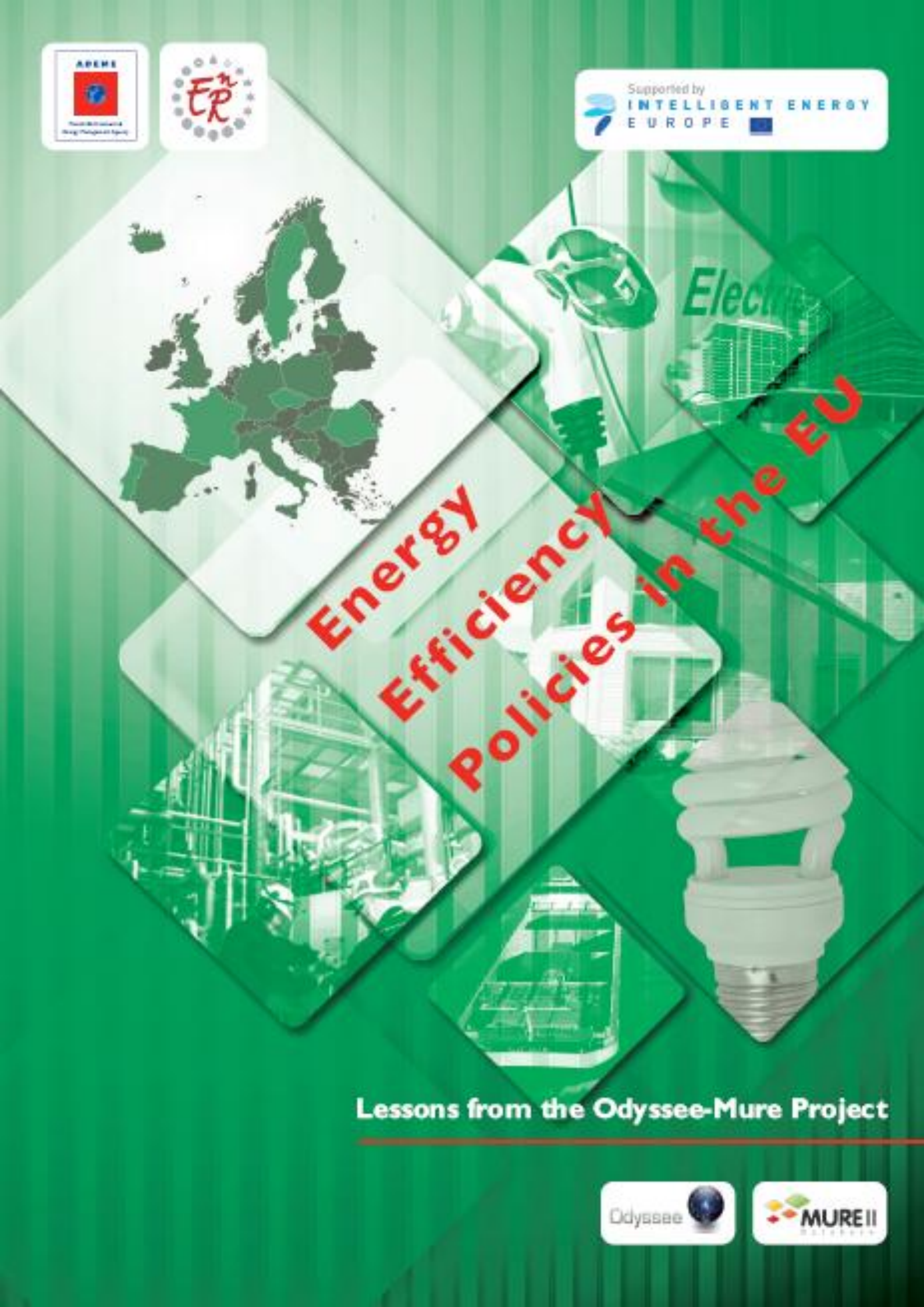

Supported by
INTELLIGENT ENERGY
EUROPE
Energy Efficiency Policies in the EU
Lessons from the Odyssee-Mure Project
Odyssee
MURE II

Acknowledgements

This publication on energy efficiency and policy monitoring was prepared within the ODYSSEE-MURE project coordinated by ADEME. It is financed under the Intelligent Energy Europe Programme with the support of 29 national institutions from 25 EU Member States, Norway and Croatia, generally with co-funding from their own governments. This study would not have been possible without the active participation of the national teams and their associated partners in terms of data supply.

This brochure was prepared by Barbara Schlomann and Wolfgang Eichhammer from the Fraunhofer Institute for Systems and Innovation Research (Fraunhofer ISI). All the information on energy efficiency indicators is taken from the MURE database and website, managed by ISIS in Italy and Fraunhofer ISI in Germany. This synthesis report draws on three sectoral reports written by MOTIVA (industry), AEA Technology (Transport) and Fraunhofer ISI (buildings).

