sources by introducing priority on grid access for renewable electricity, as well as a renewable energy quota system. Unlike the fixed guaranteed feed-in prices under the CIP6/92 regime, the new support mechanism was designed as a market-based mechanism. The Bersani Decree also introduced a tradable green certificate system, under the quota obligation.

This green certificate mechanism required power producers and suppliers to produce a certain percentage of electricity from renewable sources, starting from 2% and gradually increasing. Green certificates were to be used to fulfil this obligation. Producers and suppliers could also fulfil their renewable quota obligation by purchasing certificates from third parties. The certificates were traded on a parallel market independent of the electricity market. The price of a green certificate stood at EUR 109/MWh (USD 172.7/MWh) in 2005.

The Bersani Decree also enhanced the support to the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) to work on research, innovation, and technology transfer for renewable energy technologies. The decree liberalised parts of the energy markets, in particular the activities of electricity production, which had been monopolised by ENEL up until then. This law also made the distribution and supply of electricity to captive customers subject to licensing, and reserved the transmission and distribution for the government. In addition, it provided for the creation of a Transmission System Operator (TSO[100]) and a Single Buyer (SB), and proposed the creation of a Market Operator.

In 1999, a White Paper[101] on the exploitation of energy from renewable sources was adopted. This document provided the basis for policies and strategies for meeting production targets up to 2008-2012 (for each type of source). Wind was allocated 700 MWe by 2002, 1,400 MWe by 2007 and 2,500 MWe by 2008/2012 (Glorioso, Lionetti and Presicce, 2007). The White Paper also highlighted the role of regional governments in reaching these goals.

In 2003, the country implemented the European Directive 2001/77 for the promotion of electricity from renewable sources under Article 2 of Legislative Decree 387/03. This decree introduced additional measures improving incentives and support for renewable energy projects. Under this EU Directive, the share of renewable energy was bound to increase from 5.2% in 2005 to 17% of the final energy consumption in 2010.

Revision of the green certificate scheme and the introduction of auctions (2007-2012)

In 2007 the green certificates price reached EUR 130/MWh (USD 197.2/MWh). According to Law 244/2007, small generators (up to 1 MW, except for wind power limited to 200 kW) could choose to sell their green certificates on the market or receive a feed-in tariff. The period for the release of green certificates was extended to 15 years for new and refurbished installations (Law 244/2007).

100. ENEL formed the national TSO (GRTN), which became operational in 1999.
101. In 1998 ENEL published the White Paper (LibroBianco per la valorizzazionedellafontirinnovabili) to introduce the national target.

The 2008 Finance Act and the subsequent 2009 Ministerial Decree increased the quota by 0.75% annually over the years 2007 to 2012. This translated into a quota obligation of 5.3% in 2009, 6.05% in 2010, and 6.8% in 2011.

Under this Act, the Italian government introduced a "banding" mechanism into the certificate system, which accounts for technology maturity. The quantity of green certificates granted to renewable energy producers having larger than 1 MW installations was multiplied by a coefficient, which is varied with the technology from 1.0 for onshore wind energy to a maximum value of 1.8 for wave and tidal energy.

The market regulates the value of the certificates, although in case of an excess of certificates on the market (long market), GSE (electricity market operator) must buy them at a fixed price. This price is calculated (article 25, paragraph 4 of the Legislative Decree 28/2011) as 78% of the price of certificates sold by GSE. In case of a shortage of certificates (short market), GSE can sell those certificates coming from the former feed-in (CIP6) scheme at a published price, calculated as the difference between EUR 180/MWh (USD 263.1/MWh) and the annual average market price of electricity in the previous year, which is EUR 87.38/MWh (USD 121.63/MWh) in 2011, net of VAT.

In addition, one green certificate was now worth 1 MWh, instead of 50 MWh which was the previous value. Therefore, the certificate system became more suitable for smaller renewable energy installations.

The certificate scheme was handled by GSE (electricity market operator) and AEEG (Regulatory Authority for Electricity and Gas). GSE's role was to verify that the participants were fulfilling their quotas and inform AEEG, who could impose a penalty in case of non-compliance.

The implementation decree of Budget Law 2008 created a mechanism to withdraw unsold green certificates from the market in order to maintain the green certificate price. The price was set to the average price of the previous three years.

A new legislative decree (Number 28 of 3 March, 2011) transposed the European Directive for the promotion of renewable energy sources (2009/28/EC) into a national target of 17% of renewable energy in the gross final energy consumption by 2020.

Expected future changes

In 2013 the quota system will be replaced by a feed-in system for schemes under a given threshold and a tendering scheme for new plants (except biomass) with a capacity above the threshold. The threshold is differentiated by renewable energy sources, in any case over 5 MW of output capacity. Details of the implementation will be elaborated in upcoming Ministerial Decrees.

GSE must buy all certificates that exceed the annual demand. Legislative Decree 28/2011 rules that for renewable energy installations starting operation after 31 December 2012, the feed-in premium system in place over 2011-2012 will be replaced by a feed-in tariff scheme. The tariff would include the price at which GSE purchased the electricity generated by renewable sources from the producers.

The duration of the support will be equal to the average lifetime of the technology. This incentive is to be granted under private contracts with the national transmission system operator. The incentive will remain constant throughout the support period. The 2011 Decree sets a goal of 23,000 MW of renewable capacity installed by 2016 and is likely to produce major changes in the national support policy to renewable energy.

PORTUGAL

Portugal has no proven oil or natural gas resources of any significance, although historically its energy mix relied largely on those fuels. The country's electricity consumption increased significantly from 23.5 TWh to 46.5 TWh during the period from 1990 to 2003. Energy independence and the use of indigenous renewable energy resources have become an important part of the country's energy strategy. According to the Portuguese Renewable Energy Association (APREN) electricity generation from renewable energy sources accounted for 46.8% of mainland Portugal's total consumption in 2011.

Early regulatory and tariff support for renewables (1988-2001)

The first law guaranteeing grid access for Independent Power Producers (IPPs) using renewable energy sources came into force in 1988[102]. At that time the legislative framework was only applicable to small hydropower (below 10 MW), but an amendment in 1995[103] extended it to other renewable energy sources, such as wind power.

The scheme has been reviewed several times since then, following the evolution of the electricity market and its liberalisation. The production of electricity from renewable energy sources was included in the PRE regulation (Production on Special Regime).

This legislation also set a feed-in tariff scheme for the first time. The first simple scheme was revised in 1999[104], when a more complex formula was introduced. The new feed-in tariff formula took into account the avoided costs of investing in conventional power plants; the avoided costs of operating and maintaining a conventional power plant; avoided environmental costs in terms of CO_2 emissions; and the inflation rate. The feed-in tariff has been revised several times, but the concept of compensating for avoided costs is still in use.

Portugal started promoting research and development (R&D) on renewable energy technologies in the early 1990s. Public energy R&D was managed through the Institute for Industrial Engineering and Technology (INETI), and considerable resources were dedicated to renewable R&D. Several new companies were created at this time to explore the country's wind energy potential and develop wind energy technology. For example, the wind energy development company Enernova was created as a subsidiary of the public utility Electricidade de Portugal (EDP). These companies, along with the National Renewable Energy Association (APREN), created in 1988, were key drivers for the implementation of wind energy schemes[105] during the 1990s.

INETI has undertaken a detailed evaluation of Portugal's wind resources, and published a wind atlas for the country. This data is combined with the increasing availability of finance for wind developments and an improvement in tariffs paid to renewable electricity producers. Therefore, it led to a surge in new projects from 2000 onwards.

However, one of the limitations for wind energy in Portugal was the quality of the grid infrastructure, which increased the connection costs and delays.

Incentives to stimulate renewable electricity production (2001-2012)

Consistent with the European Directive on renewable electricity (2001/77/CE), Portugal launched the E4 Programme (Energy Efficiency and Endogenous Energies) in 2001. The E4 set an objective of 39% (later increased to 45%) of the country's gross electricity consumption to be supplied from renewable energy sources (including large hydropower) by 2010.

A series of initiatives (including the development of the legislation and incentive schemes) were launched between 2001 and 2003 to stimulate the electricity market, including

- A Decree-Law establishing a range of favourable feed-in tariffs for electricity produced from renewable energy sources[106].
- A Decree-Law regulating the delivery of electrical energy into the low-voltage grid (micro-generators, including PV)[107]

- A broader scope of financial incentives for energy efficiency and use of endogenous energy sources in the framework of the POE/PRIME Programme[108] (the Operational Programme for Economic Development).

In 2001, the new legislation supported the wind energy sector by clarifying the licence-granting process for grid access and simplifying the administrative procedures.

Along with these measures, in the same year, the feed-in tariff formula was also updated, with the introduction of a new factor, to differentiate between technologies. Under the new legislation, EUR 0.082/kWh (USD 0.144/kWh) would be paid for the first 2,000 hours of wind energy production each year. The tariff is reduced by blocks of 200 hours, reaching a minimum of EUR 0.04/kWh (USD 0.07/kWh) after 2,600 hours.

A special tax, payable to the local municipality, of 2.5% of the total revenue from wind projects was also introduced. This provision was introduced to ensure benefits to local communities.

Between 2001 and 2005, a major source of investment support was the "Incentive Scheme for Rational Use of Energy-SIURE Renewable Energies" which provided capital grants for different types of renewable installations. The scheme was run by the Ministry for Industry and Energy and supported by the European Union.

The most significant increase of wind power installed capacity in Portugal took place between 2004 and 2009. During this time more than 500 MW was installed annually.

In 2005, revisions to the previous feed-in tariff legislation[109] limited the power purchase agreements to the first 33 GWh produced per MW installed, or 15 years, and decreased the tariff to EUR 73/MWh (USD 114.83/MWh). Once this threshold had been reached, the operators would receive the market price plus the prevailing market value of green certificates at that time.

In 2005, a tender for 1,800 MW of wind power was released in three phases: phase A – 1 200 MW won by the ENEOP consortium; phase B – 400 MW won by the Ventinveste consortium; phase C – 200 MW distributed between several small projects.

Following completion of the tendering process, an industrial cluster for wind energy was developed, representing an investment of approximately EUR 290 million (USD 456.16 million). The industrial cluster was an outcome of the tendering conditions, since a condition of bidding involved working with local manufacturing companies to establish clusters of industries. The initiative aimed to create jobs and local economic development, while reducing the installation costs for new wind generators.

The Portuguese company Redes Energeticas Nacionais S.A. (REN) carries out the development of the transmission grid. There is a single operator for the national grid, EDP Distribuicao (EDPD). Grid connection procedures are normally completed in a timely manner[110]. The National Transmission Grid Development and Investment Plan for the period 2012-2017 (P-DIRT) includes gradual and phased expansion of the electricity network.

No new wind power capacity was added from 2005 until 2012. The National Renewable Energy Action Plan (NREAP) was presented to the European Commission in August 2010. The Plan included 6,875 MW for wind power of which 75 MW was for offshore wind. In order to reach this objective, approximately 1,000 MW of new wind projects are required, which will need to be

102. Decree-Law no. 189/88 passed on 27 May, 1988. With Decree 189/88, Portugal introduced a legislative framework to regulate the production of renewable electricity.
103. Decree-Law no. 313/95 passed on 24 December, 1995.
104. Decree-Law no. 168/99 passed on 18 May, 1999.
105. A number of wind projects were established on Portuguese islands in the late 1980s and early 1990s, but the first mainland wind scheme was built in 1992. This consisted of twelve 150 kW machines, totalling 1.8 MW.
106. Decree-Law no. 339-C/2001 passed on 29 December 2001 with following amendments.
107. Decree-Law no. 68/2002 passed on 25 March, and amended in 2007. The share of wind power in micro-generation continues to be negligible.
108. Provided direct subsidy payments, though it did not have a significant impact on the growth of wind energy.
109. Decree-Law no. 33-A/2005 passed on 16 February, 2005.
110. In Portugal electricity generation is allocated between: (a) PRO or Ordinary Regime Production, which makes offers on the market, includes plants such as oil/coal-fired conventional thermal, combined cycle gas turbines and large hydro, and (b) PRE or Special Regime Production, with feed-in tariffs. The PRE group includes all the renewable technologies generating electricity plus some non-renewable fuel-fired cogeneration plants. PRE gets priority in case of grid congestions. PRE production can only be restricted when a very specific production source can solve the grid congestion. Currently, the owner of a project in Portugal has no obligation or responsibility to forecast its production.

contracted by future tenders. In 2011, a Decree-Law was introduced to define the conditions regulating the awarding and management of grid interconnection points for IPPs[111].

Impacts of the economic crisis and reduction in renewable energy support

On May 2011 the Portuguese economy was under scrutiny by the International Monetary Fund (IMF), the European Central Bank (ECB), and the European Commission (EC). The Memorandum of Understanding (MoU) that rules the conditions for the financial assistance to Portugal defined measures to be taken on the energy sector. The provisions relevant for renewable electricity production under the Special Regime are as follows:

"5.8. Review in a report the efficiency of support schemes for renewables, covering their rationale, their levels, and other relevant design elements.

5.9. For existing contracts in renewables, assess in a report the possibility of agreeing a renegotiation of the contracts in view of a lower feed-in tariff.

5.10. For new contracts in renewables, revise downward the feed-in tariffs and ensure that the tariffs do not over-compensate producers for their costs and they continue to provide an incentive to reduce costs further, through digressive tariffs.

For more mature technologies develop alternative mechanisms (such as feed-in premiums). Reports on action taken will be provided annually in Q3-2011, Q3-2012 and Q3-2013."

Following the bailout, national elections were organised, and the government was changed. Since 2011, there has been significant regulatory instability in the Portuguese wind energy market. The existing support schemes (feed-in tariffs) have been under negotiation with the producers and there were several actions that triggered insecurity, including a new legislation in February 2012[112] which suspended all power allocation procedures for an indefinite time.

111. Decree-Law no. 312/2011 passed on 10 December, 2011.
112. Decree-Law no. 25/2012, passed on 6 February.

In April 2012, a public consultation was released to review the National Renewable Energy Action Plan, decreasing the scheduled capacity for all renewable energy technologies in 2020. The wind power capacity was lowered to 5,300 MW in 2020, which corresponds to the installation of the remaining power granted in the 2005 tender, and a few other equipment projects[113].

As a consequence, no new wind power capacity could be allocated up to 2020, unless a review is conducted in 2014 as envisaged in the review document.
With Decree-Law 25/2012, the current negotiations and the new NREAP in place, the Portuguese renewable energy sector is waiting for the end of this period of instability, and for improved conditions after the 2014 redefinition of the energy policy.

Development of Iberian (Portuguese-Spanish) electricity market

In 1999, the Portuguese and Spanish governments signed a "Protocol for Cooperation between the Spanish and Portuguese governments for the creation of the Iberian Electricity Market".

The Protocol was intended to guarantee Portuguese and Spanish consumers better access to domestic and foreign electricity networks. It gives Iberian electricity operators the possibility of contracting directly with the end consumers in a common Iberian electricity pool.

The Iberian Electricity Market or "MercadoIbérico de Electricidade" (MIBEL) became operational in July 2007. The initiative triggered the establishment of an integrated regional electricity market. MIBEL has one common price for electricity for Spain and Portugal if there is sufficient interconnection capacity.

The MIBEL spot market is to be managed by the Spanish market operator (OMIE), and the derivatives market is to be managed by the Portuguese market operator (OMIP).

Following the 2006 Badajoz Summit and the signing of the regulatory compatibility agreement between Portugal and Spain in March 2007 under the MIBEL, the

113. Decree-Law no. 51/2012, passed on 20 May, allowed for the installation of 20% more power than the power stated in the grid connection allowance, in return for a discount on the feed-in tariff.

first virtual capacity auctions took place. In Spain, they were organised jointly by Endesa and Iberdrola, and in Portugal, by REN Trading.

By the end of 2009, the governments of Portugal and Spain had formally published the International Treaty signed in Braga (in 2008) to establish the Iberian Market Operator (OMI), thereby taking another important step towards bringing the regional market to full maturity.

The first meeting of the common Board of Directors of the companies managing MIBEL – i.e. OMIE (spot market) and OMIP (derivatives market) – was held in 2011. It represented an important step towards the implementation of the Iberian Power Market Operator (OMI) after 11 years of negotiations for the creation of a regional electricity market.

SPAIN

Technology demonstration and introduction of tariff for RES (1980-1996)

The Law of Energy Conservation (Ley 82/80 de Conservación de la Energía) was passed in 1980. The Law established the objectives of improving the energy efficiency of industry and reducing dependency on energy imports.

The first Renewable Energy Plan (PER'86) was published in 1986. This plan proposed targets for renewable energy production and for private and public investment in renewable energy systems. It was later replaced by the second Renewable Energy Plan (PER'89), which set further targets for development and investment in renewable energy projects. Both of these early plans focused largely on demonstration projects.

In 1991, the government approved a new National Energy Plan that included the Energy Saving and Efficiency Plan (PAEE 1991-2000). This plan set an overall target for energy production from renewable sources in the country. It also established an incentive programme for cogeneration and renewable energy to increase their share from 4.5% of domestic electricity production in 1990 to 10% by 2000.

The market developed strongly in the mid-1990s when utilities started to place large orders for wind farms.

The joint venture formed in 1994 between Gamesa (the dominant Spanish manufacturer today) and Vestas, allowed the Danish wind company to comply with local content requirements.

The Royal Decree 2366 of 1994 was the first attempt to introduce tariffs for renewable energy by providing tariff bands[114] as well as a method for estimating the remuneration level for the produced electricity. However, this scheme did not provide significant support to the wind sector.

Spain was able to increase its installed wind capacity and simultaneously develop a local wind industry by actively supporting local manufacturing with policies. These policies encouraged foreign companies to establish manufacturing bases in Spain in return for access to the domestic market.

Targets for RES, introduction of feed-in tariffs and market development (1997-2000)

Electric Power Act 54/1997

The feed-in tariff system was fully developed through the Electric Power Act of 1997 (Act 54/97[115]). This Act introduced the process of liberalisation of the electricity sector in the country. It differentiates between the average rate of electricity production and the "Special Regime" for facilities using non-consumable renewable sources as primary fuel[116]. The Special Regime included obligations and rights for producers, among which were:

- the mandatory incorporation of the electricity produced into the electric grid
- the payment of a premium for this energy, with the intention of improving its market value. Under the

114. The Decree distinguished among six eligible technology groups, of which only three assumed the use of non-fossil fuel resources. For example, installations using wind, solar and geo-thermal were in Group A. This differentiation was only relevant for tariff levels or bands. It was applicable to projects smaller than 25 MW or 100 MW with special permission from the government. Large hydro projects were not included.
115. Ley 54/1997 del Sector Eléctrico Español, Jefatura de Estado was passed in 1997,and modified by Royal Decree 436/2004.
116. The law introduced the differentiation between the average rate of electricity production and the "Special Regime" for facilities using non-consumable renewable energies as primary fuel, such as biomass or any other biofuels, in plants up to 50 MW.

