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Climate change and energy efficiency

CLIM0001

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25/05/2013

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

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

David Attenborough

“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

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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.

CONTENTS

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:

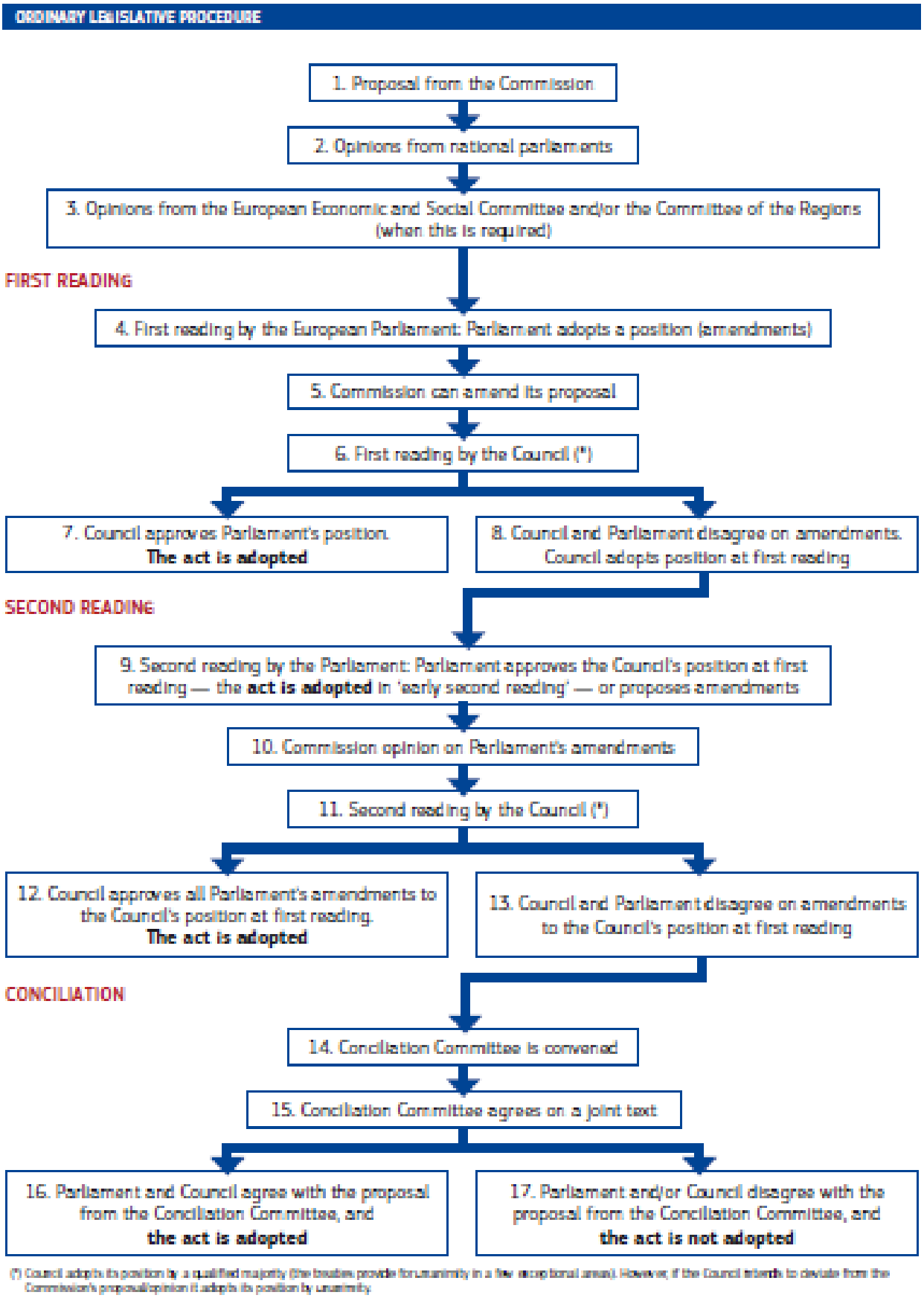
- the EU's broad priorities are set by the European Council, which brings together national and EU-level leaders
- directly elected MEPs (Members of the European Parliament) represent European citizens in the European Parliament
- the interests of the EU as a whole are promoted by the European Commission, 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:

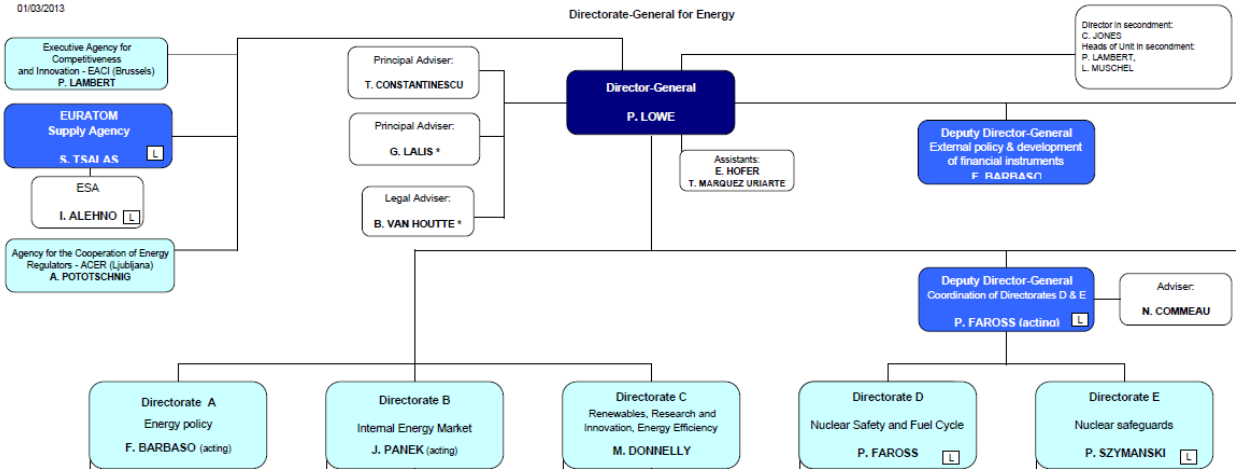
- Contributing to setting up an energy market providing citizens and business with affordable energy, competitive prices and technologically advanced energy services.
- Promoting sustainable energy production, transport and consumption in line with the EU 2020 targets and with a view to the 2050 decarbonization 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[1]. 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[2]. 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.

[1] 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).

[2] OJ L 328, 24.11.2006, p. 1.

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% CO_2 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 CO_2 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.

1.3. Member States competent authorities and their competences.

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 (CO_2) emissions and improve energy efficiency. These include: a directive to promote electricity from renewable energy, voluntary commitments by car makers to reduce CO_2 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, CO_2 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-CO_2 gases, agriculture)
- Aviation
- CO_2 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 CO_2 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 (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.

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:

- CO2 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.

The 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 CO_2 emissions avoided through CCS in 2030 could account for some 15% of the reductions required.

CO_2 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 CO_2 is routinely separated and captured as a by-product from industrial processes. Captured CO_2 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 CO_2 (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[3]. 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;

[3] COM(2011) 109 Final

- 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 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[4]. 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:

[4] 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

- 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.
- 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 CO_2 emissions in some industries that should not face a double burden from the CO_2 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 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. 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 CO_2 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 CO_2 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.
- CO_2-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 CO_2 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 CO_2 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 (CO_2)	-7%	-54 to -68%	-93 to -99%
Industry (CO_2)	-20%	-34 to -40%	-83 to -87%

Transport (incl. CO2 aviation, excl. maritime)	+30%	+20 to -9%	-54 to -67%
Residential and services (CO_2)	-12%	-37 to -53%	-88 to-91%
Agriculture (Non-CO_2)	-20%	-36 to -37%	-42 to -49%
Other Non- CO_2 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 CO_2 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 CO_2 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 CO_2 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 CO_2

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[5]:

– 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 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)[6] 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[7]

– Energy 2020 — A strategy for competitive, sustainable and secure energy[8]

– Energy Roadmap 2050[9]

– Energy Efficiency Plan 2011[10]

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[5] 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.