Among the many participants in the ODYSSEE-MURE network, particular thanks are due to[1]: Reinhard Jellinek (AEA, Austria), Yvonne Baillot and Francis Altdorfer (Econotec, Belgium), Ludmil Kostadinov (EEA, Bulgaria), Helena Bozic, Branko Vuk and Dino Novosel (EIHP, Croatia), Kyriatos Kitsios (CIE, Cyprus), Jiri Spitz (Enviros, Czech Republic), Peter Dal (DEA, Denmark), Sulev Soosaar (TUT, Estonia), Martin Howley and Emer Dennehy (SEAI, Ireland), Pier Giorgio Catoni and Giulia Iorio (ENEA, Italy), Saara Elväs and Lea Gynther (Motiva, Finland), Gregory Chedin (ADEME, France), Lazlo Elek (ENCEN, Hungary), Barbara Schlomann and Wolfgang Eichhammer (Fraunhofer ISI, Germany), Minas Iatridis (CRES, Greece), Gaidis Klavs (IPE, Latvia), George Cassar (MRA, Malta), Joost Gerdes and Piet Boonekamp (ECN, the Netherlands), Eva Rosenberg (IFE, Norway), Ryszard Wnuk (KAPE, Poland), Grazyna Berent-Kowalska and Szymon Peryt (GUS, Poland), Antonio Almeida (ADENE, Portugal), Maria Rugina (Icemenerg, Romania), Jan Magyar (SIEA, Slovak Republic), Fouad Al Mansour (JSI, Slovenia), Pilar de Arriba Segurado (IDAE, Spain), Linn Stengård, Helen Lindblom, and Annika Persson (STEM, Sweden), Anne Wagner (AEA Technology, United Kingdom).

The author wishes to give special thanks to Joost Gerdes, Pilar de Arriba Segurado, Francis Altdorfer, Grazyna Berent-Kowalska, , Emer Dennehy, Joost Gerdes, Lea Gynther, Martin Howley, Reinhard Jellinek, Gaidis Klavs, Szymon Peryt and Sulev Soosar for their valuable comments and review of the draft of the report.

Finally, we extend our thanks to Timothée Noel from the Intelligent Energy for Europe Programme (IEE) for his support and belief in this project and his encouragement and advice.

Didier Bosseboeuf

Project leader

[1] Alphabetic order of countries

Key Questions and Messages

This publication presents and analyses the policies implemented in the buildings, transport and industry sector in the European Union, its Member States and Croatia and Norway. It mainly relies on the **MURE database** with policy measures on energy efficiency, covering all EU countries plus Croatia and Norway and also includes the quantitative impact of the measures (**www.muredatabase.com**). The tool can be used to support energy policy formulation by the European Commission, e.g. as part of the monitoring and evaluation of the National Energy Efficiency Actions Plans submitted under the Directives on End-use Energy Efficiency and Energy Services (ESD) and under the new Energy Efficiency Directive (EED).

This section lays out the key questions and messages from a cross-cutting view on energy efficiency in the EU and from the three sectoral reports.

Energy Efficiency Policy in the EU

- The EU has considerably further developed over the past years the frame for energy efficiency policies. The most important initiatives relevant for energy efficiency include:
    - the Effort Sharing Decision 406/2009/EC (2009);
    - the EU-Energy Strategy 2020 (November 2010);
    - the Energy Efficiency Plan 2011 reemphasizing the (indicative) 20% energy efficiency target and stating that the EU is on track only to achieve only half it
    - the Low Carbon Roadmap 2050 incl. long-term GHG reduction objectives (March 2011); the Energy Roadmap 2050 (Dec. 2011) exploring how long-term GHG targets can be reached while also ensuring security of supply and competitiveness.
    - The new Energy Efficiency Directive (EED) from October 2012. The entry into force occurred in November 2012. The EED includes provisions on the setting of energy efficiency targets in the MS (Art. 3), general energy efficiency policies (esp. the introduction of energy efficiency obligations or equivalent measures in Art. 7) and measures addressing specific energy consumption sectors as e.g. buildings (Art. 4 and 5), energy audits and management systems for enterprises (Art. 8) or CHP Art. 14).
    - The Recast of the Eco-design Directive 2009/125/EC: 14 implementing regulations are in place now and 39 in preparation for EuP, plus additional ones on ErP (e.g. windows, insulation material). For some products, voluntary agreements are discussed.
    - The revised Labelling Directive 2010/30/EU extends the scope from household appliances to all energy-related products. Up to now, delegated regulations for 7 product groups are in place (incl. a new for TV).
- It is expected that the EED, due to the fact that its impacts were diluted in a lengthy discussion process with the Member States, will not be fully able to achieve the 20 % saving target but only around 15 -17% requiring further policy development already in 2014 after the evaluation of progress by the Commission.
- The main question around a future target system for energy efficiency beyond 2020 is whether the present target triad (GHG emissions, renewables and energy efficiency) should be further developed or whether there should be a single headline target to improve energy efficiency and which one.

Buildings Sector

The building brochure, while providing a general view on energy efficiency policies in the buildings sector, focuses on important issues and questions of energy policies directed towards **financing the energy efficient transformation of the built environment**. From the study presented in the building brochure, the following key messages emerge:

How large are the energy efficiency potentials in the building sector (including both the building energy uses and the electric appliances/equipment)?

- Previous studies have shown that up to 2020 economic potentials exist of the order of 255 Mtoe in terms of final energy that could contribute largely to the 20% primary energy target of the EU Commission. In fact, considering that the primary energy target has been formulated before the economic crisis, realizing this economic potential would be sufficient alone to reach the target.
- Buildings (including appliances) contribute with 80 Mtoe (residential sector) and 35 Mtoe (tertiary sector) roughly 45% of the target but due to the long investment cycles the contribution of building beyond 2020 and in particular up to 2050, is far greater.