Special Regime, electricity producers could sell their surplus energy at a regulated tariff to the distributor, or to the market at a premium price. Under the new system the power producer could choose between the feed-in tariff and premium for the period of one year.

This Electric Power Act established a new "Plan for the Promotion of Renewable Energies[117]" (PFER 2000-2010), to supply at least 12% of total energy demand from renewable energy sources by 2010. Under this Act, the electricity distributor had an obligation to buy all electricity produced from renewable sources. The National Energy Commission (CNE[118]) was responsible for settling the costs incurred by the distributors. Under this tariff plan, the costs of renewable electricity production were accounted for in the annual calculation of the electricity price, thereby ensuring that the additional cost to consumers was proportionate to their electricity consumption. Transmission and distribution access were opened to third parties. A transitional period of 10 years was established for the liberalisation of electricity supply, whereby all consumers could gradually choose their supplier.

Royal Decree (2818/1998)

Royal Decree (2818/1998) on the production of electricity from renewable energy regulated the requirements and procedures for projects eligible under the Special Regime. Among other things it set out the details of registration procedures in the National Energy Commission's (CNE) registry.

This 1998 Decree established the right of renewable energy producers to sell their entire electricity production to the grid, and to be paid the wholesale market price plus a premium. It set the initial values for these premiums and the process for their annual updates, taking into account variations in the average price of electricity sales. Additional sets of incentives were introduced in 1999, including research budgets and a programme for promoting renewable energy among the general public.

Wind had become a national success story, and the installed wind capacity grew from 7 MW in 1990 to over 377 MW in November 1997 – more than double the government's target of 168 MW by 2000. The efforts of various regional governments to capitalise on the development of the wind power market helped create a large support for local wind power development.

A large share of the investments (such as for manufacturing and construction) also benefitted local economies. Several regional governments used local content requirements to attract wind industry manufacturers to their regions in an attempt to increase industrial development and economic growth. These provinces included Navarra, Galicia, Castile and Leon and Valencia, many of which insisted on local assembly and manufacture of turbines and components before granting development concessions.

The Royal Decree (436/2004) also established the methodology to update and systematically improve the legal and economic framework for the electricity sector's activities under the Special Regime[119].

Decree 436/2004 obliged operators of wind farms with capacities greater than 10 MW to provide the distributor with a forecast of the electricity they intended to inject into the grid at least 30 hours before the start of each day. Penalties were established for deviations. This decree also supported distributors' obligation to purchase all the electricity produced at a price above the market rate.

Strengthening targets for RES and feed-in tariff (2000-2010)

To further strengthen the growth of renewables in Spain, the Institute for Diversification and Saving of Energy (IDAE) prepared a Renewable Energy Plan involving members of the national government, the regional governments and academic and professional institutions. The 2005 plan set revised capacity targets for 2010, which included a wind target of 20,155 MW. This plan superseded the Renewable Energy Plan passed in 1999. IDAE was put in charge of monitoring the state of the 2005 plan's targets.

The 2005 plan had an investment outlay of approximately EUR 23.6 billion (USD 38.1 billion). Of this amount almost 97% was expected to come from private sources. Just EUR 681 million (USD 1.1 billion) or 2.9% of the total, was to be provided as public investment aid.

The 2007 modification to the Spanish feed-in tariff system (Royal Decree 661/2007) introduced two alternative remuneration options for wind power.

- Feed-in tariff (guaranteed payment): comprising a guaranteed feed-in tariff[120] (understood as a state-regulated minimum tariff for all electricity from renewable sources); and a variable feed-in tariff for hydro-electricity operators and biomass projects, based on a variable, time-dependent tariff, set up by statutory law. This tariff varies with the time of day and the season. The feed-in tariff guaranteed an internal rate of return of 7% to wind energy.

- Feed-in premium: paid as a complement to the electricity market price with a minimum and maximum overall remuneration level (for all renewable sources except solar PV and geothermal), determined on an hourly basis.

The new decree laid out the administrative and authorisation procedures for offshore wind farms. During 2008, 7.6% of Spain's primary energy needs and 20.5% of the national electricity was produced from renewable sources.

Spain reached the 2010 target of 7.5% of gross energy consumption from renewables in 2008. The government then created a "pre-assignment register" in May 2009 to stop the sector overshooting the revised targets in its 2005-2010 renewable energy plan.

The tariff system was revised in 2010 (Royal Decree 1614), with the feed-in premium temporarily reduced by 35% (from EUR 30.98 to EUR 20.13/MWh – USD 44.4 to USD 28.9/MWh). This reduction only affects installations under the Royal Decree 661/2007. The new decree also included a provision to limit the number of hours of operation that would qualify for the feed-in tariff or premium each year[121].

For a given year, when the average number of equivalent hours for the overall wind power installations surpasses 2,350 hours, the individual wind farms that produced above 2,589 hours would only receive the market price for the hours above the limit.

The Council of Ministers approved on 11 November 2011 the National Renewable Energy Plan 2011-2020; which is in line with EC Directive 2009/28/ EC on the promotion of the use of energy from renewable sources, stating that Spain should supply at least 20% of its gross final energy consumption from renewable sources by 2020. The 2011 plan follows up on the mandate of Royal Decree 661/2007, which regulated the activity of electricity production under the "Special Regime" and the Law 2/2011, of March 4, on "Sustainable Economy".

UK

The UK has long been regarded as one of the best places in Europe for wind energy development. After a slow start, developments over the last few years indicate that the country has started to realise its wind power potential.

Electricity sector reform and privatisation (1982-1990)

117. These targets were defined in the Plan for the Promotion of Renewable Energy Sources of 1999. The plan had an indicative character and implied no compulsory behavior for energy sector actors.

118. The National Energy Commission is the regulating body of Spain's energy sector. It was created by Act No. 34/1998 and Royal Decree 1339/1999 further developed its functions. Its goals are to ensure effective functioning of energy systems, while promoting objectivity and accountability in their performance.

119. It further consolidated the regulatory framework laid down by Law 54/1997 for renewable energy producers operating under the Special Regime and derogates the previous legislation under Decree 2818/98.

120. Tariffs are differentiated by technology and project size, and guaranteed for different time periods. The tariffs are adjusted for inflation and account for other elements such as operational efficiency of the system, the cost of technology used, market development of the technology, etc. The updating process is also linked to the fulfilment of capacity targets per technology, as defined by the Renewable Energy Plan. Each time a "Special Regime" technology has exceeded the target, its remuneration scheme is reviewed in order to adapt to the new market conditions for the technology. PV and wind are two examples of technologies affected by changes of regulation due to meeting and surpassing their planned capacity targets.

121. In 2010, significant changes affected the renewable energy market. The "deficit of the electricity tariff" is defined as the difference between the government-regulated revenues of electrical companies and their real costs in terms of energy generation, transport and distribution. The deficit was estimated at EUR 3 billion (USD 4.3 billion) in 2010. The government proposed a road map to reduce the deficit to EUR 2 billion (USD 2.7 billion) in 2011 and EUR 1 billion (USD 1.3 billion) in 2012. The temporary measures modified the remuneration schemes for wind, solar PV and CSP by limiting the possibility of choosing between the feed-in tariff and feed-in premium, reducing the tariff and the number of hours of production eligible under the scheme. This regulation was approved on a temporary basis (valid up to 2013) until the tariff deficit would be cancelled.

The development of electricity production from renewable sources in the UK was largely driven by the reform and privatisation of the energy sector in the late 1970s and the 1980s. The erstwhile Central Electricity Generation Board (CEGB) during the mid-1970s and the 1980s was involved in research and demonstration projects for renewable energy technologies. As early as 1980 the CEGB supported the development of several demonstration sites across the UK to promote the commercial use of wind energy.

In 1982, the Oil and Gas (Enterprise) Act paved the way for the privatisation of British Gas and British Petroleum (BP). This Act set the stage for much of the national privatisation programme[122]. Over the following decade this process eventually led to a very comprehensive reform of the energy sector (largely in England and Wales).

The 12 regional electricity companies (RECs) responsible for distribution and electricity retailing in the UK were privatised in 1990. This was followed by the privatisation of the two dominant power generation companies in the UK (National Power and PowerGen), which had more than 70% of the market share in 1991. The privatisation process enabled the progressive entry of Independent Power Producers (IPPs) into the market.

Auctions via the Non-Fossil Fuel Obligation (1990-1998)

The Electricity Act of 1990 provided the first real opportunity to deploy renewable energy in the UK. Under this act, the Non-Fossil Fuel Obligation (NFFO) was proposed in order to provide financial support for nuclear but also for renewable energy[123]. To pay for the NFFO, the Electricity Act of 1990 allowed a fossil fuel levy (FFL) to be raised.

122. Pre-1990: A single nationalised organisation, the Central Electricity Generating Board (CEGB), was responsible for generating and transmitting the bulk supply of electricity in England and Wales. Post-1990, the CEGB was split into three generation companies: National Power (in 2000 renamed as International Power Plc.), PowerGen, and Nuclear Electric, as well as a single high voltage transmission company, National Grid.

123. The definition of non-fossil fuel technologies under the 1990 Act included renewable energy technologies although initial support was directed towards nuclear power plants. The European Commission sanctioned the adoption of the NFFO to support nuclear power only for an eight-year period running between 1990 and 1998

The newly privatised regional electricity companies were obliged to purchase power from both nuclear and renewable energy generators at a premium price. The proceeds from the fossil fuel levy were used to reimburse them for the difference between this premium and the average monthly purchasing price in their regions. Based on this model, the first commercial wind farm in the UK was built at Delabole, Cornwall in 1991.

The Non-Fossil Fuel Obligation remained in place from 1990 to 1998[124]. Several bidding processes took place during this period, with proposals focusing on the best wind sites[125]. The NFFO bidding process focused on getting the lowest price and did not impose penalties on companies who were awarded a site, but did not initiate contracting. Contracts were also awarded very early in the development process, before planning permission was even applied for. Many projects failed to receive permission and a proportion of those that received permission were uneconomical due to their extremely low bid prices. As a result, a significant part of the awarded capacity was left unused.

When the NFFO mechanism began in 1990, no specific capacity target was set for renewables. When the NFFO-1 contracts were announced, the target was set at 600 MW declared net capacity (DNC[126]).

The payments per kWh for NFFO-1 contracts were agreed between the public authorities and the power producers before the bids were proposed, leaving limited room for competition. Unlike the NFFO-1 contracts, most of the NFFO-2 contracts were for "new" capacity and there was some degree of competition. The declared net capacity for NFFO-2 was for 1,000 MW.

The integration of renewable sources into the NFFO-1 and 2 had wide-ranging impacts. The initial rush for setting up wind farms created a high level of anxiety among local communities and a high degree of "push-back" was created towards wind farms. The negative image engendered in the early 1990s continued to be felt into the next decade. In 1993, three more rounds of the NFFO were announced. The declared net capacity for NFFO-3 was set at 1,500 MW.

124. Five NFFO rounds were organised: NFFO-1 (600 MW), NFFO-2 (1 000 MW), NFFO-3 (1 500 MW), NFFO-4 (1 700 MW), NFFO-5 (1 177 MW).

125. The successful bidders received an allowance of five years to build and commission a project, followed by a 15-year power purchase contract. As all contracts for each round were awarded on the same day, the developers were all working in parallel to one another and to similar time-scales. It became particularly evident with wind projects that planning permission was being applied for at approximately the same time by a host of developers, and the construction of wind farms was also taking place on similar sites simultaneously.

126. DNC is the amount of base load capacity required to produce an equivalent amount of energy over a year – 4 MW of wind at a 25% capacity factor equates to 1 MW DNC

By 1997, the UK's newly constituted Labour government investigated a mechanism to overcome the problems of the NFFO, yet continued to use competitive markets to deliver the least-cost renewable energy solutions.

The next round was announced in 1997[127] when NFFO-4 provided a capacity target of 1,700 MW for new contracts for renewables. The NFFO-5 order was announced at the end of 1998 with a capacity target of 1,177 MW but much of this capacity was again left unused. As the NFFO did not provide penalties for companies who won at auction but failed to take up a contract, it created the opportunity for companies to make unrealistic low bids in order to prevent competitors from securing contracts.

No more NFFO auction rounds were held after 1998, although there were variations. The general trend for the later rounds of auctions was an allowance of five years to build and commission a project, then a contract period for Power Purchase Agreements (PPAs) of 15 years. The last of these contracts is set to expire in 2018. The marginal bids set the price for Rounds 1 and 2, whereas Rounds 3, 4 and 5 were "pay-as-bid"[128]. The last rounds of auctions were largely considered to be financially unviable. Until recently these agreements constituted a major part of the UK's current renewable energy capacity, not including large hydropower.

127. In 1997 the manifesto of the newly elected Labour Party stated the party's target of procuring 10% of UK's electricity supply from renewable energy sources by 2010.

128. In a pay-as-bid auction, prices paid to winning suppliers are based on their actual bids, rather than the bid of the highest price supplier selected to provide supply (out of all selected suppliers of a specific round of auctions). For this reason, pay-as-bid auctions are also known as "discriminatory auctions" because they pay winners different prices tied to the specific prices offered in their bids.

Table XIII - : Average price results (listed in GBP) for NFFO Rounds (1 to 5)

	NFFO-1	NFFO-2	NFFO-3	NFFO-4	NFFO-
l of nteed ict	1990-1998	1991-1998	1994-2009	1997-2012	1998-2(
:ity of ng bids DNC)	152	472	627	843	1 177
ed ity DNC)	145	172	293	156	55
ge price kWh)	0.065	0.066	0.044	0.035	0.027
ge price	0.093	0.092	0.055	0.045	0.034

Source: Wiser, R. and M. Bolinger, 2012 and IRENA/GWEC

Targets, Renewables Obligation Certificates and the Climate Report (2000-2010)

Until the early 2000s, the UK's policies were largely supportive of the privatisation of the energy sector. In 2000 the government announced a target of 10% of UK's electricity to be supplied from renewable energy by 2010, provided the costs were acceptable to the consumer. The Utilities Act of 2000 further reformed energy markets in England and Wales, and the New Electricity Trading Arrangements (NETA) came into operation in April 2001. The regional electricity companies were separated into regulated distribution network companies and supplier functions.

In February 2000, the Department of Trade and Industry (DTI) published a call for public consultation on the Renewables Obligation[129]. The primary legislation was included in the Utilities Act 2000. In 2002, the Renewables Obligation (RO) came into effect, and succeeded the NFFO.

The RO imposed an obligation on all registered electricity suppliers in England and Wales to supply their customers in the UK with specified amounts of electricity from renewable sources. No distinction was made between the different renewable energy technologies, and all received the same level of support per kWh. As such, the RO was set up as a "pure" trading scheme.

The RO mechanism set a target for renewable energy, and allowed the trading of Renewable Obligation Certificates (ROCs), which would deliver the lowest-cost renewable generation.

The RO required all licensed electricity suppliers to comply with their target for the supply of electricity from renewable sources. Suppliers could comply with these obligations by either presenting ROCs or by making a buy-out payment[130].

By 2003, the government had consented to more offshore wind power capacity than all the wind farms built over the decade 1990-2000. The first large-scale offshore wind farm in the UK, North Hoyle, was commissioned in December 2003.

The publication of the Stern Review on the economics of climate change resulted in a substantial increase in the political profile of climate policy in the UK and had a strong impact in raising public awareness about clean energy choices.

The 2006 Energy Review provided an explicit recognition that there was room for significant improvement in the UK's renewable energy policy. The report proposed establishing a public consultation on adapting the RO, to reflect the fact that some technologies would no longer require its full support and that support for emerging technologies – such as offshore wind – would need to increase. It further proposed a formal consultation to "band" the RO and to provide differentiated levels of support to different renewable technologies. Therefore, the ROCs were allocated on the basis of technology groupings, where emerging technologies[131], would be awarded more certificates per unit of electricity generated than mature technologies.

In 2007 wind energy overtook hydropower to become the UK's largest renewable generation source, contributing 2.2% of the country's electricity supply, with onshore wind providing the major share.

The 2008 Climate Change Act committed the UK to reducing its emissions by 80% by 2050. This required a rapid advance in the growth rate of renewable energy. The Act further specified a reduction in emissions of at least 34% by 2020, on a 1990 baseline[132].

In 2008, the UK government revised the Electricity Act. In practice, due to the implementation of "banding" by 2009, 1 MWh from an onshore wind farm received 1 ROC while 1 MWh from an offshore wind farm received 2 ROCs, which was a shift from the earlier practice where all renewable energy technologies received 1 ROC per MWh.

Banding helped provide more economically viable support for the more costly technology options.

The annual compliance period for ROCs runs from 1 April in any year to 31 March in the following year. Separate ROCs are issued to generators in Scotland (SROCs) and Northern Ireland (NIROCs), but the three types of certificates are fully tradable and can be used by any UK electricity supplier for compliance with the RO.

There is no minimum or maximum price for ROCs. The prescribed level of the RO and the level of compliance determine the price of a ROC through the "recycle mechanism" funded by the buy-out fund[133].

In April 2010, there were further changes, including the extension of the Renewable Obligation scheme for new projects from 2027 to 2037 which provided greater long-term certainty to investors and increased support to offshore wind projects. The RO helped increase the share of electricity generation from renewables in the UK from 1.8% in 2002 to 6.8% in 2010.

A feed-in tariff scheme was introduced in April 2010 for small-scale renewable energy producers. The feed-in tariff opened electricity generation to communities, households and to micro-renewable generators with a capacity of less than 5 MW. It also offered an adaptable tariff that varied by technology and size of installation.

The UK government announced in December 2010 that it would introduce "phasing" for offshore wind projects accredited after 31 March, 2011 where generators can register the installed capacity for their projects in up to five phases (with a minimum of 20% in the first phase). Each phase will be eligible for support for 20 years (up to 2037).