[6] 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).

[7] Communication from the Commission — EUROPE 2020 — A strategy for smart, sustainable and inclusive growth, COM(2010) 2020.

[8] Communication from the Commission — Energy 2020 — A strategy for competitive, sustainable and secure energy, COM(2010) 639.

[9] Communication from the Commission – Energy Roadmap 2050, SEC(2011)1565 Final

[10] COM(2011) 109 Final

– Directive on energy efficiency[11]

– Directive on the energy performance of buildings[12]

– Directive on the energy performance of buildings (recast)[13]

– Directive on cogeneration of heat and power[14]

– Directive on energy end-use efficiency and energy services[15]

– Ecodesign Directive on energy-related products[16]

– Directive on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products[17]

– Regulation on labelling of tyres with respect to fuel efficiency and other essential parameters[18]

– Energy Star Agreement[19]

– Biomass Action Plan[20]

– Renewable energy road map — Renewable energies in the 21st century: building a more sustainable future[21]

– Directive on the promotion of the use of energy from renewable sources[22]

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[11] 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

[12] Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.

[13] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings.

[14] 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.

[15] 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.

[16] 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).

[17] 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.

[18] 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.

[19] 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.

[20] Communication from the Commission — Biomass Action Plan (SEC(2005) 1573).

[21] Communication from the Commission — Renewable energy road map — Renewable energies in the 21st century: building a more sustainable future, COM (2006) 848.

– Offshore Wind Energy: Action needed to deliver on the energy policy objectives for 2020 and beyond[23]

– White Paper 'Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system'[24]

– Action Plan on Urban Mobility[25]

– Directive on the promotion of clean and energy-efficient road transport vehicles[26]

– Revised Fuel Quality Directive[27]

– Investing in the Development of Low Carbon Technologies (SET Plan)[28]

– Resource Efficiency Flagship Initiative[29]

– Roadmap for a Resource Efficiency Europe[30]

– EU's Renewed Sustainable Development Strategy[31]

– 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[32]

– 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)

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[22] 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.

[23] Communication from the Commission — Offshore Wind Energy: Action needed to deliver on the energy policy objectives for 2020 and beyond, COM(2008) 768.

[24] COM(2011) 144 Final.

[25] Communication from the Commission — Action Plan on Urban Mobility, COM(2009) 490.

[26] 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.

[27] 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.

[28] Communication from the Commission — Investing in the Development of Low Carbon Technologies (SET Plan), COM(2009)519.

[29] COM (2011) 21 final

[30] COM (2011) 571 final

[31] Review of the EU Sustainable Development Strategy, COM (2009) 400 final

[32] Regulation (EC) no 397/2009 of the European Parliament and the Council OJ L 126/3, 21 May2009.

– Communication – Renewable energy: a major player in the European energy market[33]

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.

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

[33] COM (2012) 0271 final

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 CO_2 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 (CH_4) decreased by 30.6 per cent, while emissions of nitrous oxide (N_2O) decreased by 32.9 per cent.

The share of emissions of perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6) (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 SF_6 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. CO_2 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 CO_2 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