How large are the upfront-investment required to mobilize these potentials?

- In order to realize those economic potentials substantial upfront investments are necessary despite the fact that the investments will pay largely off in the future.
- The required investments for the built environment differ according to the assumptions, especially with respect to the question whether differential investment compared to a less energy efficient solution of full costs have to be considered which is a matter of debate when it comes to an increase of the present refurbishment rates beyond the autonomous rates.
- In case that full costs are considered for all investments outside the present investment cycle, upfront investments up to 2020 are of the order of 800 billion Euro, or roughly 80 billion Euro annually.

Which individual policies already address financing needs for the energy efficient transformation of the built environment and what is their role in the context of other instruments? What role for private sources of financing?

The report discussed the pros and cons of the main present financing tools to provide the required upfront investments:

- **State budgets:** this is for example the case of a number of subsidy programmes described in the MURE database such as the KfW programme in Germany. The large drawback of this type of financing is that in times of tight budgets it will be difficult to find the additional investments as the costs cannot be easily passed on to the tax payers although the energy savings will at the end relieve the pressure on the economy from reduced energy costs. It seems unlikely that through this path all the investment needs identified in the building sector could be covered. The advantage of this type of financing is that the means can be directed towards deep renovations.
- **Financing from state-like budgets**, e.g. the use of income from the emission trading scheme to finance energy efficiency investment. The drawback of this financing source is that it is heavily dependent on the CO_2 price, the advantage that is independent from the direct state budget. However, the temptation is large for governments to use such income not in a dedicated manner for energy efficiency options. In order to finance the large investment volumes required for building rehabilitation, the CO_2 price should be considerably higher than present levels in order to contribute substantially to the annual investment needs identified above.
- **Leveraging of private investments from companies in the energy sector** through energy saving obligations/White Certificates: This has the advantage in opening new, more stable, financing sources. At the end the cost will be passed on to the

consumer. The advantage is that private investments are leveraged and that energy companies may possibly develop into energy service companies. The disadvantage is that, if no special provisions are taken, mainly shallow refurbishments are undertaken.

- **Leveraging of private investments from through energy service companies**: Here the charge is totally on the private sector. The investor gets his money from the reduced energy cost of the client. This has the advantage that markets are developed for energy services and that the energy consumer is (in principle) not charged additionally and may even get a (small) reduction in energy cost during the phase when the investment is paid off. At present, mainly energy conversion options or options that pay off rapidly are financed in such a way (boilers, HVAC systems, building control systems etc.) while deep renovations including the building envelope are rather rare due to the long payback time. An option may be to subsidise the payback to a rate interesting for the energy service companies. The report cites examples such as the EPC Plus approach proposed by the Berlin Energy Agency, how deep renovation can be achieved through contracting in combination of other sources. Also risk mitigation is an important aspect where the state generally plays a role.
- **Financing through a levy on energy consumption ("Feed-in tariff for energy efficiency"):** this innovative policy design is in principle similar to the promotion of renewable through feed-in tariffs – while energy saving obligations are the equivalent to quote systems for renewable - and has the substantial advantage of financing stability and risk-lowering. On the other hand, given the fact that renewable already charge heavily especially electricity prices in some countries, it may be difficult to levy in the same way the large investments for refurbishing existing buildings. However, in difference to renewable, where first the costs are positive and serve to pay their cost down along the cost degression curve, energy efficiency options provide after some time, benefits to the consumers due to lower energy bills. Also the energy consumption on which the costs for energy efficiency investments are charged should cover a much larger range than just electricity consumption but also fossil fuel use.
- **Combining different sources in an Energy Efficiency Fund:** one last important possibility of generating the funds necessary for the large investments is combining different sources discussed in the previous point in a general energy efficiency funds, such as the EU Energy Efficiency fund but at a much larger level of volumes. Combining the sources would have the advantage of taking the largest basis possible, though, in most cases, the final consumer would carry the charges in some way. Energy efficiency funds offer more flexibility in promoting innovative technologies and solutions than other financing sources.

How can the state fulfill its exemplary role with respect to energy efficiency improvement as requested by the Energy Efficiency Directive?

The discussion in the report on the exemplary role of the public sector for buildings brings three major aspects to the focus:

- The **scope for low-cost measures in the public buildings and their large potential** which is well-illustrated in the report with the case of Ireland and the activities of the Office for Public Works in Ireland.
- The **limits of the approach when it comes to investments**, and in particular investments into the building envelope with comparatively large sums and longer periods of return, also illustrated with the example of Ireland.
- The **emerging role of Energy Service Companies (ESCOs)** to build the bridge beyond the public budgets but which is not without difficulties, especially when it comes to finance deep renovations including the building envelope with its long payback periods.

Are there social impacts linked to the introduction of such policies? How to tackle such social impacts?

- There is no doubt that increasing energy prices do and will have strong social impacts (fuel poverty).
- It is also without doubt that policies that mobilizing the large investments could also have impacts on some part of the population.
- The distributional impacts largely depend on the policy instruments and its design: while tax relief/credits mitigates to a certain degree the distributional impacts as taxes are paid according to the income, most other instruments, in particular those that charge the investment costs finally to the consumer of energy lead to distributional effects among consumers.
- Especially low income consumers may require particular measures to support their transition to a more efficient energy use.

Which innovative policies could be designed to finance investments in energy efficient buildings?