129. The RO is set out in the legislation called the Renewables Obligation Order (ROO). This is a form of secondary legislation known as a Statutory Instrument. It sets out the details of the RO and can only be amended if it is first subject to a consultation and then debated and approved by both Houses of Parliament. The powers enabling the government to introduce the ROO are set out in the enabling primary legislation. The ROO was made under Section 32 of the Electricity Act 1989 and imposes an obligation ("the renewables obligation") on all electricity suppliers, which are licensed under that Act and which supply electricity in England and Wales, to supply customers in the UK with specified amounts of electricity generated from renewable sources.

130. As an alternative to providing ROCs, the suppliers pay the buy-out price to the Office of Gas and Electricity Markets (Ofgem) for all or any part of their RO percentage, which is not covered by the presentation of ROCs, or they can combine the two options (ROCs plus buy-out price). This money paid to Ofgem, known as the "buy-out fund", is then "recycled" to suppliers who have presented ROCs to Ofgem. This "recycling mechanism" provides an incentive for suppliers to obtain ROCs, as those suppliers who rely on the buy-out route effectively subsidise their competitors.

131. The rationale being that emerging technologies needed more support, since they were carrying more technological and financial risk, and were more expensive due to the lack of technology learning.

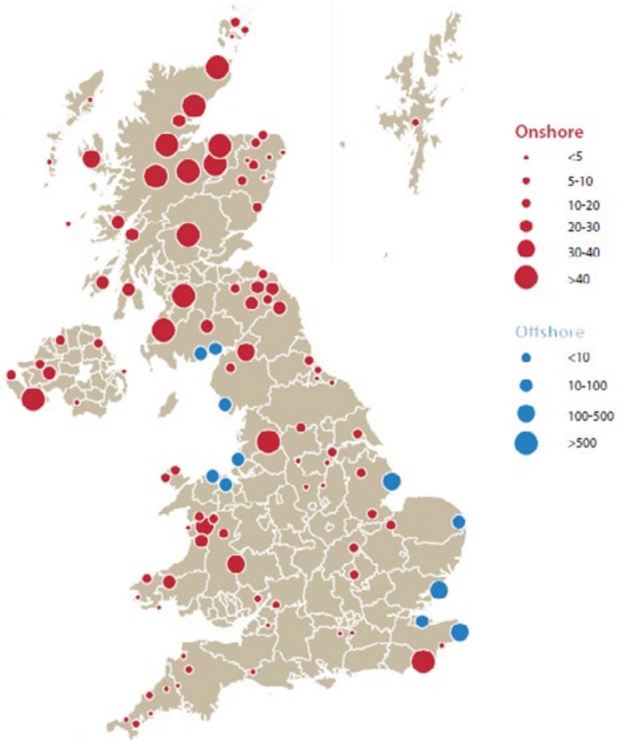
132. The 2009 UK Low-Carbon Transition Plan outlines the policies needed to decarbonise the UK economy to achieve those objectives as well as a seven-fold increase in energy from renewable sources over the same period. The 2011 Climate Action Plan describes the activities to be implemented in the next five years.

133. All buy-out payments are pooled together to form the buy-out fund. The buy-out fund is proportionally redistributed back to suppliers for every ROC submitted for compliance. This is known as the "recycle payment" and is dependent upon the volume of renewable energy generation, the size of the RO target, and timely payments into the buy-out fund by the electricity suppliers.

By 2011, wind was generating 15 TWh, accounting for almost 5% of all UK power supplies, out of a total renewables contribution of 9.5%. Onshore wind provided two-thirds of this amount and offshore wind the remainder.

Under the RO system, the UK produced 7% of its electricity from renewables in 2010/11, a poor wind year, compared to less than 3% before the obligation was introduced. An important point is that the UK support system was not financed through the central taxation system, but as an addition to consumer energy bills.

Figure XIII - : UK Capacities Map for Wind Turbine Generators (WTGs) above 225 kW (2010)



Source: DECC, 2011 and IRENA/GWEC

Growth of offshore wind

In February 2012, less than a decade after the first marine wind farm became operational in the North Sea off Blyth in Northumberland, the UK's offshore capacity exceeded 1.7 GW. The UK coast has very large wind resources, with an area of sea about the size of London capable of meeting 10% of the country's electricity needs. In order for this resource to be properly exploited, the British Wind Energy Association[134] initiated discussions with the government in 1998 with the aim of drawing up formal guidelines for negotiations with the Crown Estate[135]. These were published in September 1999.

A group of prospective developers proceeded to co-operate with the Crown Estate, which released information on the process for site allocation and leasing in December 2000. The resulting Round 1 of UK Offshore Wind Development, consisting of 18 sites of up to 30 turbines around the UK coast was announced in April 2001.

Shortly after the start of Round 1 a series of capital grants for offshore wind farms was announced through the New Opportunities Fund. Approved projects received grants of up to GBP 10 million (USD 20.5 million in current value) per project, approximately 10% of the project costs, on condition that construction had started. These grants complemented the RO and mitigated the high offshore project costs.

134. Now known as RenewableUK

135. This body officially owns the entire ocean floor out to 12 nautical miles equivalent from the UK's shores. It is in effect the landlord for the ocean floor in this area and hence must give its permission for any offshore development to take place.

Over the past decade some onshore wind developments had attracted strong local opposition, which led to lengthy and expensive development processes in many cases. To make sure that offshore wind development would not face similar difficulties, the industry association (RenewableUK) conducted "stakeholder dialogues" with parties having an interest in the development of an offshore wind energy industry, including fishermen, tourist boards and bird protection groups. The Environment Council mediated this process as an independent third-party convenor. As a result of the stakeholder dialogue, RenewableUK helped establish Best Practice Guidelines on consultation and public participation in offshore wind energy developments in 2001.

In 2003, the UK Department of Trade and Industry concluded its "Future Offshore" consultation. Its purpose was to develop a strategic framework for the offshore wind and marine renewables industries. Many issues were raised, including the consenting process and the legal framework, the need for Strategic Environmental Assessment (SEA), and the necessary electrical infrastructure.

On completion of the first phase of the SEA and the publication of the Energy White Paper, the Crown Estate invited expressions of interest from potential developers of new offshore wind sites under Round 2 in 2003. Only those companies that submitted an expression of interest were eligible to bid formally for Round 2 sites. The results were announced in December 2003, with 15 projects, with a combined capacity of up to 7.2 GW, allowed to apply for leases to operate offshore wind farms under Round 2.

The extension of the RO target to 15% by 2015 improved the economic viability of large-scale offshore projects. Furthermore, the Energy Act 2004 helped by creating a legal framework for development outside UK territorial waters.

In 2010 the Crown Estate announced the results for the Round 3 projects. Nine zones were awarded and the developers had to sign Zone Development Agreements committing them to developing 32 GW of wind farms that would be operational by 2020. Those projects would represent an investment of GBP 100 billion (USD 167.7 billion), excluding the cost of the grid. The Crown Estate also issued a framework document on zone appraisal and planning (ZAP) to aid Round 3 developers identify sites within the zones, and to manage the risk of cumulative impacts arising from clustered development.

Rounds 1, 2, 3, the Round 2 extension and the projects in Scottish Territorial Waters zones represent a total project capacity of 48 GW awarded by the Crown Estate for possible development in the UK. At 2011 costs those developments represent an investment of GBP 150 billion.

Two ROCs per MWh of offshore generation are available until 2015, possibly reducing to 1.9 ROCs per MWh in 2015/16 and 1.8 in 2016/17 as a result of the "banding" consultations held in October 2011. The future support level for offshore farms is still under discussion and one option would be to replace the RO with a feed-in tariff. However, due to delays in obtaining the planning permission and financing of projects, the expected commissioned capacity from all offshore projects should reach 5.5 GW by 2015.

Evolution of wind in Scotland

As in the case of England and Wales, the power sector reforms in Scotland led to the creation of a policy and regulatory environment favouring clean energy sources. Prior to 1990, Scotland's power sector was comprised of two vertically integrated, geographically distinct electric utilities, combining generation, transmission, and distribution, one serving the north and the other the south. The two electric utilities were privatised as vertically integrated regulated companies in 1991 after ownership of the nuclear power plants was transferred to a state-owned company.

Scottish Power[136] and SSE Plc[137] electric utilities are free to sell to the English market and use the English

136. Scottish Power has a renewables arm which operates over 20 wind farms with an installed capacity of over 1,000 MW (2010).

137. SSE currently owns 740 MW of onshore wind capacity in the UK and Ireland, and has 695 MW in construction, including 350 MW at the Clyde wind farm in southern Scotland, which is expected to cost GBP 500 million (USD 806 million) when it is commissioned in 2012.

wholesale price as a reference price for Scottish trading. These utilities also compete for customers. Strong support for renewables was shown by those power companies at an early stage. Furthermore, with devolution of more political power to Scotland in the late 1990s, the regional power companies could influence the energy policy development towards their preferred sources of power generation.

Unlike in England and Wales, renewable energy developments were supported by Scottish local communities, as they would allow Scotland to harness its own resources and provide energy security. In addition, Scotland had a highly technically skilled population, which was helpful in scaling up wind farm development. Overall the public debate on renewables tended to be more favourable in Scotland than in England or Wales. With 25% of Europe's offshore wind potential (estimated at 206 GW), and a strong manufacturing capacity, Scotland had a strong growth opportunity for both the onshore and offshore wind industry.

The Renewables Obligation (Scotland), or ROS, also came into force on 1 April 2002, and was the key incentive to implement the renewable energy objectives. Early incentives for renewable energy development under the Scottish Renewables Orders (SRO) and the NFFO schemes were superseded by the ROS, which obligated the regional electricity suppliers to source a proportion of their power from renewable sources. In addition, given that Scotland was a net energy exporter in 2000 (due to hydro power), renewable energy development in Scotland could be used to fulfil suppliers' obligations elsewhere in the UK, either by the supply of renewable electricity through interconnectors or by the sale of ROCs.

The Scottish government is responsible for the planning system in Scotland. The Planning (Scotland) Act 2006 introduced substantial changes, and is part of a wider reform and development package set in the White Paper on Modernising the Planning System from June 2005.

The White Paper allowed for the development and prioritisation of Scotland's resources. Its measures included increased devolution of decision-making with the possibility of appeals to local authorities, and the exemption of very minor developments from the planning application process. Local authorities in Scotland then became responsible for determining all wind farm proposals under 50 MW. The Scottish government, in consultation with local planning authorities, determines all projects exceeding 50 MW.

In 2007 Scottish Power, one of Scotland's largest energy companies was taken over by Iberdrola[138]. By that time, the cumulative capacity of renewable energy sources in Scotland had exceeded that of nuclear energy. In September 2008, the Scottish government published its Energy Policy overview.
This document outlined the government's plans of establishing R&D centres for cutting-edge renewable technology in Scotland and conducting joint development with other European countries. This would allow Scotland not only to maximise its energy exports but also maximise the preservation of wealth, the development of skills, intellectual property rights, and manufactured products.

By 2008 Scotland already met 16% of its demand for electricity from renewable sources – primarily hydro and onshore wind. Progress towards renewable energy targets has mainly been driven by the RO legislation and by the demand from England and Wales via the RO.

The Renewables Action Plan was published in June 2009. Under the 2009 EU Renewable Energy Directive, Scotland would produce 50% of its electricity demand from renewables by 2020. And, following the election of a new majority government in May 2011, this objective was increased to 100% of Scottish demand to be met by renewables in 2020.

Although Scotland will be contributing to the UK objectives for the reduction of greenhouse gas emissions, and is sharing the same 2050 greenhouse gas reduction targets, it has set a more aggressive national plan whereby a 42% reduction on 1990 levels is to be achieved by 2020. This ambitious target has been based on the availability of large renewable resources in the country, strong public support, and active regulatory support to renewable energy development.

138. Iberdrola, S.A is Spain's largest energy group and the fourth-largest utility company in the world by market capital. As part of the Iberdrola group of companies, ScottishPower is the fifth-largest energy company in the world. Iberdrola's sister company ScottishPower Renewables, was the UK's largest developer of onshore wind farms as of 2010.

Furthermore, the government has taken several steps to ensure that local communities would benefit from the renewable energy generated in their area. A community benefit register was established in 2011, which will help empower communities and help generate loans for community-owned renewable energy projects.

The share of renewable electricity in the gross electricity consumption grew from 12.3% in 2002 to 27.4% in 2009. This placed the country on course to meet its interim target of 31% by 2011, and provides a platform to move towards the 100% target by 2020.

In June 2011 the government published the "2020 Routemap for Renewable Energy in Scotland". This updated and expanded routemap reflected the new target of 100% electricity demand from renewable energy by 2020, and 11% renewable heat. At that time, 2.4 GW of onshore capacity had been installed in Scotland with 1 GW under construction. There are currently two offshore wind sites within Scottish territorial waters.

In comparison to England and Wales, Scotland has been successful in ensuring significantly higher community buy-in, long-term targets and political support. This has been made possible by the government's strategy of developing wind as an energy source with several parallel benefits for Scotland, a cutting- edge industrial base, enhanced energy security, as well as environmental and community benefits.

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ACRONYMS AND ABBREVIATIONS

AA - Appropriate Assessment
ACER - Cooperation of Energy Regulators
AEE - Asociación Empresarial Eólica (Spanish Wind Energy Association)
B&N - Baltic and Nordic countries: Estonia, Finland, Latvia, Lithuania & Sweden
BNEF - Bloomberg New Energy Finance
C&SE - Central and southeastern countries: Austria, Bulgaria, Hungary and Romania
CAES - Compressed air energy storage
CAPEX - Capital expenditure
CECRE - Spanish Control Centre for Renewable Energies
CEER - Council of European Energy Regulators
CRES - Centre for Renewable Energy Sources and Saving
CWEC - California Wind Energy Collaborative
DD - Direct drive
DFIG - Doubly-fed induction generators
DSM - Demand-side management
DSO - Distribution system operator
DWIA - Danish Wind Industry Association
EC - European Commission
ECN - Energy Research Centre of the Netherlands
EEG - Energy Economics Group, Vienna
EERA - European Energy Research Alliance
EIA - Environmental Impact Assessment
EII - European Industrial Initiative
EMI - Electromagnetic interference
EnR - European Energy Network
ENTSO-E - European Network of Transmission System Operators for Electricity
EOINET - European Environment Information and Observation Network
EU - European Union
EU-27 - European Union of 27 Member States
EV - Electric vehicle
EWEA - European Wind Energy Association
EWI - European Wind Initiative
FACTS - Flexible AC Transmission Systems
FIP - Feed-in premium
FIT - Feed-in Tariffs
FP5 - EU's Fifth Framework Programme for Research and Development
FP6 - EU's Sixth Framework Programme for Research and Development
FP7 - EU's Seventh Framework Programme for Research and Development
FRT - Fault ride-through
GHG - Greenhouse gas
GWEC - Global Wind Energy Council
HTS - High-temperature superconductor
HVAC - High voltage alternating current
HVDC - High voltage direct current
HVDC-VSC - High voltage direct current system using voltage source converters
IDAE - Institute for Diversification and Saving of Energy - Spain
IEA - International Energy Agency
IPCC - Intergovernmental Panel on Climate Change
IRENA - International Renewable Energy Agency
JRC - Joint Research Centre, a directorate general of the European Commission
LCOE - Levelised cost of energy
MEF - Major Economies Forum on Energy and Climate
MIBEL - Iberian electricity market
MS - EU Member State
MSP - Maritime spatial planning
NFFO - Non Fossil Fuel Obligation
NGO - Non-governmental organisation
NIMBY - Not in my backyard
NREAP - National Renewable Energy Action Plan
O&G - Oil and gas
O&M - Operations and maintenance
OECD - Organisation for Economic Co-operation and Development
OEM - Original equipment manufacturer
OFGEM - UK Office of the Gas and Electricity Markets
OPEX - Operational expenditure or O&M cost
PAC - Pump hydro accumulation storage
PER - Spanish Renewable Energy Plan
PMG - Permanent magnet electricity generators
R&D - Research and development
RD&D - Research, development and demonstration
RE - Renewable energy
REE - Spanish transmission system operator (Red Eléctrica de España)
RES - Renewable energy sources
RES-E - Electricity from renewable energy sources
RET - Renewable energy technologies
ROC - Renewables Obligation Certificates
SEA - Strategic Environmental Assessment
SET-Plan - European Strategic Energy Technology Plan
Solar PV - Solar Photovoltaic energy
TGC - Tradable Green Certificates
THM - Top head mass of a wind turbine
TPWind - European Wind Energy Technology Platform
TSO - Transmission system operator
TYNDP - Ten-Year Network Development Plan
VAT - Value added tax
Wind EII - Wind European Industrial Initiative
WWEA - World Wind Energy Association

Units

GW - Gigawatt
MW - Megawatt
kW - Kilowatt
TWh - Terawatt hour
GWh - Gigawatt hour
MWh - Megawatt hour
kWh - Kilowatt hour
m/s - Metres per second

EU-27 Member States

AT - Austria
BE - Belgium
BG - Bulgaria
CY - Cyprus
CZ - Czech Republic
DE - Germany
DK - Denmark
EE - Estonia
EL - Greece
ES - Spain
FI - Finland
FR - France
HU - Hungary
IE - Ireland
IT - Italy
LT - Lithuania
LU - Luxembourg
LV - Latvia
MT - Malta
NL - Netherlands
PL - Poland
PT - Portugal
RO - Romania
SE - Sweden
SI - Slovenia
SK - Slovakia
UK - United Kingdom

CAPÍTULO 4

FOMENTO À GERAÇÃO SUSTENTÁVEL DE ENERGIA EÓLICA - Leontina Pinto

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1. EOLIC INSERTION

This chapter presents a glimpse of the Brazilian eolic insertion in the Brazilian energy matrix, including estimated potential, current availability, market characteristics and future perspectives. Comparative figures show the importance of this source within the country energy matrix

Abstract

Eolic is a relatively new energy source in Brazil. The country potential is estimated as 300-400 GW – more than two times the current total installed capacity.