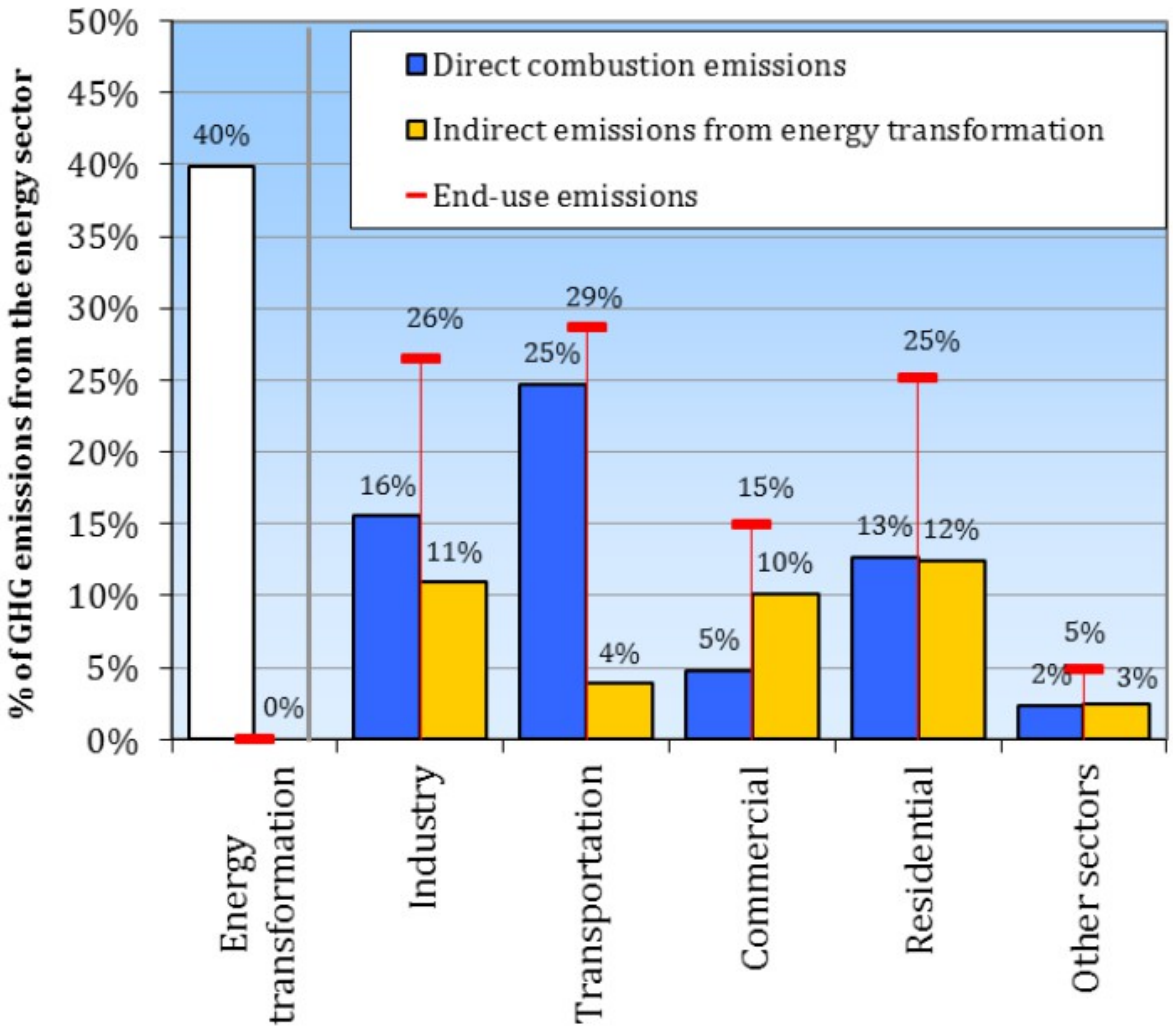
are driven mainly by the decline in the use of fertilizers and manure, and in numbers of livestock. In 2010, in the EU-15, CH_4 accounted for 44.3 per cent of agricultural emissions while N_2O accounted for 55.7 per cent. The land area under agricultural use across the EU-27 States has decreased by approximately 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 CO_2 eq in the EU-27 and of 178 Tg CO_2 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.