From the discussion of innovative building polices in the building report the following message are derived:

- Innovative approaches to finance building rehabilitation should have the substantial advantages of financing stability and risk-lowering
- Such features may be characteristics of an energy efficiency levy or Energy Efficiency "Feed-in tariffs" (FiTs). This is in principle similar to the promotion of renewables through feed-in tariffs – while energy saving obligations are the equivalent to quota systems for renewable.
- Given the fact that renewables already charge heavily especially electricity prices in some countries, it may be difficult to levy in the same way the large investments for refurbishing existing buildings.
- However, in difference to renewable, where first the costs are positive and serve to pay their cost down along the cost degression curve, energy efficiency options provide after some time, benefits to the consumers due to lower energy bills.
- Also the energy consumption on which the costs for energy efficiency investments are charged should cover a much larger range than just electricity consumption but also fossil fuel use.
- Levying 6% annually would raise between 70 and 100 billion Euro annually, hence enough to cover the financing needs for the building investments.

Which policy combinations may mobilize the required large upfront investments?

The report identifies some coherent combinations of policy instruments which describe an increasing perimeter covered by the instruments and could be able to provide in principle – with more or less barriers - the large upfront-investments specified earlier:

- Policy Path 1: a combination of regulation and financial incentives based on state budgets
- Policy Path 2: a combination of regulation, financial and fiscal incentives
- Policy Path 3: a combination of regulation, financial and fiscal incentives and saving obligation schemes
- Policy Path 4: a combination of regulation, fiscal incentives and an energy saving trust
- Policy Path 5: a combination of regulation, fiscal incentives, energy saving trust and saving obligation schemes
- Policy Path 6: a combination of regulation, financial and fiscal incentives, energy saving trust and saving obligation schemes

In summary solutions exist to cover the large investment needs for the built environment. However, Member States and the EU need to design stable mixtures of policy instruments, depending only partially on state budgets in order to provide the required long-term stability to investors in efficient buildings, including deep renovations.

Transport Sector

The transport brochure discusses the need for a sustainable hierarchy for measures to improve energy efficiency in transport, while providing detailed insight into the elements of such a sustainable hierarchy. From the study presented in the transport brochure, the following key messages emerge:

Why there is a need for a sustainable hierarchy for measures to improve energy efficiency in transport?

- There is a growing realisation that a focus on improving the efficiency of vehicles is only part of the solution in the transport sector. A more holistic approach involving the reduction of transport demand and the shift of transport to more environmentally friendly and energy efficient modes is needed if the European Union is to meet its 2030 and 2050 targets.
- However very few EU Member States presented a comprehensive package of transport measures in their National Energy Efficiency Action Plans (NEEAPs).

What elements are part of the sustainable hierarchy?

- The most commonly implemented policies at Member State level are those that seek to improve the efficiency of vehicles or encourage the purchase of cleaner vehicles. Other measures seek to encourage modal shift or change driver behaviour.
- The majority of policies focus on cars: improving the efficiency of cars, encouraging the take-up of energy efficient cars and changing the behaviour of car drivers. This focus on cars may be partly due to the homogeneous nature of cars.
- However, cross-cutting measures such as voluntary agreements and white certificates are now being applied to other vehicle types, and may be more appropriate than codes and standards when dealing with heterogeneous technologies like heavy goods vehicles (HGVs).
- Vehicle efficiency improvement measures are predominantly implemented at EU level through regulations targeted at vehicle manufacturers. There are also some novel policies at the national level, particularly on HGVs and public transport vehicles, including the introduction of longer road trains and voluntary agreements with freight logistics companies.

What are main lessons from the different measures introduced to implement the sustainable hierarchy to improve energy efficiency in transport?

- Modal shift can play an important role in reducing energy consumption and greenhouse gas (GHG) emissions from transport. Measures include enhancements to public transport provision, fiscal incentives to encourage the use of public transport or non-motorised modes, differential toll charges, the promotion of walking and cycling, and urban mobility planning.
- Measures to encourage the uptake of cleaner vehicles include labelling, taxation and infrastructure charges, grants and subsidies and scrappage schemes. Differentiation of car purchase tax by fuel efficiency/CO_2 emissions have now been introduced in almost two-thirds of Member States, but differentiation of annual circulation taxes is less common.

- Scrappage schemes for older inefficient cars, have been introduced quite widely across the EU, although often for relatively limited periods. Many of the schemes also provide incentives for the purchase of new cars, often stipulating CO_2 performance standards which must be met.
- Measures to promote the uptake of electric vehicles have expanded substantially in the last few years, and seek to combat the most common barriers, high capital cost and lack of charging infrastructure.
- Changing driver behaviour to encourage more fuel efficient driving is widely recognised as potentially offering significant savings, and several countries have introduced training courses and awareness raising campaigns for both car drivers and freight, and bus and coach drivers.
- Increasing the utilisation of vehicles, e.g. through car sharing, can also contribute to improving the overall efficiency of passenger transport, and is typically encouraged though a range of 'soft' measures to change driver and passenger behaviour.

In summary there is an urgent need in many EU Member States to develop comprehensive packages of transport measures in their National Energy Efficiency Action Plans despite the fact that the Directive on Energy Efficiency provides possibilities to exempt this sector from the target setting process.