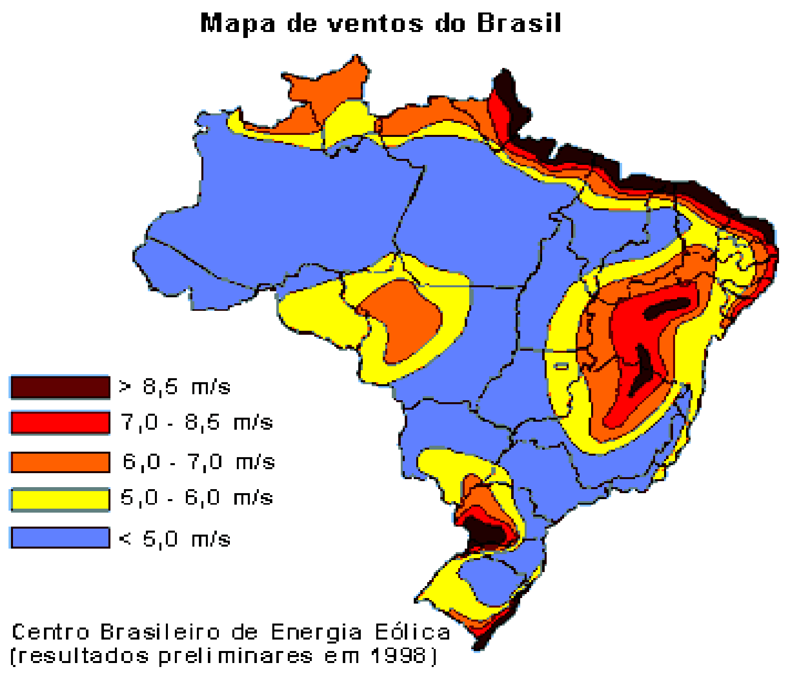
Although relatively young, eolic insertion in the Brazilian electric energy matrix has been explosive: wind parks are reaching increasingly higher efficiency and lower prices. Brazilian sector energy auctions have contracted approximately 7,5GW installed capacity, and trend points up and up. Official long-term plans project, for year 2021, that eolic energy will account for 9% of the total matrix, a 1009% growth in 10 years.

Eolic energy has been mainly directed towards the regulated market, which offers better revenue conditions. MDL credits and incentives for small consumers complete the picture.

1.1 Estimated potential

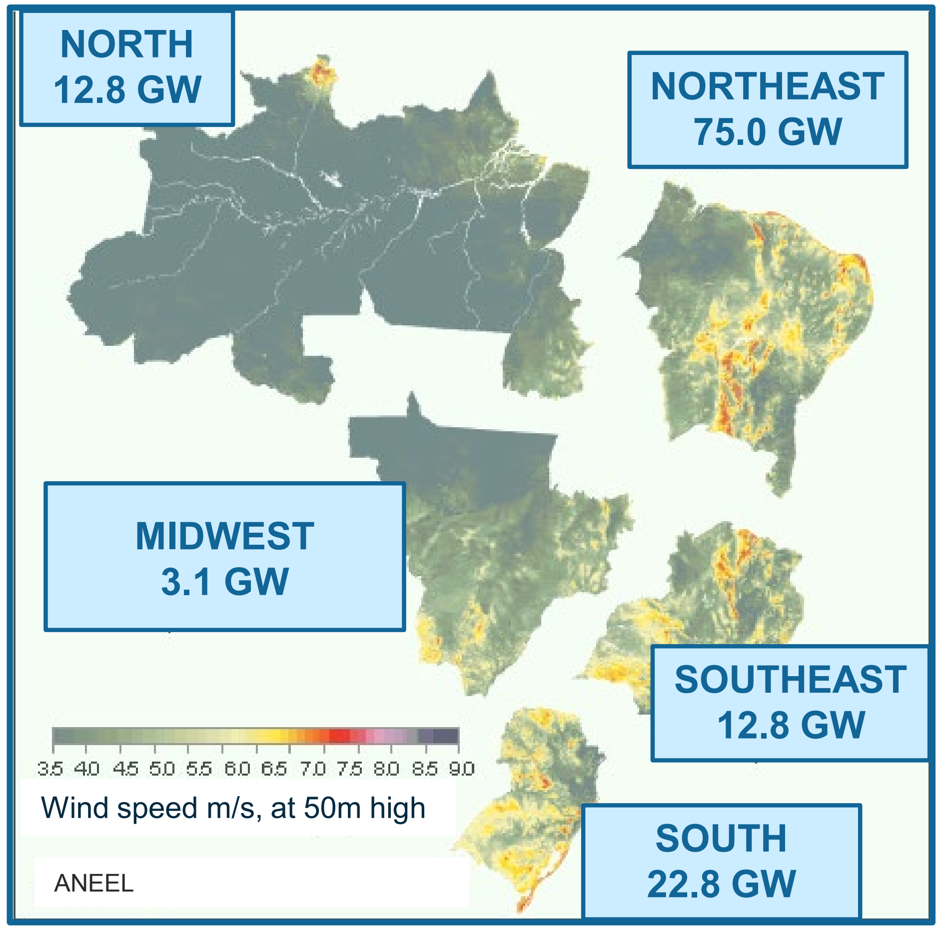
The first comprehensive estimate of the Brazilian eolic potential was carried out by the Brazilian Center of Eolic Energy (Centro Brasileiro de energia eólica), from the Federal University of Pernambuco, depicted in Erro! Fonte de referência não encontrada. [1]).

Figure 1 - Estimated wind velocities in Brazil



Some years later, the Electric Energy Research Center (CEPEL) released the 2001 Brazilian Eolic Atlas [2], shown in Erro! Fonte de referência não encontrada., with an initial estimate of approximately 150 GW at a height of 50m. Although no recent updates are available yet, experts agree that new technologies and refined data will level this potential to at least 300-400 GW or even more.

Figure 2 - Estimated wind velocities in Brazil



1.2. The begining

The first wind generator in Brazil and in Latin America was installed in Fernando de Noronha island, by the Brazilian Center of Eolic Energy (CBEE) and the Energy Company of Pernambuco (CELPE), supported by the Danish research center Folkcenter. Ten years later and only five plants more, the Brazilian government created the Alternative electric energy incentive program (PROINFA), contracting 1,3GW of energy, thus providing the startup for the decelopment and consolidation of the eolic industry in Brazil [3].

Figure 3– First Eolic Plant – Fernando de Noronha

From 2009 on, official auctions, targeting the regulated market, consolidated the eolic energy as the most competitive and efficient source, overcoming practically all other sources (except the large hydro plants, which largely benefit from economy of scale).

The auctions proved to be a success. Table 1 presents the process evolution: efficiency increases as prices drop.

Table 1 – Brazilian auctions, eolic results

LEILÃO	CAPACIDADE (MW)	FATOR DE CAPACIDADE	R$/MWh
PROINFA	1 422	37%	270,32
LER 2009	1 806	43%	148,4
LER 2010	528	51%	122,69
LFA 2010	1 520	43%	134,13
A-3 2011	1 068	45%	99,48
LER 2011	861	50%	99,54
A-3 2012	282	54%	88,82

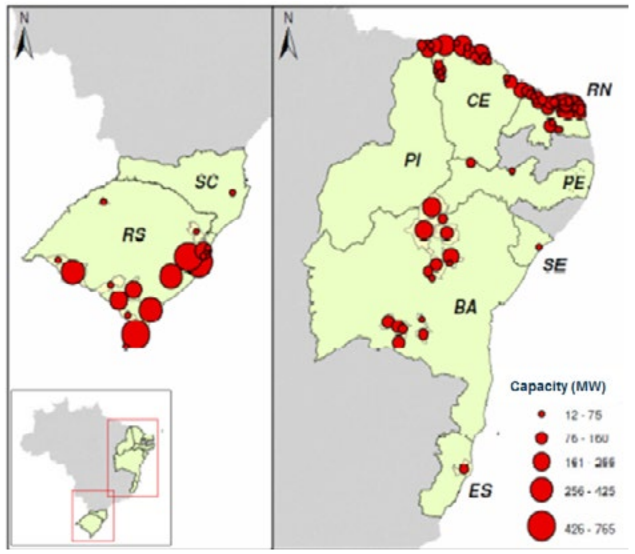
Table 2 presents currently operating wind farms. Brazil has successfully crossed the 2,5 GW barrier, and the Brazilian high capacity factors has been confirmed.

Table 2 – Wind farms in operation

State	Number of farms	Installed Capacity (MW)
Rio Grande do Norte	25	727,2
Ceará	18	588,8
Bahia	20	444,0
Rio Grande do Sul	14	440,0
Santa Catarina	13	231,6
Paraíba	13	69,0
Rio de Janeiro	1	28,1
Pernambuco	5	24,8
Piauí	1	18,0
Paraná	1	2,5
Sergipe	1	34,5
Total	112	2608,5

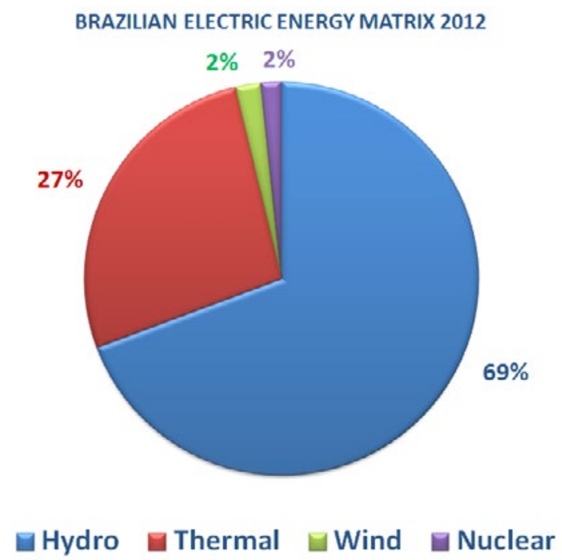
Not coincidentally, most plants are located on the Brazilian Northeastern and Southeastern states, as shown in Figure 4, extracted from the official expansion plan [4] (Rio de Janeiro plant, the only "out-of the mainstream", is not regarded in the figure).

Figure 4 – Eletric energy matrix, 2012



These figures, however, represent only a small part of the whole matrix, as shown in Figure 5. Brazil is still heavily based on hydroelectric generation and climatological risks are mitigated by thermal plants. There is still a long way until the eolic energy may actually play a significant role on country resources.

Figure 5 – Electric energy matrix, 2012

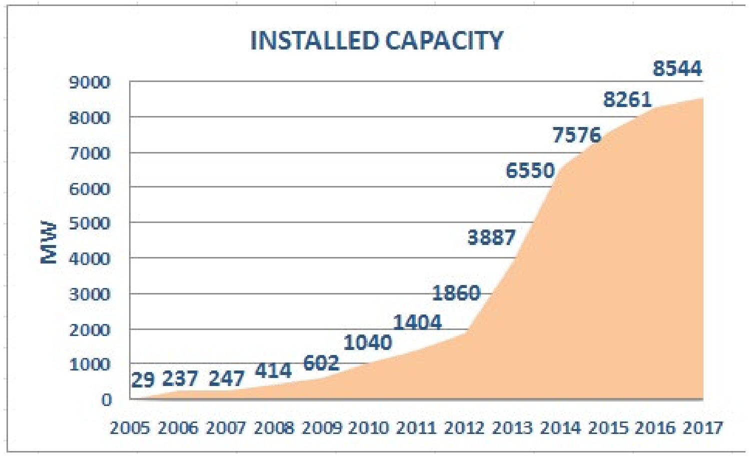


1.3. The future

The competitiveness of wind energy fits beautifully into the government clean energy policy, paving its way to the matrix insertion. It may be said that eolic energy (together with traditional hydroelectricity) is a priority on Brazilian official expansion plan.

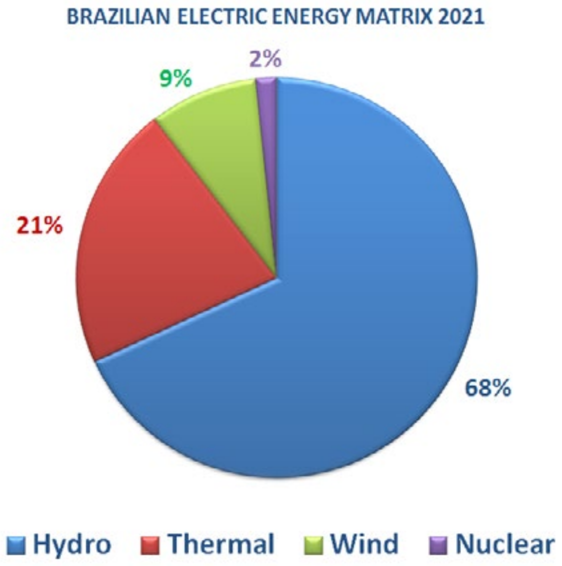
Figure 6 presents the expected evolution of eolic energy until 2017.

Figure 6 – Electric energy matrix, 2012



Finally, Figure 7 presents the expected energy matrix for 2021, as planned by the Brazilian Planning Authority (EPE), highlighting the expressive eolic participation growth.

Figure 7 – Eletric energy matrix, 2021



1.4. Energy Market

Regulated x Deregulated ambients

Brazilian energy markets are split into a regulated framework, where captive consumers are supplied by distribution companies, and de-regulated market (or free market) where free consumers (demand higher than 3 MWmed) may celebrate supply contracts with generators or traders.

The main challenge of eolic energy sales in the de-regulated framework is the high seasonality. As consumers require a constant product, excess or lack of energy must be cleared on the short term market – which is highly volatile (almost unpredictable). On the other hand, regulated market acquire energy by (also) regulated auctions, with special rules that eliminate seasonality variations; it is an almost no-risk enterprise, which partly explains the extremely low prices achieved.

MDL Market

The issue of carbon credits, which certify the emission reduction of greenhouse gases, may be seen an additional source of revenue, despite the dramatic price drop (€5 to €1/ton CO_2 in roughly one year). Effort and time requirements are significant: a typical eolic MDL process would take at least 18 months.

This picture is however beginning to change and make MDL more interesting (and possibly viable). The United Nations has decided to create the so-called Clean Development Mechanism Program, targeted specifically to Brazilian eolic projects. This program works as an "umbrella": after the first project is approved, subsequent projects will enjoy a simplified processing – typically six months.

In other words, though still at a very low price, the simplified MDL market may yield a marginal (but not negligible) extra revenue, which may help achieveing project feasibility.

1.5. Distributed Generation

Electric system operation is preparing for the future under the concept of distributed generation and smart grids. Renewables will play an important role, progressively substituting polluting sources.

Consumers will take control of their load, and modulate it according to their goals. Transmission will "carry" not only energy, but information. Distribution will adjust generation availability and consumer's requirements, instantly negotiating the best solution.

Local distributed generation will reduce transmission costs/losses and environment impacts. It is expected that, as the learning curve progresses, energy quality will also improve, since the necessity of additional equipment for compensating long-distance energy links will be no longer necessary.

One of the first steps towards this direction is the creation of distributed generation special regulations [5] targeting micro-generation (under 100KW) and mini-generation (100-1000 KW). Through a compensation system, consumers may install their own renewable generation and exchange energy with their local distributor. Generated output will be recorded and deducted from the bills along next three years.

1.6. Off-shore generation

Offshore energy (projects built on the sea) would, in principle, offer the advantage of a better location (closer to the main loads) and efficiency (stronger winds). Unlike Europe, however, off-shore farms would not bring the advantage of a lower land cost, as it is neither difficult nor expensive to find attractive eolic locations. Nevertheless, off-shore generation) is still a distant reality

The main reason for that choice is the price: as of 2012, off-shore energy cost was estimated as £149–191/MWh (roughly R$ 450-580/Mwh). Even considering the universal declining cost tendency and all initiatives towards this target, the best expectation [6] for the off-shore costs by 2020 is £100/MWh (roughly R$ 300/Mwh) – still significantly higher than the current prices. While acknowledging that Brazilian winds may exhibit different characteristics and achieve a better performance, there is still no significant evidence that this may be an immediate trend.

Figure 8 - Wind Farm Palmares do Sul, Rio Grande do Sul

2. CLIMATE CHALLENGES

This chapter discusses the climato-logi¬cal dynamics of renewable energy, with a special eye on the eolic patterns and possible interaction with the other sources. We also discuss the ef¬fect of climate changes and future expec¬tations.

Abstract

Wind behavior is by nature variable, and so is eolic energy. A deep knowledge on its climatological behavior may help anticipate the future and mitigate risks.

Moreover, interaction among sources deserves a special attention: wind, hydro and even photovoltaic energy are complementary. In other words, a careful management may plan different sources to "cover" each other, ensuring a global smooth dynamics, avoiding lack of generation and offering the consumer a constant supply.

2.1. Brazilian wind basins

As there are hydrological basins, where all rivers exhibit the same behavior, it is possible to identify "wind basins" – regions where wind speed displays similar dynamics. We will focus on the "eolic regions" that is, space delimited regions where wind speed time series share a similar pattern [7,8].

Unfortunately, Brazilian wind speed measurements are poor: wind farm sites are built over a two- or three year time series, definitely too small to characterize, within an acceptable accuracy, its climatological behavior. Nevertheless, there are plenty of meso-scale data available from international data banks [9], able to yield regional information, accurate enough to build a climatological model.

These data are provided on a gridded basis, encompassing the whole planet. Figure 9 and Figure 10 show the gridded regions of interest in Brazil, where new wind sites are under study or construction.