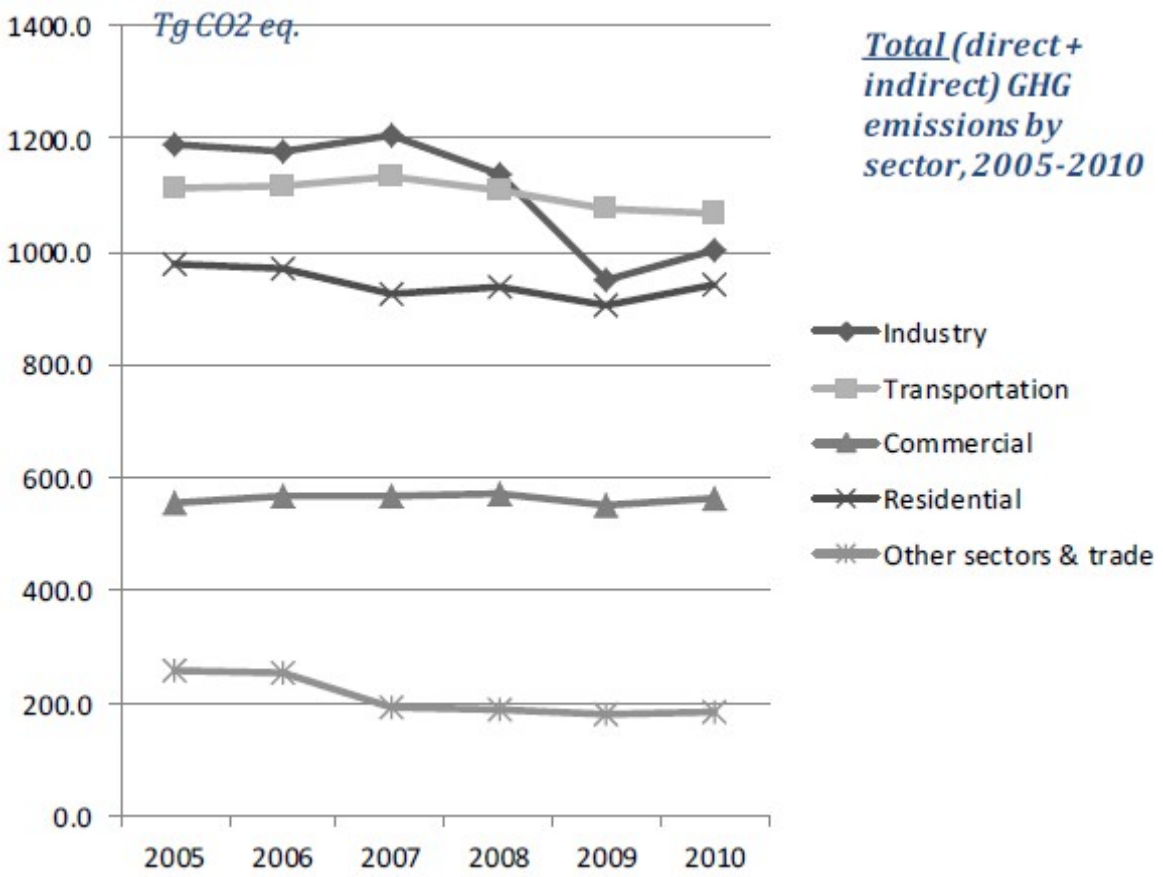
Between 1990 and 2010, GHG emissions from the waste sector decreased by 30.4 per cent in the EU-27 and by 36.7 per cent in the EU-15, mainly driven by the reduction in solid waste disposal and of biodegradable waste going to landfills, and the increase in landfill gas recovery due to the implementation 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 CO_2 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 CO_2 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
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)[34] 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.

Information, capacity building and market transformation

[34] 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 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 CO_2 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 CO_2 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 CO_2 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 CO_2 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 CO_2 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/ CO_2	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	all residential, non-energy intensive industry and services

				consumption of the company	
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	trading of energy efficiency obligations	no formal certification; no trading

			price		
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

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.

	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 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	Austria: Successfully establishing a regional Market for Third Party Finance (2001 – ongoing) Netherlands: More with Less Programme (2008-2020)	Heating and hot water systems

	time Different forms of 3 rd party financing, ranging from pay back as share of savings to financial lease	Poland: Thermo-modernisation and Renovation Fund (1999-2016)	
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

The KfW Programme for the promotion of CO_2 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 CO_2 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 CO_2 – reduction program (CO_2 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 CO_2 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 CO_2 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 CO_2 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 "CO_2 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 CO_2 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 CO_2 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 CO_2 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.

	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.
Technological	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.

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 CO_2 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.

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	High price Limited range Time to charge	Research and demonstration programmes Infrastructure investment

support new technologies	Inconvenient charging No charging points Lack of power or performance Unfamiliarity	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 CO_2 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) CO_2 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 CO_2 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 CO_2 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).