Industry Sector

The industry brochure is looking for answers to the following policy issues in industry:

How well do EU and national policies and measures currently conform to the internationally recognised policy priorities for the improvement of industrial energy efficiency and how much additional effort is needed?

- The question concerns, e.g. the Energy Efficiency Directive and IEA recommendations for industry. Particular focus is placed on the analysis of the different aspects of energy management and measures addressing small and medium sized enterprises (SMEs).
- The Energy Efficiency Directive proposes a set of measures (e.g. energy efficiency obligations, mandatory audits and certification/ qualification schemes) which represent an ambition level quite far from the current implementation status of these measures in Europe, requiring massive additional effort from the Member States.

How well do the national policies and measures address energy efficiency drivers in industry?

- There is no clear correlation between the impact level of the measures and the measure types. Both high-impact and low-impact measures are of various types. The situation reflects the varying relative importance of energy efficiency drivers.
- The focus on energy management in most countries is increasing among the measures but not in pace with the emphasis given to it by, e.g., the EU policy, IEA energy efficiency recommendations and the international standardization bodies.
- While several energy efficiency measures are already in place for SMEs, more tailored programmes are needed to address their special needs.
- There is an increasing need for energy advice in all sizes of industry and there is a need to step up activities in the area.

Are there innovative measures which address the drivers well?

- Though there are innovative measures in the industry sectors, the most successful measures combine the following four elements:

- Energy management
- High-efficiency industrial equipment and systems
- Energy efficiency services for SMEs
- Complementary policies to support industrial energy efficiency

Is there adequate packaging of measures?

- There appears to be quite wide general consensus in the international energy efficiency *fora* on the importance of using multiple policy instruments in order to address the variable barriers for energy efficiency. Yet, it is not uncommon that countries rely on a rather limited mix of policies and measures.
- Economic incentives are frequently used to address financial drivers. Negotiated and voluntary agreements have a significant policy status on some countries. Norms and standards as well as various obligations have not been used extensively. Use of information measures has grown but not as much as could be expected given the need to further energy management.
- Two types of measure packages can be identified from the MURE database and the NEEAPs. Sometimes several independent measures also work together. In other cases different types of instruments have been included in one overarching measure. Both approaches are common.

Does the financial and economic crisis already have a visible impact on policy design and implementation?

- The impact of the economic and financial turmoil since mid-2008 could not yet be seen on the types of measures implemented as of beginning of 2012. However, there are indications that financial measures are being cut as the recession has continued.

What is the level of monitoring and evaluation of measures?

- Conscientious monitoring and evaluation schemes are most common in measures involving tax exemptions. Other well monitored measures are subsidy schemes, audit programmes, voluntary/negotiated agreements and legislative initiatives related to energy management. Systematic monitoring and evaluation of other measure types is less common.

Given the significance and expectations placed on Emissions Trading, what is the role of other measures in industry?

- Emission trading provides (in principle) an economic signal. However in the industry sector a large number of non-economic barriers persist such as split incentives (e.g. inefficient electric motors are integrated into machines and sold in a package to the user where the energy consumption occurs). Those non-economic barriers require particular instruments such as energy audits or specific agreements among industrial equipment suppliers and users.
- As long as the price signal from the ETS is extremely low, there is a specific need for financial programmes to promote energy efficient investments in the industrial sector.

In summary in quite many countries the policy mix needs to be balanced better to address the multiple drivers of energy efficiency in industry. Quite many countries apply only a couple of measure types, often mainly those addressing financial drivers.

Table of contents

List of Figures

List of Tables

List of Boxes

1 Introduction

The aim of this brochure is to provide insight into energy policy measures in each end-use sector in the EU (industry, transport and buildings), as well as at the overall policy level. It summarises three sectoral reports on industry, transport, buildings that are available on the ODYSSEE web site (www.odyssee-indicators.org). 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 -such as industrial growth, structural changes, lifestyle changes - are also considered.

The main basis for the analysis is the **MURE database** including policy measures on energy efficiency, covering all EU countries plus Croatia and Norway (see Box 1-1). A more detailed analysis of data on energy trends, drivers for energy use, explanatory variables and energy-related CO_2 emissions in the transport sector is contained in a further report from the ODYSSEE-MURE Project[2].

Box 1-1 MURE database

The MURE database (www.muredatabase.com) provides an overview of the most important energy efficiency policy measures in the EU Member States, Norway, Croatia and the EU itself. The database is structured by final energy consumption sectors (household, tertiary, industry, transport) and also includes a general cross-cutting section. At the level of sectors, the focus is on single policy measures in order to allow a specific analysis of each measure. More general programs comprising several measures are mainly described in the cross-cutting section of MURE. The homogeneity of the measure descriptions over sectors and countries is ensured by detailed guidelines (Schlomann & Eichhammer 2011). All measures are classified according to specific keywords, thus allowing queries based on criteria as e.g.:

- their status (completed, on-going or planned);
- their year of introduction and completion;
- their type: legislative/normative (e.g. standards for new dwellings), legislative/informative (e.g. obligatory labels for appliances), financial (e.g. subsidies), fiscal (e.g. tax deductions), information/education, cooperative (e.g. voluntary agreements) and taxes (on energy or CO2-emissions);
- the targeted end-uses and the main actors involved by the policy measures;
- their semi-quantitative impact: low, medium or high impact, based on quantitative evaluations or expert estimates;
- the end-uses involved and the quantitative impact of the policy measure related to a specific end-use (if this information is available)