Figure 9 – Gridded regions, Northeast

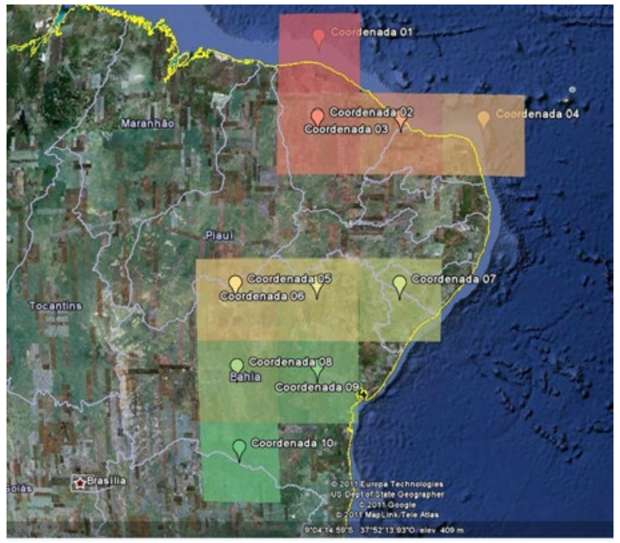
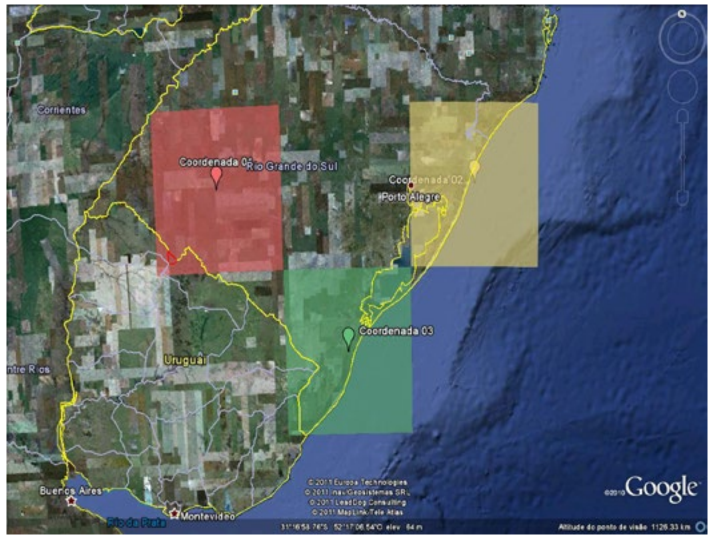


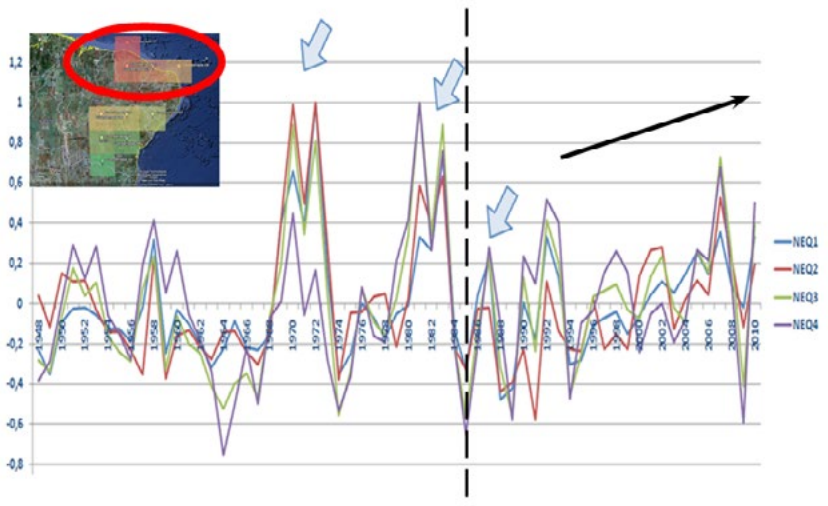
Figure 10 – Gridded regions, Southeast



"Wind basins" and their dynamics are displayed on Figures 11-14, by time series which cover the 1948-2011 period.

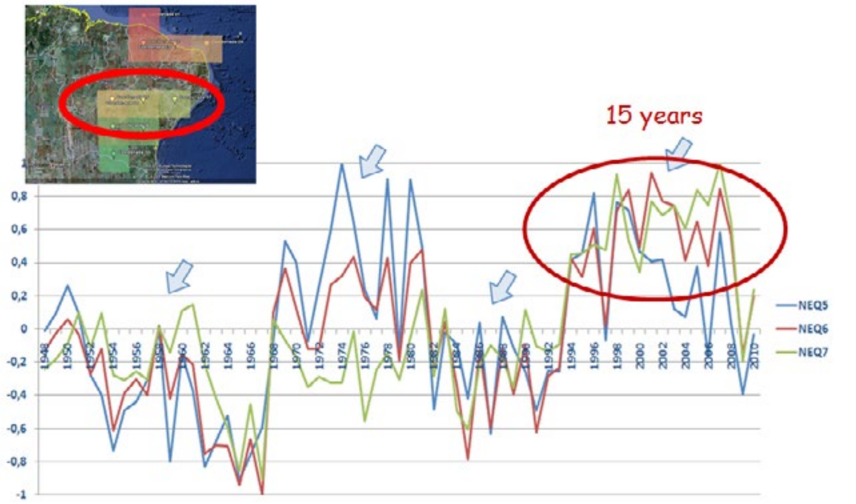
A close analysis of region NE 1-4 (coast), displayed on Figure 11, shows a strong influence on the "El Niño/La Niña" phenomena (highlighted by the blue arrows). It is also possible to see the strong 5-year periodicity established after the 1998 "El Niño" (marked by the black line) and the following ascending dynamic. It is interesting to observe that each strong "El Niño/La Niña" produces a strong impact on this region and may completely modify wind patterns and behaviors.

Figure 11 – Basin 1 (Northeastern coast)



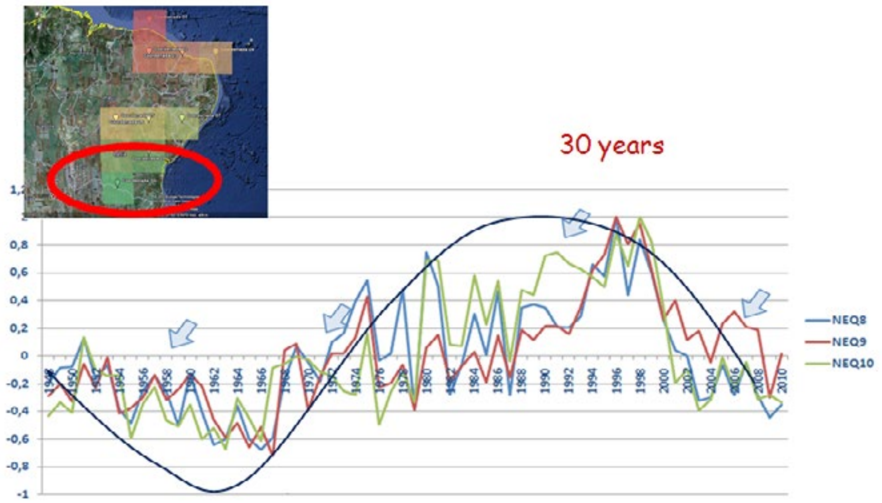
Central Bahia, displayed in Figure 12, presents an ascending curve blended with a 15-years periodicity – in other words, wind speed (and therefore generation) will not be as strong as last year's observations.

Figure 12 – Basin 2 (Central Bahia)



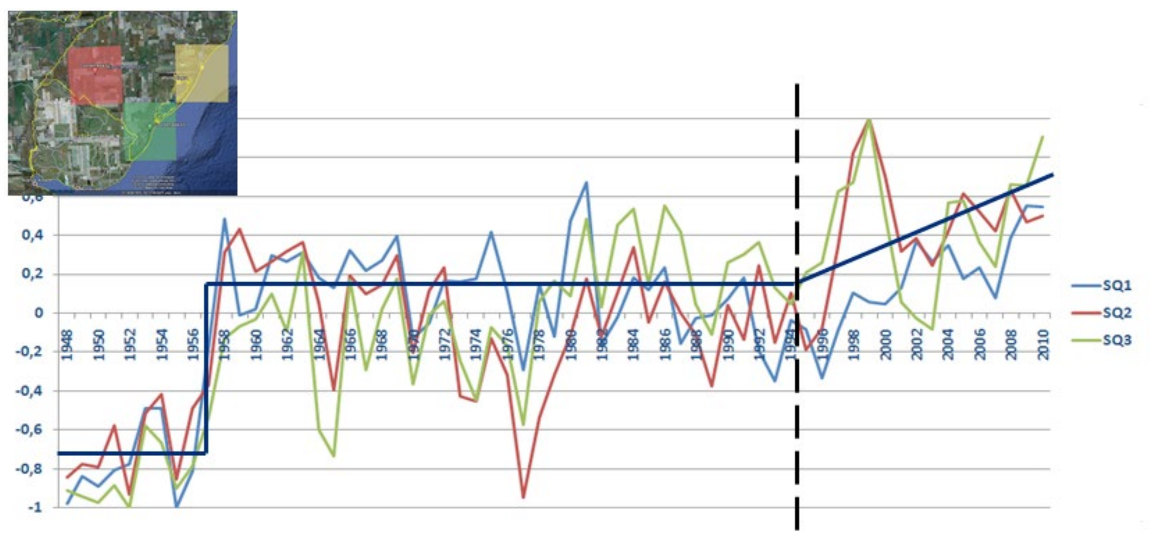
Southern Bahia, illustrated in Figure 13, shows an even surprising periodicity: 30 years. Although it may be too early to be sure, pattern reflects other known dynamics; this topic is under investigation.

Figure 13 – Basin 3 (Southern Bahia)



Finally, Figure 14 shows Southern Brazil's pattern. Wind strength suffered a steep increase in 1958, remained practically constant until the 1998 "El Niño" (dottet line) and exhibits now a clear and constant increase.

Figure 14 – Basin 4 (Southern Brazil)



All regions share a common characteristic: climate changes occur along the time. It is not only a matter of the possibility of future changes: patterns show clear, periodic and steep modifications, mostly driven by anomalous climatological episodes. It is important to closely monitor such events and their impacts, as they may result in important effects on energy yields.

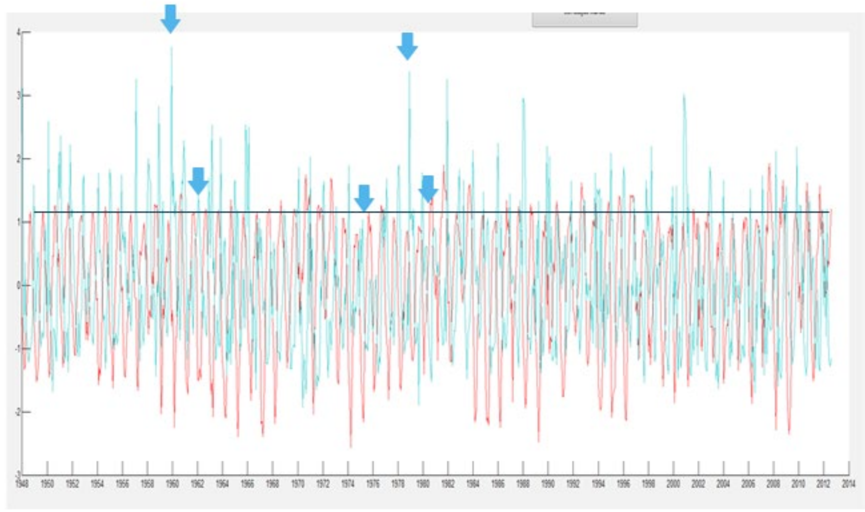
2.2. Brazilian efficiency rates

One of the most controversial discussions on the energy sector refers to the Brazilian eolic efficiency – superior to most known wind farms worldwide. Indeed, very few wind farms may exhibit efficiency factors as high as 50% - as most of the Brazilian investors claim.

This controversy may be easily solved by a comparison between a typical wind pattern – for instance, a Spanish region – and a typical Brazilian site – for instance the Northeastern cost, namely Ceará state. Figure 15 presents both time series from 1948 to 2010 (Meso scale data, obtained from the National Ocean and Atmosphere Authority, NOAA (9)), normalized for best comparison.

It may be seen that Spanish wind speed variance is high: maximum wind speed floats from high to low values (blue arrows). Brazilian wind speeds, instead, show an "well-behaved" uniform potential year after year (delimited by the black horizontal line). In other words, Brazilian wind is constant and reliable, explaining the claimed high efficiency rates.

Figure 15 – Wind speed time series
Spain (blue) x Ceará (red)



2.3. Source complementarity

All climatological processes are uncertain, and seasonality-dependent. Climatological-based renewable energy, as hydroelectric or eolic, introduces a risk factor on demand supply. A severe draught or a calm-wind year may lead to undesirable energy shortages.

This inconvenience may be overcome by an intelligent optimized planning and management. In fact, Brazilian renewable resources are highly complementary, as showed in Figure 16: wind and sun follow a similar pattern while water almost "mirrors" the other sources. In other words, lack of water implies in plenty of wind and sun. A coordinated expansion planning [10] may exploit these characteristics aiming a more constant global generation.

While hydro availability displays a descending trend wind and solar pursuit an ascending and consistent behavior. In other words, the last twenty years brought us less water and more sun and wind.

While it is not clear if these trends correspond to a signature of climate changes or a periodic cyclic episode, it is important to take these characteristics into account and follow the future episodes, in order to better study climate dynamics and hopefully construct a better model of future energy scenarios.

Figure 16 – Sources complementarity

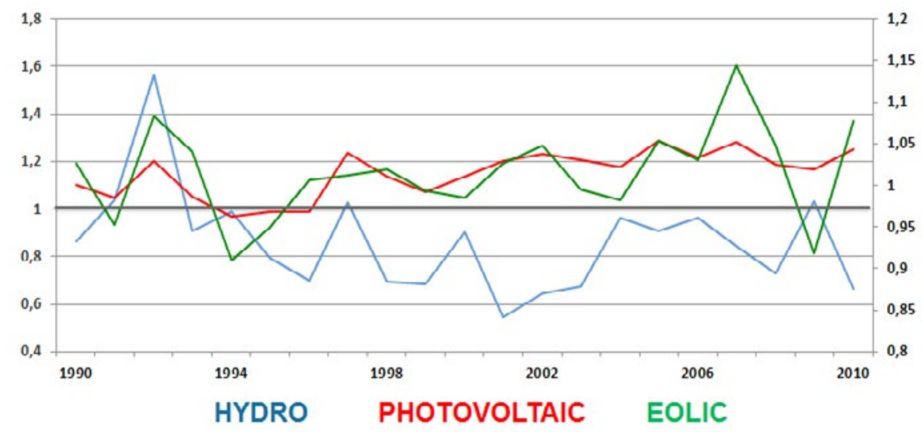


Figure 17 – Alto Sertão Wind farm - Bahia

3. EMISSION MINIMIZATION

This chapter presents the impact of eolic energy in Brazil in terms of CO2-equivelent emission reduction. It will be seen that this benefit has a broadwer effect than in other countries, due to the particular characteristics of the energy system

Abstract

It is widely known that eolic energy is a clean, renewable option for the future, as wind-based energy substitute thermal generation and associated emissions. The Brazilian system's characteristics are specially tailored for eolic integration, since wind fluctuations are compensated not by thermal dispatch (which would increase emissions) but by hydro generators.

The inclusion of eolic energy in the Brazilian energy matrix opens the possibility of a better emission-free (or at least a better minimum-emission) dispatch, at a feasible cost.

Wind variability and CO_2

3.1. Wind variability and CO2

It is widely known that eolic energy is a clean, renewable option for the future, as wind-based energy substitute thermal generation and associated emissions. However, some critics claims that the intermittency of wind attenuates this advantage, since thermal units will have to start-up and shut down to adjust to eolic variability – creating additional costs and emissions – see for instance the case of Illinois [11]. The literature offers many proposals [12,13] for a better dispatch, minimizing the increase of thermal costs and emissions associated to the wind uncertainty.

This is not the case of the Brazilian system. Thermal dispatch is decided on a long-term basis dispatch [14], and generation, if needed, is base-loaded. Short-term variations (in load or even plant availability/failures) are compensated by hydro plants and associated reservoirs, able to provide a rapid response to system's needs. An integrated dispatch, including all sources, will maintain (as long as possible) thermal generation constant and automatically adjust hydro generation to wind fluctuations, with null additional emissions.

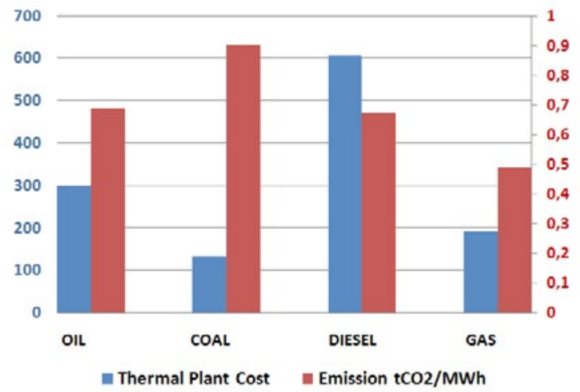
The Brazilian Association of Eolic Energy (ABEEOLICA, [15]) maintains the CO_2 reduction resulting from thermal substitution in Brazil – at the moment of this writing, equal to 2.247.472,5 T/ano.

3.2.Towards a green dispatch

Conservation and green energy are not always synonyms: for instance, a renewable-based system may not achieve emission reduction through energy conservation. Even thermal systems may exhibit different emission levels, according to specific dispatches. It is important to calculate - and, of course, inform the client the impact of his consumption in total energy emission. Moreover, in an ideal world, client may be rewarded by clean demand management.

Brazilian thermal plants are composed by different coal, gas, oil and diesel units, corresponding to different cost and emission levels, as illustrated in Figure 18 (data obtained from the "top-down" methodology – IPCC [16] and applied by the Brazilian Planning Authority – EPE, [17]). As it may be observed, coal plants play the "villain"; the first to be dispatched on a pure cost-effective dispatch, the last in emission reduction.

Figure 18 – Different thermal units costs x emissions



References [18,19] present a simulation of the traditional minimum-cost operation of the Brazilian existing/planned system, covering the 2008-2016 period, synthetized in Figure 19. Emissions rise until 2012/2013 peak, following our severe draught on these years. It may be seen that emissions begin to drop from 2015 on, as new significant hydroelectric plants are schedule to begin operation. As expected, coal plants have an important role, as the first economic option to meet the load.

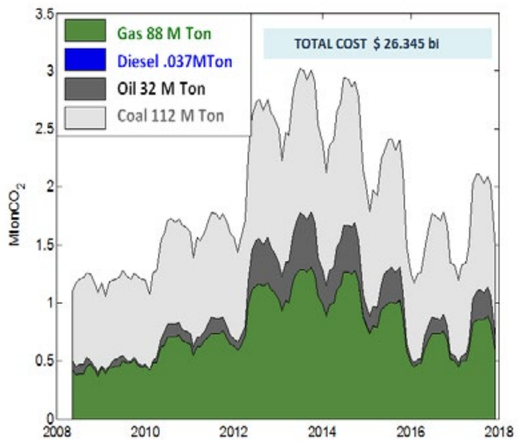


Figure 19 – Minimum cost dispatch: $26 bi, 232Mton

An ideal green-oriented system would prefer the minimum emission dispatch. In this case, gas takes the preference and coal is our last option. Figure 20 presents the solution of the minimum emission approach: emissions are significantly reduced - though operation cost is severely increased. As expected, most coal emissions were substituted by gas - substitution was only partial because the sum of other sources are not able to complete load necessities.