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

	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 CO_2 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

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

Range of policy options

Policy option	Barriers addressed	Policy sub-types
Research and /spending programmes to	Lack of awareness of ecodriving techniques	Eco-driving demonstration programs

support new technologies	Lack of awareness of the benefits of eco-driving	
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)

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 CO_2 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 CO_2 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 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.
- 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 (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.

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.

<u>EU policy landscape</u>

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 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. 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 CO_2 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 CO_2 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 CO_2 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 CO_2 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 CO_2 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 CO_2 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 CO_2 reduction target negotiation between companies and the federal government. Companies that reduce energy-related CO_2 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 CO_2. 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 CO_2 which is more than one third of the total CO_2 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 CO_2 free due to the hydro and nuclear mix). The target agreements achieved until 2010 amount to more than one million tonnes of CO_2 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 CO_2-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 CO_2 emissions were a little less than 2 %, as electricity demand with its higher specific CO_2 emissions increased its share in all networks. However, in one network (Ulm), the CO_2 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 CO_2 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.

<u>Status and preliminary results of the 30 Pilot Networks project in Germany</u>

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 CO_2 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 CO_2 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 CO_2 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 (CO_2 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 CO_2 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.

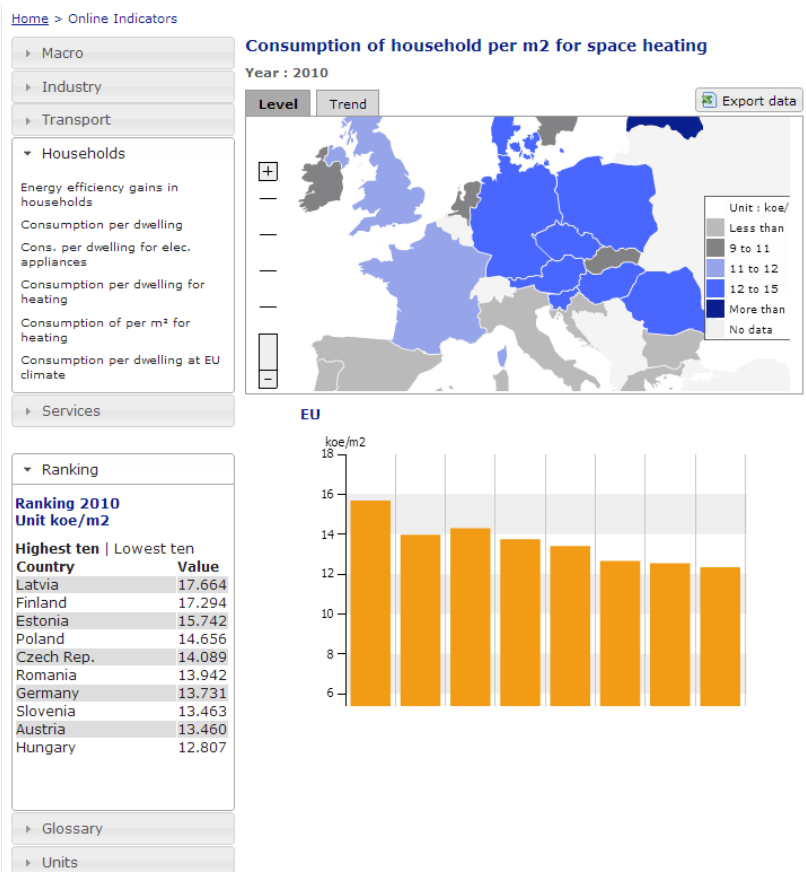
3.1.1. ODYSSEE database

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:

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 CO_2 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 CO_2 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 CO_2 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 m^2 for buildings at EU level is around 220 kWh/m^2 in 2009, with a large gap between residential (200 kWh/m^2) and non-residential (around 300 kWh/m^2).

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 m^2 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 CO_2 emission of new cars has decreased by 20% (or 2.2%/year) on average in the EU since 2000. The target of 140 g CO_2/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 CO_2 emissions continue to increase: emissions in 2010 were 21% above their 1990 levels.

3.2.6. Industry

- Energy efficiency improved rapidly between 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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