[2] ADEME (2012) Energy Efficiency Trends in the Transport Sector in the EU: Lessons from the ODYSSEE MURE project, March 2012

The MURE database (www.muredatabase.com) provides an overview of the most important energy efficiency policy measures in the EU Member States, Norway, Croatia and the EU itself. The database is structured by final energy consumption sectors (household, tertiary, industry, transport) and also includes a general cross-cutting section. At the level of sectors, the focus is on single policy measures in order to allow a specific analysis of each measure. More general programs comprising several measures are mainly described in the cross-cutting section of MURE. The homogeneity of the measure descriptions over sectors and countries is ensured by detailed guidelines (Schlomann & Eichhammer 2011). All measures are classified according to specific keywords, thus allowing queries based on criteria as e.g.:

- their status (completed, on-going or planned);
- their year of introduction and completion;
- their type: legislative/normative (e.g. standards for new dwellings), legislative/informative (e.g. obligatory labels for appliances), financial (e.g. subsidies), fiscal (e.g. tax deductions), information/education, cooperative (e.g. voluntary agreements) and taxes (on energy or CO2-emissions);
- the targeted end-uses and the main actors involved by the policy measures;
- their semi-quantitative impact: low, medium or high impact, based on quantitative evaluations or expert estimates;
- the end-uses involved and the quantitative impact of the policy measure related to a specific end-use (if this information is available)

For each policy measure a detailed description is available in MURE. The MURE database further provides EU Member States with a structured format to report on measures taken under the National Energy Efficiency Action Plans requested by the European Commission in compliance with the Energy Service Directive (ESD). Two additional categories have therefore been added to the MURE database:

- If a measure is included in the National Energy Efficiency Action Plan under the EU Energy Efficiency and Service Directive ESD (2006/32/EC), it is classified as “NEEAP measure” in the MURE database. This allows an easy identification of policy measures reported in the NEEAPs and a specific analysis of these policies.
- In order to separate of EU-wide measures which are common to all countries (mainly EU Directives) from pure national measures, a set of “EU measures” was defined in the MURE database

In addition, the MURE simulation tool, which is linked to the database, was used by the EU Commission to assess the energy saving potentials over the period 2010-2030[3].

The building sector, as it is subject of this chapter, refers to two main categories of buildings: residential buildings and non-residential buildings[4]. Whereas residential buildings are relatively homogenous and can further be divided into single/two-family houses and apartments blocks, non residential buildings are more heterogeneous. They refer to buildings in the service or tertiary sector and include several building categories (esp. office buildings, hospitals, schools and universities, hotels and restaurants, buildings in wholesale and retail trade).

The energy use in buildings shows different consumption patterns with regard to space and water heating on the one hand and electricity (without electricity consumption for space and water heating) on the other hand (see Enerdata 2012). This is also reflected by the – often

[3] DG TREN (2009): Energy Savings Potentials in EU Member States, Candidate Countries and EEA Countries

[4] With regard to the sectoral structure of MURE, the building sector can be more or less equated with the residential and tertiary sector in the MURE database (including electric appliances in both sectors).

different – policy measures addressing these final end-uses. Therefore, a further subdivision of the building sector by end-uses is useful. In the following, the building sector is subdivided by the following end-uses:

- Space and water heating, both including residential and tertiary buildings; in tertiary buildings, other process heat (apart from water heating) is also added to this category.
- Electricity consumption in buildings (without electricity for space and water heating), which shows more differences between the residential and the tertiary sector. In residential buildings, the predominant electricity uses are electric household appliances, information and communication technologies (ICTs), lighting, cooking, and space cooling. In tertiary buildings, the relevant electric end-uses taken into account here are ICTs, lighting, ventilation and air-conditioning, electric motors and commercial appliances.

The structure of this chapter follows this sectoral and end-use approach:

- First, a general overview is given on energy efficiency policies included in the MURE database by different criteria of classification. The report then discussed the role of financing measures in the portfolio of energy efficiency policies in the building sector (section 3.1).
- In the following two sections, the energy efficiency policies addressing the building sector are analyzed separately with regard to space and water heating (section 3.2) and electricity (section 3.3). The different financial instruments are exemplified with country-specific information from the MURE database.
- Section 3.4 provides a view of the impact of energy efficiency measures as extracted from the measures presented in the second National Energy Efficiency Action Plans NEEAPs and gathered in the MURE database.
- Finally, Section 3.5 discusses different aspects of energy efficiency policies for the financing of the upfront investments identified up to 2020:
    - the size of the required upfront investments,
    - the role of different financing mechanisms and of private actors,
    - the exemplary role of the public sector and how the measures there can be financed,
    - social impacts and distributional effects of energy efficiency policies in the building sector,
    - innovative financing policies.