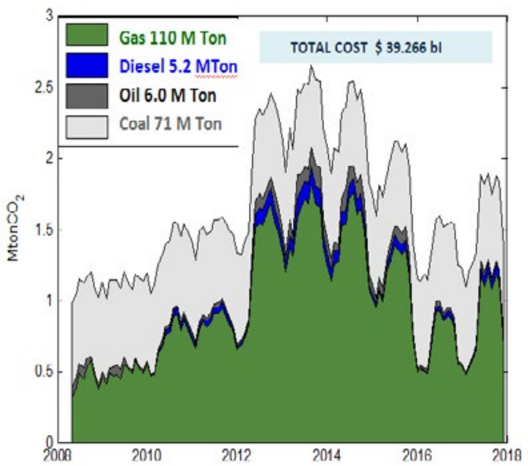


Figure 20 – Minimum emission dispatch: $39bi, 192Mton

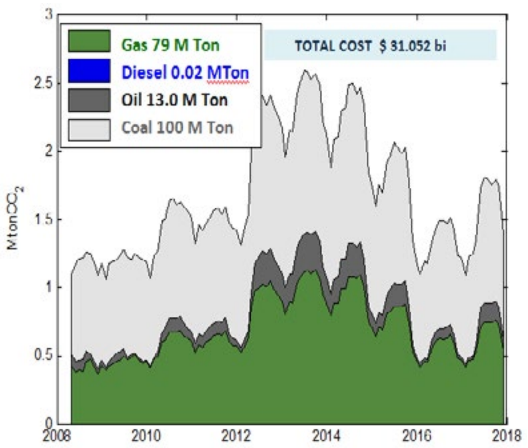
The acceptance of this plan will depend, of course, on resources and willingness to pay. It will not be easy to impose this cost increase on a society like the Brazilian, where health and education are still main priorities.

Eolic energy may be the compromise between cost- and emission- minimization dispatches, opening the door to a true green consumption without the cost burden – possibly unbearable to a country which still struggles with social necessities.

Figure 21 displays the optimum economic dispatch considering the inclusion of – say a share of 4GW of eolic energy (expected operation energy by the end of this year) – there is a dramatic increase on operation quality.

It is interesting to observe the cost/benefit "compromise": new emission curve resembles the minimum emission at a much lower cost. The corresponding solution achieved a good operation cost (not too far from the "pure" economic goal) and a good emission level (almost the "pure" minimum emission).

Figure 21 – Minimum cost dispatch, eolic included: $31bi, 192Mton



In other words, the inclusion of a small share of eolic energy in the system was able to bring the operation to the "green" level, without the high and undesirable economic burden. The impact of the carbon offset may be perceived in terms of soil preservation: the saved emissions are equivalent to the deforestation of 1933 Km^2 - roughly the area of the city of Rio de Janeiro.

The green dispatch is a promising paradigm shift and promises the best of both worlds. It will be possible to aim a minimum emission target (if not a zero emission target) within a comfortable cost level. This may be a theme for future researches and discussions, as Brazil – for the hydroeolic match – seems the perfect place to effectively implement this reality.

Figure 22 –Alegria Wind Farm, Rio Grande do Norte

4. MAKING IT HAPPEN

This chapter presents the typical steps to typical steps for the implementation of a wind energy project: conceptual analysis, business design, wind farm construction and commissioning.

Abstract

The success of a new source depends on a good, reliable and efficient project design and implementation, able to envision not only the strengths but most of all the risks of a project and corresponding impacts/mitigation actions.

This chapter presents the main aspects of a good eolic project design, construction and commissioning, presenting the typical steps and timing for a wind farm conception and implementation.

A general project development may be divided into some main phases: project concept, concession, construction and commissioning. This chapter will summarize the necessary steps of the whole process

A general project development may be divided into some main phases: project concept, concession, construction and commissioning. This chapter will summarize the necessary steps of the whole process

4.1. Project conception

This conceptual phase analyses a potential project, risks and return, targeting to evaluate its feasibility and attractiveness. It may be seen as the preliminary evaluation, assessing the attractiveness of the project, detecting possible weakness and mapping associated risks/mitigation actions.

Although each entrepreneur will build his/her own risk/return methodology, this report will offer the main topics for a typical assessment of a Brazilian wind farm, summarized in Figure 23.

Figure 23 – Project Conception

4.2. The potential yield

Potential yield evaluates the energy which may be generated and offered to the aarket. This is still a preliminary evaluation; the final, more precise study will require a complete micrositing assessment. It is however important to include characteristic aspects as seasonality, efficiency factor, losses and uncertainties. The main input for these studies is the set of wind speed measurements – the longer the history the better.

A special care should be taken with vicinity, as modifications on neighborhood environment may drastically change wind characteristics and therefore farm production. Shadow effects (modification in wind speed and characteristics produced by neighbor present or future wind farms is a serious concern.

4.3. Connection to the network

The produced energy must be transported to the final consumer. Connection to the grid may be a challenge, since most of the best prospective sites are located on remote regions, far from the existing transmission network.

Until the present moment, all investors targeting the regulated market were guaranteed a free access to the network. In other words, all projects sold through regulated auctions were granted the construction of necessary lines to access the grid – which were, in turn, contracted by the authorities through subsequent auctions. This model has not however been successful, and there are even wind farms ready to be commissioned and waiting for the delayed transmission lines. This de-synchronization is a significant bottleneck for the system and the market, and is expected to be solved soon – probably by new auction rules.

It is important to observe that this guarantee does not stand for projects target to the de-regulated market. This may be a critical point, since remote wind farms may require large, pricey transmission lines – which may not even be feasible due to environmental codes.

4.4. Environmental permits

Environmental permits are crucial for the feasibility analysis. Environmental licensing is a legal obligation before any potentially damaging and polluting activities take place in any part of Brazil's territory. Project permits are obtained from local state government environment agencies or from the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), which must follow regulations and guidelines established by the Brazilian Environmental Policy.

As each authority may differ on requirements and regulation interpretation, there is currently a trend among Brazilian regulators towards a unified licensing procedure, possibly under the coordination of a single institution. It is also interesting to observe that, state agencies may require additional permits or certificates from other different institutions, as the Institute of Historical and Artistic Heritage IPHAN (Instituto do Patrimônio Histórico e Artístico Nacional)

In any case, all Brazilian wind farms must comply with the regulations established by the Brazilian Environment Council (CONAMA) [20], which specifies three steps for the environmental licensing procedure:

1) Preliminary permit – (licenciamento prévio, or LP) – obtained at the initial conceptual phase, necessary for tenders and concession grants. As wind farms are usually categorized as low impact interventions, this procedure corresponds to a relatively easy simple process based on a Simplified Environmental Report (Relatório Ambiental Simplificado RAS) describing the project characteristics, land use, archeological protection, environment diagnostic/ prognostic, impacts and mitigation actions.

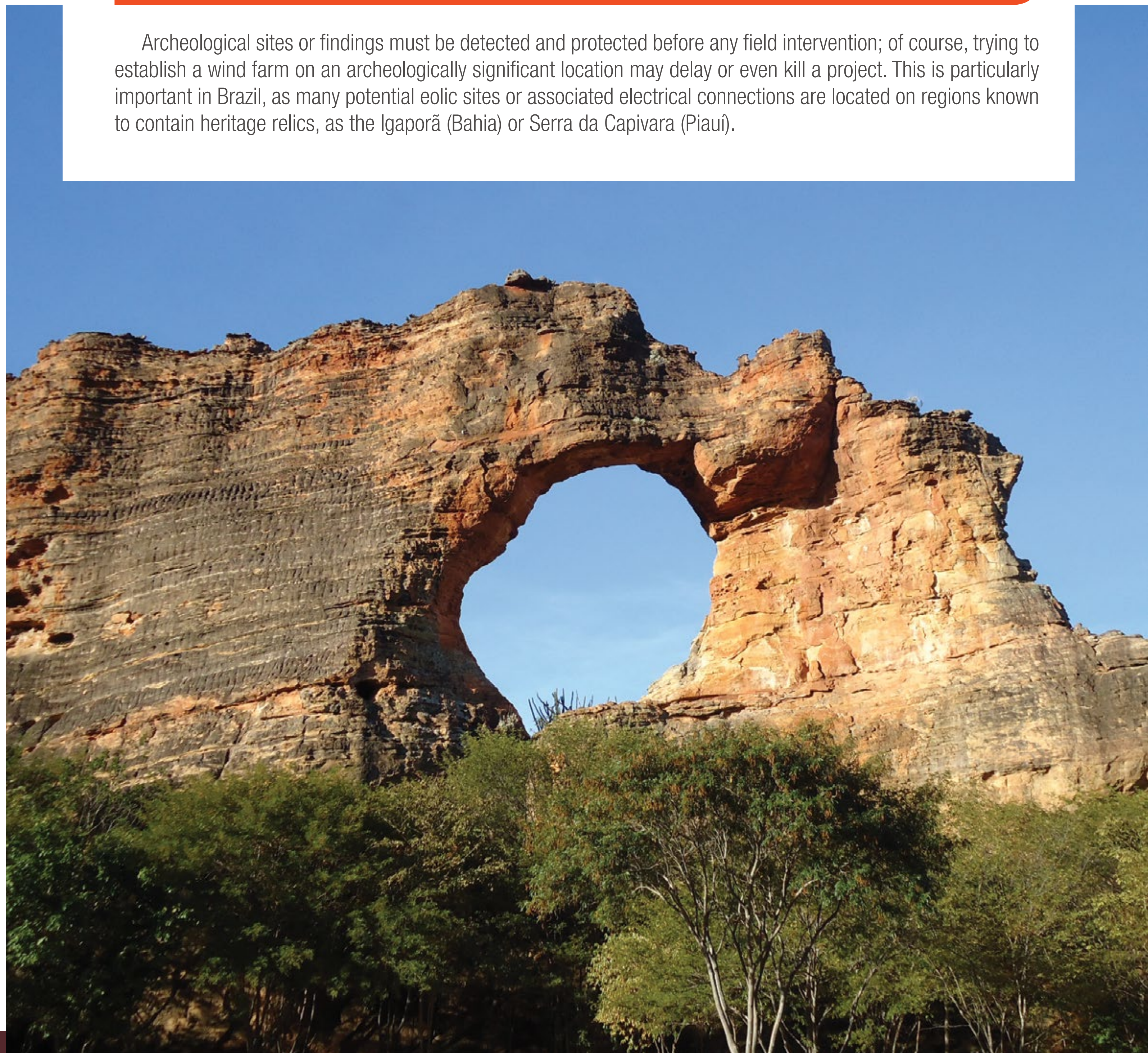
In some cases, if (at environment authorities' discretion) the environmental impact is perceived as significant, further studies may be required – such as a complete Environment Impact Study and associated report (Estudo/Relatório de Impacto Ambiental – EIA/ RIMA)

2) Installation permit – (licença de instalação, ou LI) – necessary for the start-up of construction work. This permit will confirm accordance with the preliminary permit, detail impacts and control actions, inspection and monitoring plans.

3) Operation permit – (licença de operação ou LO) – necessary for operation startup. This permit is granted upon verification of compliance with previous plans and actions – with a special focus on some well-known impacts, as vegetation intervention, fauna aggression, noise and other potential impacts.

4.5. Archeological Studies

Archeological sites or findings must be detected and protected before any field intervention; of course, trying to establish a wind farm on an archeologically significant location may delay or even kill a project. This is particularly important in Brazil, as many potential eolic sites or associated electrical connections are located on regions known to contain heritage relics, as the Igaporã (Bahia) or Serra da Capivara (Piauí).



4.6. Geological/topological studies

As any construction, it is necessary to perform the geological/topological studies not only to guarantee construction stability, but also to prevent soil movements or groundwater contamination. This topic is especially important on Brazilian northeastern coastal and southern lagoons terrain, where soil/vegetation equilibrium is fragile and construction may negatively interfere with groundwater.

4.7. Infrastructure analysis

No project will be successful without proper infrastructure. It is necessary to assess important topics as

- Manufacturers availability – ensuring adequate equipment be available at a reasonable cost

- Supply chain quality – yielding reliable equipment, which will not fail to deliver expected performance

- Human resources – which will require the construction of a previously non-existing group of skilled professionals,

- Transportation – a challenge, considering the possible unavailability of local ports, necessity of transporting enormous towers and blades trhough small local roads, etc. In some villages even water is a scarce resource

- Workers and public health/safety – it will be necessary to transform possibly impoverished areas into prosperous villages; education will be the key word

4.8. Preliminary business plan

The preliminary business plan corresponds to a basic assessment of project costs, revenue, financing, internal return rate, payback, etc. It is important to notice that a good design must take into account market regulations, opportunity costs, climatological risks and possible portfolios with different sources or plants.

4.9. Wind Farm Concession

The authorization for eolic energy exploitation is granted by the National Electrical Energy Agency (Agência Nacional de Energia Elétrica – ANEEL). The necessary procedure is described in [21] and requires

- Technical qualification: project characterization, including location, terrain, technical specifications, electrical studies, etc.

- Legal qualification: shareholders, Memorandum of Association, project responsible, etc.

- Land property registries attesting ownership

- Environment permits according with project status (preliminary, installation or operation)

- Studies proving the non-interference of the project on already existing or authorized wind farms

- Certification from the electrical authority (usually the National System Operator ONS) attesting feasibility of grid connection (which will require basic electrical studies)

- Expected generation – based on historical certified measurements (one year for grant applications filed by 2012, three years for applications thereafter)

- Complete schedule of project development (construction, commissioning and operation), including environment permits.

4.10. Construction

Construction phase transforms dreams in reality. Although each project will follow its specific schedules according to owners availability and necessities, it is possible to envision a typical implementation cycle in terms of timeline and costs, displayed on Figure 24 and Figure 25.

Of course, these figures do not assume anomalous events, such as infra-structure bottlenecks, manufacturers' delays, archeological findings, local community resistance, and so on. A good conceptual study will help preventing these inconveniences and keep schedule on time.

Figure 24 – Project timeline (obtained from Rio Energy)

	MONTHS																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Installation permit																		
Construction site establishment (terrain preparation, building roads/platforms)																		
Structural works																		
Substation construction																		
Concrete production																		
Tower/blade assembly																		
Operation permit																		
Comissioning																		
Operation (test mode)																		
Commercial operation																		

Figure 25 – Project costs breakdown (obtained from PacificHydro Brazil)

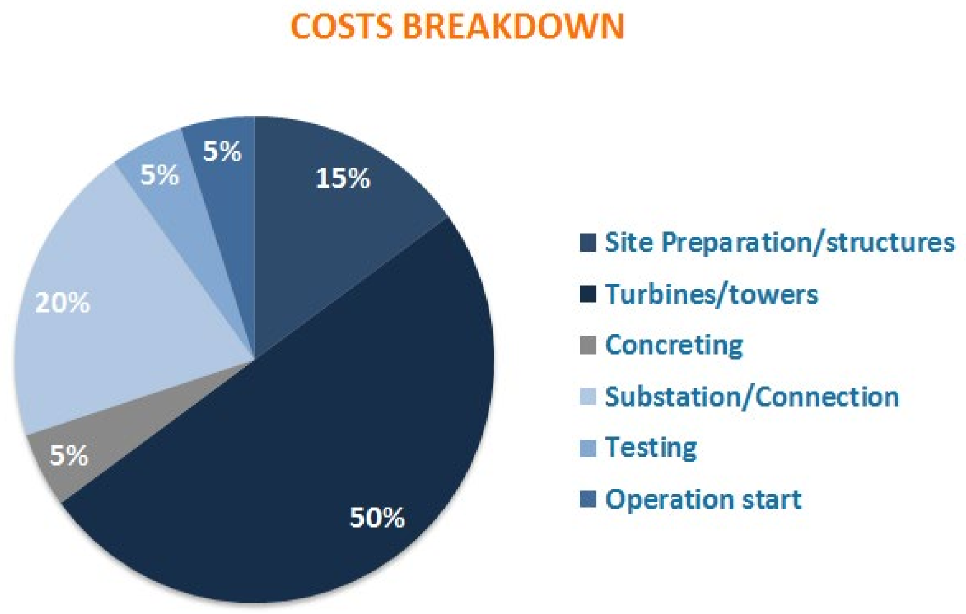


Figure 26 – Asembly of Parazinho, Rio Grande do Norte

5. MAIN BENEFITS

This chapter discusses the benefits of the construction of wind farms in Brazil, with a special focus on socio-economic impacts and community daily life improvements.

Abstract

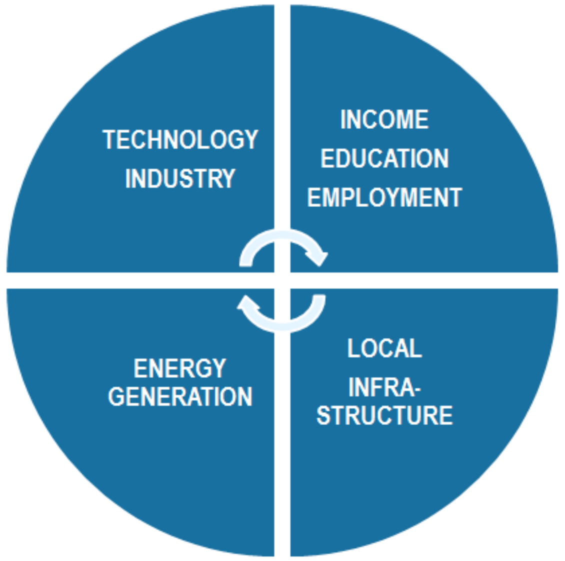
Most of the best Brazilian eolic sites are located on remote regions, some of which had previously no access to basic needs such as clean water and sanitation. For these populations, living on the edge of modern facilities, the entrance of wind farms meant progress and development.

This chapter will show the profound modifications on these communities' lives, some of which were literally introduced to the XXI century.

5.1. The main achievements

Figure 27 presents the development cycle (with feedback) introduced by the arrival of wind farm complexes in a remote Brazilian community.

Figure 27 – Development cycle –brought by wind farms



This report will discuss the overall benefits through some well-known actions and examples. We do not (and could not) intend to be comprehensive and list the thousands of initiatives carried out by the hundreds of investors and manufacturers. For the sake of fairness and avoiding advertisement, no brands or companies will be mentioned.

5.2. Technology and Industry

The first accomplishment is the development of a national industry capacity, leading to technological advances and innovation. Federal and State governments have built a comprehensive chain of incentives, targeting the establishment of a genuine national industry.

Disregarding eventual mishaps, the programs have been successful. Most of the main manufacturers are already established in Brazil. Bahia state has achieved the complete eolic supply chain and Ceará/Rio Grande do Sul are on their way.

Northeastern universities, who have struggled in the past with lack of funds, see their research flourishing. Some well-known examples are the Wind tunnel of Federal University of Ceara (UFCE) and the ever-growing production of research groups of Campina Grande (UFCG), Natal (Campus João Câmara) Pernambuco (UFPE) and Bahia (UFBA), including the Reconcavo University.

5.3. Income

The first perceived impact is, of course, the income raise. Land owners – sometimes merely settlers, since property is seldom legally established – have rented (sometimes leased) their land without modification of their use. For instance, subsistence farming was not affected, homes were not moved (Figure 28) and larger owners could continue raising their cattle without significant disturbance (Figure 29). As a rule of the thumb, 70% of the residents were assisted regarding the legalization of their land.

Figure 28 – Local resident

Figure 29 – Cattle/wind farms

5.4. Education

With income, comes higher expectations, which cannot be reached without education. Most of the best successful actions are the improvement of school teachers' skills and specialization, as well as adult literacy.

Figure 30 – Adult literacy

Professional education is the next step – target to the industry needs (Figure 31) or simply to local skills and aspirations (Figure 32)

Figure 31 – Carpentry classes

More and more actions cover tourism, biodiversity and agreements with local universities for the research, custody and protection of archeological heritage (Figure 33).

Figure 32 – Sewing classes

Figure 33 – Documentation of rupestrian paintings

A further step targets the formation of resources specialized for the eolic industry. An association of CTGAS-ER (Gas/Renewable technological center of the Brazilian Oil Company (PETROBRÁS)) and SENAI (National Service of Industrial Learning) has formed the first group of teachers from 10 Brazilian states as specialized trainers on Wind Energy Leveling. The goal is to match and complement the knowledge about the technology of wind turbines, operation and maintenance of wind farms in order to prepare these teachers for the dissemination of technological information throughout the country.

5.5. Employment

Recent studies [22] show that the eolic energy has a significant potential for employment in Brazil. Figure 34, extracted from this reference, shows that, until year 2020, almost 200.000 new jobs will be created, of which almost 80% correspond to direct jobs.

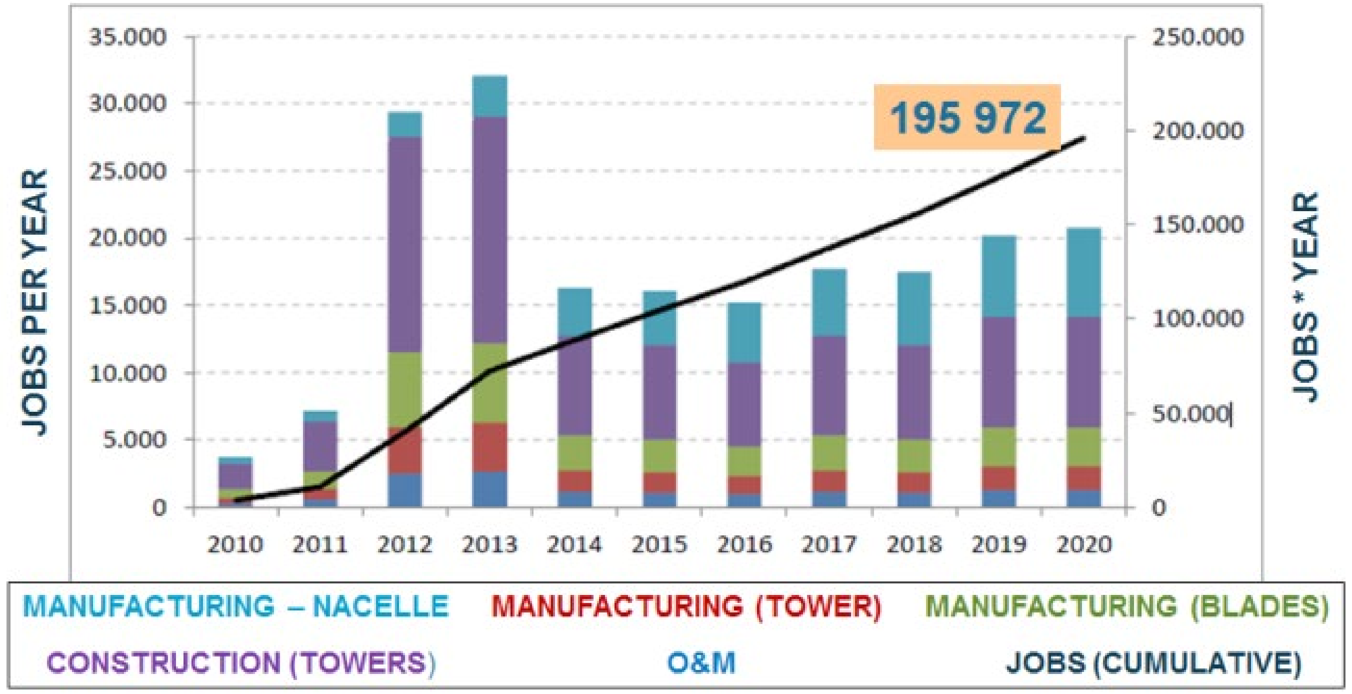
From sustainability point of view, it is important to notice that 52% of total jobs correspond to construction and building, which do not require highly specialization. In other words, there is a perspective of 100.000 new jobs for the local communities (trained by the investors) – which do not usually enjoy other economic opportunities.

Although a strong development opportunity, however, these jobs are temporary, as construction only lasts two-three years. The permanent jobs, directed to O&M (only 4% of the total), last longer – typically the plant useful life, initially estimated as 20 years (may be much more). These are the "high quality" jobs: comprise climatologists, environment specialists, high-end graduated professionals.

This situation, however, is far from ideal. It is important to observe that the initial economic "boom" will not last forever. Beyond income associated to land owners, there is no guarantee of a sustained economy growth. Therefore, it will be important to take this opportunity of resources, education and infra-structure creation (roads, for instance) to launch some more activities able to continue the region development – as tourism, handicraft, agriculture or other local industry production.

Another important concern is the transformation of small communities in busy spots, concentrating income and opportunities. If not properly controlled, this sprawl may attract newcomers, not always desirable – such as violence, drugs or alcohol. These problems may be even amplified as the projects are ready and opportunities decrease.

It will be necessary a careful observation, together with preventive measures, in order to create solutions before problems occur.



5.6.Infrastructure

Most wind farms are built on remote and isolated locations, with poor (or even nonexistent) road or rail access. The entrepreneurs were forced to build roads capable of carrying wind blades and towers, as well as all equipment and accessories needed for their construction and operation.

A compilation from the Brazilian Eolic Energy Association (ABEeolica) [23] shows expressive numbers. The Brazilian wind expansion will require 1000 new turbines and towers, 3000 blades and 10.000 truck trips to carry them to the most remote parts of the country – which, in turn, requires efficient ports and roads wide enough (and plane enough) to ensure an adequate transport.

This is not an easy task, especially when it comes to roads. They must pass by virgin lands, eventually protected sanctuaries; clearing the paths may lead to deforestation. In summary, it is important to observe if the green energy will not be achieved through non-sustainable practices.

Anyway, when (and if) road network is ready, communities associated to eolic energy will no longer be isolated. As previously discussed, progress comes with responsibility: it will be necessary to carefully monitor the consequent migrations, creating local infrastructure (potable water, sanitization, education, health and employment are only some of the basic needs to be provided).

On the other side, communication with the outside world generates a world of new opportunities – which, with the help of the initial income brought by the wind, may lead to a sustainable development process.

Figure 35 – Trairi Wind Farm, Rio Grande do Norte

6. OVERALL VIEW

This chapter discusses the challenges of the eolic energy in Brazil: social, economic and environmental (visual, acoustic, fauna/flora impacts), as well as possible mitigation actions.

Abstract

As all other themes, wind farms are not a complete unanimity. Beloved by many environmental activists, eolic energy is also rejected by a (small) part of the population, which fears negative impacts.

This chapter discusses the main challenges of this source from a Brazilian point of view, pointing out possible problems and ways to overcome them.

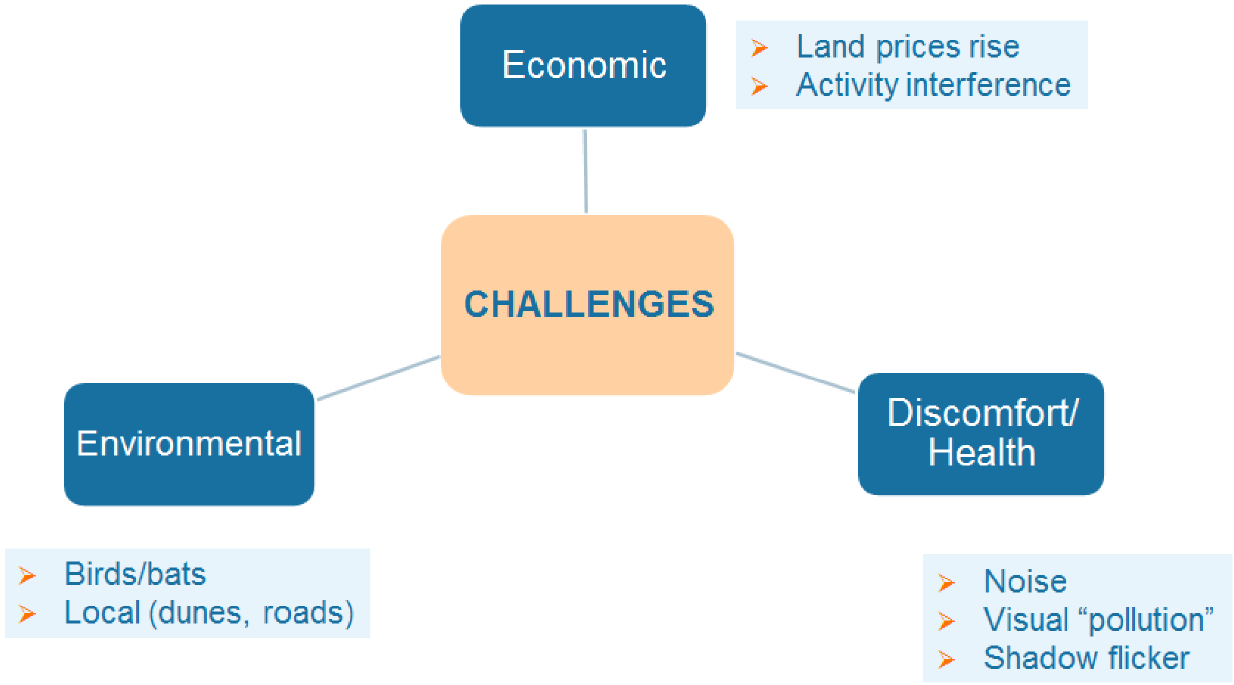
Figure 36 presents the possible negative impacts of a wind farm – again, focusing the Brazilian characteristics (this report will not cover, for instance, ice throw).

6.1.Economic challenges

Economic issues arise from interference on already established status quo. It is the case, for instance, of coastal touristic regions, where eolic generation is perceived as a danger to the traditional activity: land prices will rise, visitors may consider wind farms an aggression against nature. The once beach paradise may lose its appeal and tourists may cease to come. There is a natural reaction against the newcomer, which will only fade by patience and persuasion. One possible argument is the improvement on energy quality and supply, essential for any economic activity.

Social, economic, environmental and health aspects interact and, if problems are not mitigated from the very beginning, may lead to a severe rejection among an entire community, sometimes making it impossible to implement the project.

Figure 36 – Wind farms possible negative impact



Some of these impacts reach more than one category – for instance, environmental aggressions may produce discomfort or health problems. For the sake of simplicity, this report will perform a separate analysis of each factor, admitting that the combination will be straightforward.

Community expectations are another challenge. The population expects, with the coming of wind energy, a better life and a distribution of wealth that reaches everyone. Failure to meet these expectations implies, inevitably, in a strong rejection.

6.2. Discomfort/Health

There is a significant claim against some “side-effects” of wind farms, even an unclear “Wind-farm sickness”.

Of course, it is difficult to establish a clear limit between annoyance and a threat to health. Discomfort may disturb a night sleep and pave the way to health diseases. On the other hand, tolerance varies from person to person and from culture to culture.

This report will focus this issue from the Brazilian point of view, including community complaints and/or specific legislations.

6.3. Noise

The first effect – the typical noise, in many places louder at night, when winds are stronger – was the first villain to be fought. Brazilian legislation establishes a maximum 40 db(a) level during daytime and a maximum 32 db(a) by night at 200m distance from the farms. Many entrepreneurs agree that they fail to comply with these requirements. It must however be said that no known complaints have been made about the subject, and no tourist site claim to be affected.

Moreover, technology has improved along the time, and new generators are much more silent than the older ones. Modern equipment, together with good and careful relationship with local communities has helped setting up differences and finding satisfactory solutions.

6.4. Shadow flicker

Shadow flicker is the flickering effect caused when rotating wind turbine blades periodically cast shadows through constrained openings such as the windows of neighbouring properties.

It may be really disturbing and, on sensitive people, may cause some discomfort or even reactions. There is no known significant complaint about shadow flicker in Brazil, and it may be avoided by a careful planning. There are reported cases of families who agreed to move to newer houses, as their original homes could be impacted by this effect.

6.5. Visual pollution

Visual taste is of course subjective, and perceptions will vary. The main complaint about visual pollution usually applies to old plants, mounted on old-fashioned lattice towers and poorly spaced. This is not the Brazilian case, where equipment is modern and even perceived as elegant.

However, there is a serious concern about the installation sites. The first farms were displaced right on the coast, sometimes blocking ocean view or in the middle of tourist attractions. As society learns from experience and becomes better organized, it is expected that these episodes will not recur in the future.

6.6. Environmental

The main environmental concern is the construction over protected sites, as the famous northeastern dunes. The first projects, targeting the best winds, were located over natural coastal dune cascades (at that time

Figure 37 – Lençois, Maranhão

unprotected) spoiling a natural and invaluable heritage. These constructs sparked a wave of protests, which are expected to grow over time, delaying or preventing predatory land use

Different points of view will always co-exist, and not all communities are aware of their treasures. Maranhão state is beginning to receive (and welcome) their first wind farms [24]. Population – most of them still under lack of employment and opportunities, see eolic plants as a long-dreamed way to progress [25].

For instance, in the very remote community of Atins, at the coastal dunes of Maranhão, where time seems to be still and electric energy did not yet reach every home, people seems to welcome wind farms. This village, on the frontier of one of the most renowned protected Brazilian park Lençois, is reported to be longing for the improvements to be brought by new eolic projects [26].

The second concern focuses migratory birds and bat colonies. Although low winds, as the Brazilian pattern, represent a less lethal threat, there is still danger to some species which require special attention.

Migratory birds may collide with eolic blades, causing instant death or severe injuries. Bats, besides collision risks, are severely affected by disorientation possibly caused by turbine noise. Moreover they may also be killed by lung hemorrhage, when suddenly passing through a low air pressure region surrounding the turbine blade tips. For some (still) uknown reason, the Brazilian freetailed bat appears to be vulnerable.

There are a number of proposed mitigation actions under investigation. One – the simpler – is just preventing the construction of wind farms near migratory bird routes or bat colonies. More sophisticated solutions, as special color paintings or ultrasound devices, are being discussed and may be adopted in a near future.

7. SYSTEM INTEGRATION

This chapter discusses the integration of wind farms to the electrical grid, including the smart grid concept and future trends.

Abstract

The integration of wind farms to the electric network requires expertise and care. As an intermittent source, eolic energy needs the complement of special studies and equipment to compensate for its natural fluctuation output.

However, the future of this integration is much broader. The current network is on the edge of a paradigm shift: the smart grid concept, which will open the doors to the infinite possibilities. The future system will be based on virtual plants, combin¬ing renewables, distributed generation and the cutting edge electronic devices to create a "liv¬ing network" able to "evaluate" availabilities, "project" scenarios, "sense" consumers' needs and find the best operation point at each moment.

7.1. Grid integration

An uncertain and volatile source of energy as a wind farm cannot be connected to an electrical grid without a set of comprehensive studies. It is important to assess the impacts of wind farms on the utility transmission and distribution systems [27]

This document does not intend to cover specialized electric details, which might be unnecessary or even hard to comprehend by a wider audience. Instead, this report will offer a brief description of possible electrical problems and mitigations via regulatory requirements (known as "grid codes"). The interested reader will find a full overview in [28].

7.2. Voltage and reactive power control

Brazilian grid exhibits a continental dimension. Therefore, a voltage drop may "travel" long distances, "reach" the eolic plant and disconnect it from the system. If a large number of farms are concentrated at the same area (as is the case of Northeastern coast), a system fault could trigger a significant amount of generation from the system, and lead to a generalized loss of load. Therefore, adequate control must be installed in order to prevent protection against voltage collapse.

7.3. Frequency control

The consequence of a mismatch between the active power supply (generation) and demand (load) is a change in the plants' rotational energy, and hence a drift in the system frequency. As electric equipment and appliances are designed to operate under strict frequency limits, a frequency drift may produce generalized damage throughout the system. Customized equipment must be used to avoid this threat.

Moreover, it would not be acceptable that a generation fault caused a frequency unbalance, most systems use a generator as "spinning reserve", able to cover these situations.

7.4. Fault ride-through capability

During a short-circuit, the voltage on the faulted phases is null. A large voltage depression would propagate across large areas

until the fault is cleared by the opening of circuit-breakers. Extensive studies have shown that some wind turbine technologies are particularly susceptible to tripping, and would again disconnect from the system.

Wind plants are required to provide fault ride through capability by a set of equipment/ control procedures, sometimes required by the system operation authority (in Brazil, the National System Operation, ONS).

7.5. Harmonic distortion

Some specific characteristics of selected wind technologies, based on rotational variation, may introduce harmonics into the network – which is seen as a source of electric "pollution", causing malfunctions on many different appliances. In this case, it will be necessary to install adequate filters to "clean" the signals and ensure a good energy quality.

7.6. Grid codes

The National System Operator created a working group [29] for the Improvement of the Eolic Plants Integration Requirements, which will define and detail the necessary studies and procedures to be taken before the interconnection permission is granted.