2 Energy Efficiency Policy in the EU - a cross-cutting view

2.1 Energy efficiency policies in the EU

2.1.1 Institutions, programmes and main cross-cutting energy efficiency measures in the EU

Since 2010 energy issues are represented with a Directorate General for Energy. In December 2008 the European Union agreed on an Energy and Climate Change Package plus a Strategic Energy Review. The most important initiatives relevant for energy efficiency since then include: the Effort Sharing Decision 406/2009/EC (2009); the EU-Energy Strategy 2020 (November 2010); the Energy Efficiency Plan 2011 reemphasizing the (indicative) 20% energy efficiency target and stating that the EU is on track to achieve only half its target, as well as the Low Carbon Roadmap 2050 incl. long-term GHG reduction objectives (both March 2011); the Energy Roadmap 2050 (Dec. 2011) exploring how long-term GHG targets can be reached while also ensuring security of supply and competitiveness. The most controversially discussed initiative was the Commission's proposal for a new Energy Efficiency Directive (EED) from June 2011, including a set policy measures ensuring that the 20% saving target is achieved. After a long discussion with the Member States (MS), a compromise text was agreed on under the Danish presidency on 14 June 2012, which was also approved by the European Parliament on 11 September 2012 and the Council on 4 October 2012. The entry into force occurred in November 2012. The EED includes provisions on the setting of energy efficiency targets in the MS (Art. 3), general energy efficiency policies (especially the introduction of energy efficiency obligations or equivalent measures in Art. 7) and measures addressing specific energy consumption sectors as e.g. buildings (Art. 4 and 5), energy audits and management systems for enterprises (Art. 8) or CHP Art. 14). It is however assumed that the compromise measures will not be fully able to achieve the 20 % saving target but only around 15 -17%. A more detailed discussion of the provisions of the EED occurs in section 2.2).

The Recast of the Eco-design Directive 2009/125/EC creates a framework for an ecologic design of products that are related to energy ("ErP"). It replaces directive 2005/32/EC, known as "Energy-using Products" (EuP). "ErP" and "EuP" provides the basis for several implementing regulations: 14 implementing regulations are in place now and 39 in preparation for EuP, plus additional ones on ErP (e.g. windows, insulation material). For some products, voluntary agreements are discussed. The revised Labelling Directive 2010/30/EU extends the scope from household appliances to all energy-related products. The Directive introduces new efficiency classes A+, A++ and A+++ on top of the existing A grade, while the number of classes still limited to 7 (to be reviewed in 2014). Up to now, delegated regulations for 7 product groups are in place (incl. a new for TV).

2.1.2 Buildings

Apart from the new EED, which also includes provisions relevant for buildings, the recast of the Energy Performance of Buildings Directive (EPBD; 2010/31/EC) was the most important policy addressing the building sector. It introduced the following novelties: new buildings will have to consume 'nearly zero' energy and use 'to a very large extent' renewables in 2020; public authorities that own or occupy a new building should set an example by building, buying or renting 'nearly zero energy building' by 2018; Member States shall develop

measures to stimulate the refurbishment of buildings into very low energy buildings; the 1000 m2 threshold for major renovation has been deleted (to be effective in 2014); minimum requirements for components are introduced for all replacements and renovations; a harmonised calculation methodology to push-up MS minimum energy performance requirements towards a cost-optimal level; a more detailed and rigorous procedure for issuing energy performance certificates with mandatory controls required to check their correctness; introduction of penalties for non-compliance. The impact assessment for the recast EPBD estimates the energy savings at 60 – 80 Mtoe/year energy savings by 2020, i.e. a reduction of 5-6% of the EU final energy consumption in 2020.

2.1.3 Transport

The main EU initiative is mandatory CO2 standards as voluntary agreements on performance have failed to reach their target. The new regulation set an average target of 130g CO2/km for new passenger cars in 2015. A long term target is introduced for 2020 at 95 g CO2/km. Manufacturers will be given interim targets (65% of their fleets in 2012, to 80% in 2014). In case they exceed the targets, they will have to pay fines. In February 2011 the European Parliament adopted a legislation on CO2 emissions of new light commercial vehicles (LCV) with a target of an average CO2 emission of 175 g/km by 2017 (for category N1, i.e. below 3.5 t gross weight) (~185 g/km in 2009) and 147 g/km in 2020. Air traffic has been included in the EU ETS from 2012, emissions for all flights that arrive at or depart from an EU airport. A similar measure for international marine traffic is under discussion. Regulation (EC) No 1222/2009 introduced a labelling scheme for tyres.

2.1.4 Industry

Next to the new EED and the Eco-design Directive which are also relevant for the industry, the main relevant measure for this sector is the European Emissions Trading Scheme (EU ETS). The system is approaching the end of the second phase 2008-2012, in which allowances were given for free. The revised EU ETS accepted in December 2008 will apply over 2013-2020 and should lead to a reduction in GHG emissions of 21% compared to 2005 levels. The quantity of allowances issued each year will decrease in a linear fashion to reduce gradually the overall level of emissions each year. The industry sector will be, at least partially and for a transition period, exempted from auctioning and certificates will be allocated based on benchmarks that have been published in December 2010. To limit carbon leakage, 100% free allocation will be kept up to the benchmark by 2020.

2.1.5 Impact evaluation of selected energy efficiency measures

An overview of the most import recent energy efficiency policies and their expected impacts in terms of reduction in energy consumption and of CO_2-emissions by 2020 is given in Table 2-1.