7.7. Forecasting models

One of the most important (and more difficult) challenges of operating a set of interconnected wind farms is the uncertainty about future availability. Besides the current on-going research on different universities and centers, National System Operator created a special international cooperation between the Federal University of Pernambuco and INESC (Portugal) targeting a model customized for the Brazilian necessities and characteristics.

7.8. Building the future

7.9. The new consumer

The new consumer will not remain passive. He will take control, manage his load, chose the desired supply sources at desired prices. Energy ceases to be a service, becoming a product of necessity and / or convenience. The new consumer will ride an electric car, install photovoltaic panels or wind turbines on his yard and closely monitor his consumption and costs.

7.10. The new suppliers

New suppliers will surf a new ocean. New technologies will open different opportunities and different energy sources. Renewables, specially wind, will play the "star" role on available resources. Thermal units will embrace carbon capture technologies, thus mitigating emissions.

Worth mentioning, consumers may be their own suppliers, at least partially. Through virtual plants concept, every consumer is also a potential generator. Electric cars will "take" energy from the grid, "store" it (inside their batteries) and "return" it back (or, at least, their excess) wherever and whenever needed.

7.11. The new grid

The key for the success of this concept is the intelligent grid [30]. A set of sensors and adjustment equipment, managed by customized and efficient optimization models and programs, will be able to act like a living organism. The grid will forecast renewable generation, evaluate uncertainties, discover consumers' needs and manage the network to continuously adjust generation and load.

Consumer's generators (if any), electrical cars and suppliers will be coordinated by a centralized dispatch, which "sees" every component as a virtual plant. Price-driven mechanisms will direct correct signals and incentives so every consumer will make their own choices.

7.12. Wind plants and smart grids

One of the main targets of a smart grid environment is to make an intelligent use of all available renewable resources – including, of course, wind plants. The grid will "create" complementary options (electric vehicle batteries, hydro plants, etc.) in order to supply during low generation outputs. Conversely, when availability reaches its peak, the whole grid will be able to absorb the excess energy and store it by convenient ways.

7.13. Concrete actions

Led by a European Union-funded consortium, the EcoGrid EU project is being implemented on the Danish island of Bornholm [31]. 2000 households will be connected to a smart network that will enable homeowners, from their cell phones, to cut back their electricity usage at times of peak demand and sell excess energy back to the grid at market rates. The "soul" of this system will be a smart grid, able to instantly control the whole island energy resources (52% renewable at this time) and new fleet of electric vehicles.

In Brazil, some pilot projects – not as ambitious as the EcoGrid – are being implemented on different Brazilian cities. Buzios, in Rio de Janeiro (Light) and Aparecida, in São Paulo (EPD) are some of the pilot experiences on consumption reduction and smart metering (the consumer is able to monitor his load and, in some cases, take some management actions).

Buzios, Brazil

8. EDUCATION AND RESEARCH

This chapter discusses the need for research and innovation. There is still a complete world to discover and a whole future to build.

Brazilian challenges are unique, and require specific solutions, which may only be achieved by education, research and innovation

Abstract

Eolic energy is still a novice, and there is a whole road to pave. It is interesting to observe that, in Brazil, we are beginning almost from scratch. We need to study our wind characteristics, design system and market integration rules and regulations, build plants and blades really adequate to our climatological characteristics.

A set of integrated actions, directing and supporting the necessary research will significant contribute to build a national knowledge capacity, able to generate customized solutions for our problems.

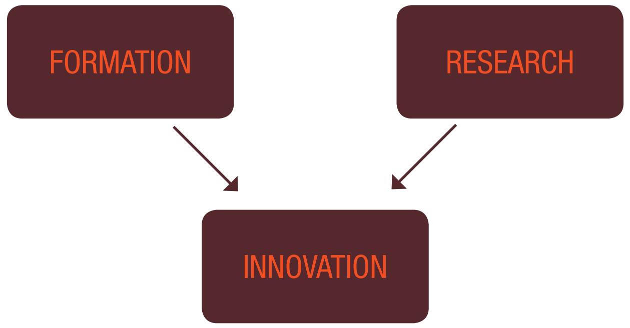
8.1. The Need of Innovation

Brazilian winds are unique. They are smooth, constant, dependable. Therefore, Brazilian wind generation is also unique, and deserves a special thought – from climatological to market issues, from manufacturing to social and economic aspects. It is time to start building a solid, reliable and sustainable eolic framework, able to respond to the country necessities.

8.2. The basis for Innovation

The basis for achieving innovation relies on a simple combination: Professional formation and scientific research. Without research, there is no advance; and without a well-prepared team no research results transform into reality.

Figure 38 – Innovation basis



8.3 Professional formation

There is a severe shortage on wind experts, as well as skilled technicians. Most learn with practice, without a formal learning evolution. It is important to tighten the bonds of international cooperation and form multiplication vectors – professors, teachers, instructors – which in turn will form the new generation of eolic professionals.

8.4. Scientific Research

Scientific research, as carried out in Universities, Research centers or Private companies, target creation – which is only possible if free and well-funded.

Resources concentration bring the danger of a topic "owner" – and prevent the exchange of ideas that lead to innovation.

This report will therefore mention some interesting research topics, hoping that other researchers will complement this list with further thoughts and suggestions.

8.5. Climatological research

There is no reliable prediction of unknown phenomena. It is crucial to understand our winds, their behavior, periodicities and – of course – climate changes. Long- and short-term forecasts should combine climatological and mathematical models, anticipate extreme events and mitigate uncertainties and risks.

A special attention should be directed to other sources complementarity – sun radiation, water inflows, etc. This characteristic may be used to build a combined portfolio, yielding a constant generation, suited to the country's necessities.

8.6. Environment research

Most environmental challenges still claim for a solution. There is still no noise reduction technology; There is no sound comprehension of the wind farm's appeal over some species of bats and birds – and how to block it. This is a multidisciplinary topic, embracing different sciences (engineering, mathematics, biologists, chemical, etc.)

8.7. Social and Economic research

Wind farms are generally situated on distant, disadvantaged communities. Moreover, these communities may experience a sudden "wealth" during wind farm implantation, which may be followed by a (unexpected) decay.

We suggest that a careful socio-economic work, if possible from the very beginning, will enable this population to benefit from present and future opportunities.

8.8. Industry and Manufacturing

As mentioned, Brazilian winds exhibit unique characteristics, and its performance would be higher with a better plant design. A customized blade would certainly offer a better yield and even higher efficiency.

Batteries are another open topic. Wind uncertainty cannot be controlled, but its impacts would be much lower with an efficient storage capacity.

8.9. Electrical Studies

Grid integration is still underway and is an open problem. Electrical adequacy may only be measured by a set of specific electrical studies – still to be designed, simulated and validated.

Inteligent grids are a step forward: adapting to new paradigms will require a considerable effort, not yet completely envisioned.

8.10. Regulatory Studies

Since the emergence of eolic energy, the wind farms exploded. This huge success, however, pays its price. Rules and regulations are made almost "by the fly", following identified necessities.

There is a need of a sound market design, targeting not only the present but most of all the future. Grid codes, smart grids, distributed generation, different source complementarities are only the tip of the iceberg. New challenges claim for new solutions, and the sooner we start the better.

8.11. Current actions

There is a coordinated action between the Regulatory agency (ANEEL) and the Brazilian Eolic Energy Association (ABEeolica) to form a research network, which would serve as a privileged link between researchers and innovation users. This initiative is still at scratch, and, when fully operational, may be an important repository of the sector knowledge.

Another interesting idea, which seems still in preparation, is the launch of a strategic R&D project by ANEEL, raising research directions and funds.

There are currently infinite opportunities of new developments and advances, waiting for a tighter approach between final users and the scientific community.

9. CONCLUSIONS

Brazilian winds offer an exceptional quality, and have attracted a growing number of investors seeking to exploit a clean and profitable source of energy.

Wind penetration in the Brazilian matrix has been surprisingly fast. New farms seem to grow continuously, sown by incentives from state and local governments, who perceive them as the opportunity to a new era of progress and wealth. Moreover, specific local characteristics demand customized solutions, creating the conditions for the flourishment of a new class of knowledge, encompassing technical, economic, social and environmental professionals.

This new reality requires a fast learning and a coordinated global and regional planning. It will be necessary to prepare the country, and the society, for the already on-going changes. It is necessary to implement wide, cross-actions, encompassing research/development, education, economic/social welfare, environmental and cultural heritage protection.

Finally, population and communities must fully understand the changes in their lives. Wealth must be used wisely, targeting not only the immediate improvements, but future developments.

If well designed, the Brazilian society will not have to wait for the future generations to see the benefits of the clean energy: this step forward may begin today.

Figure 39 - Wind Farm Palmares do Sul, Rio Grande do Sul

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CAPÍTULO 5

CONCLUSÕES CONJUNTAS - ENERGIA EÓLICA -

Leontina Pinto e Juan Ramón Martínez

JOINT CONCLUSIONS - EOLIC ENERGY

Leontina Pinto e Juan Ramón Martínez

These pages intent to gather some recommendations addressed to foster wind power development in Brazil. They draw on European experience and best practices as far as this renewable energy technology is concerned and stem from the conclusions of the two reports prepared for the project "Fomento à Geração Sustentável de Energia Eólica – CLIM0003", commissioned by the Brazilian Ministry of Environment within the framework of the EU-Brazil Sector Dialogues. The reports, entitled "Fomento à Geração Sustentável de Energia Eólica" and "European Wind Power – Barriers & Best practices for its Sustainable Development", have been produced by Leontina Pinto and Juan Martinez respectively.

Concerning technical and technological recommendations, the Brazilian energy sector may benefit from the analysis of EU experience, where the main pillar of its RD&D structure is the EU Strategic Energy Technology Plan (SET-Plan), whose role is to establish an energy technology policy for Europe. This is a strategic plan to accelerate the development and deployment of cost-effective low carbon technologies. It comprises measures related to planning, implementation, resources and international cooperation in the field of energy technology.

More specifically, concerning wind power, the European Wind Initiative (EWI), rooted in the SET-Plan, is a long-term, large-scale programme for improving and increasing funding to EU wind energy RD&D. Its purpose is to involve the industrial sector, public and private institutions and governments in the identification of priorities, objectives and activities as regards RD&D for wind energy, so as to make wind one of the cheapest sources of electricity and to enable a smooth and effective integration of massive amounts of wind electricity into the grid. The EWI coordinates public and private funding, gives funding recommendations and issues implementation plans and yearly work programmes.

In fact, Brazil's track is following this path. Apart from each State's independent programs, the Federal Government has, among other initiatives, launched the "Brazil Sustainable" plan, comprising economic, environmental and social aspects. Energy (smart grids, renewable energy / biofuels, electric cars and efficiency) is one of its main streams. The overall funding (covering energy, transportation and production) starts from an initial value of R$ 2 billion, directed to corporate loans (R$1.5 bi) and direct subsides (R$.5 bi).

Apart from funding, however, the wind energy sector (and maybe the whole renewable sector) might benefit for some coordination, establishing a dialog able to link the different parts of the whole process: planning, operation, regulation, sustainability, etc. As regards policy and regulatory practices, it is therefore suggested setting up a national renewable energy public authority or committee, whose roles might include the dialog and interaction with funding, regulatory, planning, operating and environment agents. This authority would propose the directions of R&D, development, demonstration or dissemination programmes in the fields of renewable energy; raising public awareness; providing institutional support and technical advice to the government; establishing a closer and more fluid communication between the public and private sectors; etc. This authority could be seen as the public voice concerning the renewable energy sector, and should work together with Brazilian industry associations in the identification of barriers to wind energy deployment and possible solutions, in communicating the benefits and potential of wind energy to decision makers, businesses, the media, the public, NGOs and other stakeholders; etc.

A special focus on local necessities is strongly recommended, regarding Brazilian wind characteristics and best equipment to exploit it; also long-term history recomposition, to account for the relatively small measurement time series; social/economic sustainability necessities and initiatives, targeted not only for the present but also for the future, when the economic construction boom will be over; fauna/flora impacts and mitigation; environmental impacts, including transparent and well-understood rules and constraints as regards system generation and transmission integration, balancing costs and emission reduction, market integration and energy trading, looking for pricing schemes able to allow a self-sustainable penetration.

In order to avoid present and future administrative and grid connection barriers to the high-deployment of wind energy in Brazil, it is suggested a careful, long-term spatial planning, defining the most appropriate locations for onshore and offshore wind development areas, based on wind resource, technical, socio-economic, infrastructure and environmental factors. This will lower investments risks and will streamline project application procedures. For this purpose, it will be necessary to perform a good assessment of the country's real resources and establish their best exploitation. A key issue is the concession concept, which is different than the applied to hydroelectric generation. These permits, without a centralized coordination, may negatively impact on the optimum energy deployment for the country.

After the PROINFA programme, the succeeding Brazilian auction system currently in force already features some of the European best practices and lessons learnt, i.e. financial penalties can potentially be applied for delays in project delivery[41]; it has shown continuity, yielding a considerable project pipeline and creating a well-established local supply chain; it has provided high flexibility as far as price adaptation to external cost reduction is concerned; etc.

However, some analysts fear that such low prices achieved during the latest auctions won't be high enough to guarantee economic feasibility of the projects, thereby hindering or stopping their implementation. As demand in the last auction was very low, it is difficult to envisage a further price drop or an anomalous event caused by the lack of buyers. The new auction, expected for mid-2013 will enlighten this issue, since a huge demand is expected this time. Regulatory stability is still an important challenge. Continuous, unexpected changes on investment and commercial regulations send contradictory signals and may pose a barrier for the entrance of new players.

Although large wind farm penetration is quickly growing, distributed wind generation is still a challenge and seems to deserve close attention. In this case, a well-designed Feed-in tariff (FIT) or Feed-in premium (FIP) support mechanism might provide the necessary boost and has been the primary choice for large-scale wind power deployment amongst European Member States. The main characteristics of the system could comprise:

41. So far there has been no enforcement of these penalties because extensions have been granted to delayed projects

- Guaranteed grid access and priority of dispatch.

- Stepped tariff design: differentiation of tariffs based on project size and wind yield, which avoids windfall profits and allows sites with less favourable conditions to be exploited, hence fostering geographical spread (which favours grid integration) and technological developments aimed at efficiently harnessing low wind speeds.

- Regular long-term design evaluations and short-term payment level adjustments, with incremental automatically defined tariff degressions built into law: this characteristic provides cost-efficiency, price flexibility to external costs variations and transparency.

- Tariffs guaranteed for a long enough time period to ensure adequate rate of return, addressed at increasing projects' economic feasibility.
- High-enough, mandatory target setting is a key feature, since it would send clear signals regarding the reliability and level of commitment of the Brazilian government's support policies.

- Finally, switching from a FIT to a FIP scheme when the wind energy market has achieved a certain level of maturity would improve the mechanism's market compatibility.

As wind energy share rises in the Brazilian electricity mix, short-term flexible balancing, operation, management and control will become increasingly important as far as grid integration of this technology is concerned. Along these lines, innovative wind farm operational control, involving a control unit between system operators and wind farm clusters has shown in Europe to considerably improve wind farm control strategies; and it has become a crucial practice in order for the grid to safely accept high volumes of electricity from the wind. This control strategy, together with the flexible and quick-response Brazilian hydro generation, would allow high wind power penetration into its electricity mix under secure conditions.

Moreover, additional investments in upgrading and extending the transmission and distribution grids would allow wind farms to be effectively connected to the power network and transport the produced power to load centres. In the meantime, there is number of attractive short term actions used in some European countries that can optimise the use of the existing infrastructure and transmission corridors and do not involve excessive expenditure, but instead, avoid or postpone more costly network investments. They involve dynamic line rating with temperature monitoring; rewiring with high temperature conductors; installing Flexible AC Transmission Systems (FACTs); etc.

Regarding technological aspects of wind turbines and compliance with grid codes, the so-called type D turbine configuration[42] allows easier compliance with the most demanding European grid "fault ride-through" capabilities required by recent grid codes. This could be a good starting point, but grid codes and technological characteristics should be adapted to Brazilian weather patterns and its TSO's technical rules and operating requirements in order to ensure Brazilian grid stability and quality of service

Environmental, social and attitudinal barriers are a significant source of concern for wind energy project developers. The main European best practices on this field, potentially applicable in Brazil, are built upon the following substructure elements:

- Binding environmental national and local

42. Variable speed, direct drive, and full-scale power converter with either electromagnet or permanent magnet electricity generator

legislation, especially that related to the evaluation of the effects of certain wind energy plans, programmes and projects on the environment and people;

• Search for typical mitigation strategies and plans (concerning typical problems as birds/bats, coastal impacts, local water supply/availability, social actions, etc.)

• Strategic and spatial planning, defining the most environmentally and socially suitable areas for the implementation of onshore and offshore wind energy projects.

• Promoting local ownership of wind power plants and other benefit-sharing mechanisms which, has been demonstrated, can improve public attitudes towards wind energy development and ensure buy-in from local communities.

Finally, in order to successfully implement all these recommendations, the preparation of a National Public Renewable Energy Plan or Wind Energy Plan is advised. The main purposes of a wind energy plan with firmly established objectives would include providing security to investors and fostering the development of wind energy technologies. Before setting up these objectives it is necessary to carry out specific analyses, so as to suggest concrete measures addressed to defeating previously identified obstacles. Subsequently, a designated public body, by monitoring target achievement and assessing the effects of the actions undertaken, would determine the need of applying additional corrective measures for the proper implementation of the plan.

These initial analyses are needed to lay down the foundations for the ensuing decision-making processes and conclusions, and they may involve technical, economic, social and environmental aspects. More in detail, they can comprise technological development outlooks and costs forecasts of wind energy in Brazil, studies on employment and macroeconomic impacts, on wind resource, electrical infrastructures, grid operation, etc. An important component that should be introduced alongside the preparation of the wind energy plan is the strategic environmental assessment of the plan itself. This is a preventive instrument that allows the integration of environmental aspects and objectives into the planning and decision-making process of public programmes, in order to assure their sustainability.

Another crucial aspect during the plan's elaboration before the government's approval is the consultation process, where all stakeholders need to participate, including the general public, so as to bring different perspectives to the discussion and hence reach a wider consensus. Invitations need to be extended to all economic, social and environmental actors, namely, central, regional and local public administrations (ministries, governmental agencies, etc.), industry associations, etc.

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