Table 2-1: Impact evaluation of selected energy efficiency measures in the EU

Sectors	Title of Measure	Since	Energy (Mtoe)	CO2 (Mt)
All	Recast Eco-Design Directive 2009/125/EC (Various Implementing Directives)	2009	376 TWh for the 12 first measures in 2020 (36% motors, 10% lighting, 10% tertiary lighting, 11% TV, 9% standby, 9% fans)	150 Mt of CO_2 in 2020
All	Revised Labelling Directive 2010/30/EC	2010	27 Mtoe by 2020	80 Mt of CO_2 in 2020
All	Energy Service Directive 2006/32/EC	2006	9% of final energy excl. emission trading in 2016 (89 Mtoe with "Early Action")	270 Mt of CO_2 in 2016 (incl. Early Action)
All	Energy Efficiency Directive	2012	Expected are around 294 Mtoe in primary energy terms by 2020 though the aim is to reach 368 Mtoe primary energy savings. However, part of the savings stem from the impacts of the economic and financial crisis.	893 Mt of CO2 in 2020 (incl. impacts of the economic crisis)
Buildings	Recast EPBD 2010/31/EC	2010	60 – 80 Mtoe/year by 2020	160 to 210 Mt/year CO_2 in 2020
Households	Minimum standards for televisions	2010	43 TWh in 2020 (incl. above in Ecodesign)	17 Mt of CO_2 in 2020
Transport	Tyre labelling Regulation (1222/2009/EC)	2009	1.5 Mtoe in 2020	4.5 Mt of CO_2 in 2020
Transport	Emissions new cars (130 g CO_2/km 2015)	2008	Potentially very large impact	
Transport	Inclusion of aviation in EU ETS	2012	59 Mtoe in 2020 (based on CO_2 emissions)	183 Mt of CO_2 in 2020
Industry	EU emission trading scheme	2005	Limited impact due to over-allocation	
Industry	Minimum standards for electric motors	2011	135 TWh in 2020 (incl. above in Ecodesign)	54 Mt of CO_2
Tertiary	Minimum standards for commercial lighting	2008	35 TWh in 2020 (incl. above in Ecodesign)	14 Mt of CO_2

Source: various impact assessments of the EU

2.2 Major provisions from the recent EU Directive on Energy Efficiency 2012/27/EU

The Energy Efficiency Directive 2012/27/EU was published in November 2012 in the Official Journal of the European Union (European Union 2012b). It does not introduce binding targets at national level, but "binding measures" such as an obligation to renovate public buildings and other initiatives. Key measures of the Directive are:

- that each country has to present national indicative targets by April 2013. If the European Commission estimates that those are insufficient to meet the EU's overall 2020 goal, then it can request member states to re-assess their plans. In the first semester of 2014, the Commission will review the progress towards the 20% energy-efficiency target, report on it and assess whether further measures are needed.
- that energy companies should reduce energy sales by 1.5% per year with their customers. However, 25% of the 1.5% annual obligation can be achieved through a series of different measures, in particular:
    - Early action: Member states will be able to include "early action" taken by energy companies since 2009.

  - Countries will also be able to count energy savings made in the energy transformation sector, before it is distributed to clients.
  - Industries already make under the EU Emissions Trading System for carbon dioxide (EU-ETS) will now be accounted for in the yearly obligation.

- that the public sector should renovate 3% of buildings "owned and occupied" by the central government in each country which focuses on the smaller part of the public stock as many buildings belong to regional or local authorities. Buildings need to have a useful area larger than 500 m_2 in order to be covered by this requirement (lowered to 250 m2 as of July 2015).
- that EU countries should set up a roadmap to make the entire buildings sector more energy efficient by 2050 (commercial, public and private households included).
- that energy audits and management plans are required for large companies, with cost-benefit analyses for the deployment of combined heat and power generation (CHP) and public procurement.

The measures in the EED are expected to result in a reduced 15% total energy savings by 2020, short of the 20% goal that member states had agreed on in principle.

2.3 Possible future developments in the EU target system for energy efficiency beyond 2020

Due to the discussion around the EU emission trading scheme which suffers from a large oversupply of emission rights (around one year's CO_2-inventory), which is largely due to the impacts of the financial crisis and the large inflows of CDM rights but also due to the fact that renewables have better performed than originally thought, a broad discussion has emerged about the future target system including energy efficiency in Europe.

The main question is whether the present target triad (GHG emissions, renewables and energy efficiency) should be further developed or whether there should be a single headline target to improve energy efficiency and which one. In the following, the main options are discussed with their pros and cons:

Option 1: Three independent targets

+ Emphasizes objective behind each target (supply security, economic benefits, and environment). Technology specific promotion schemes are possible.
+ If policies addressing one target are week there may still be enough room for ambitious policies with the two other targets. At present, the CO2-target is the weakest one compared to the targets for renewable and energy efficiency.
- Dynamic coordination increasingly necessary.
- Visibility/Stability of policy framework could be an issue, as dynamic adaptations are at the expense of stability

Option 2: GHG emissions as headline target

+ Insures consistency in the target system as one target dominates all objectives.
- Emphasizes unique objective.
- Presently It is difficult to insure large impacts of the polices. CO_2 is the weakest policy behind the objectives at present, in particular due to the lack in progress in international climate discussions.

- Requires specific financing policies for more expensive options.
- Floor prices are required to stabilize incentives from the CO_2 prices as well as financial flows from the EU Emission Trading Schemes which in Germany are used to finance energy efficiency and renewables.
- However, depending on the level of the floor price, the market element is increasingly taken out from the ETS which may at the end be equivalent to a CO_2 taxation
- Technology neutrality in the system hampers the uptake of more expensive technologies which may be required later on in the century to achieve very ambitious carbon reduction.

Option 3: Renewables and energy efficiency (final or primary) as the headline targets

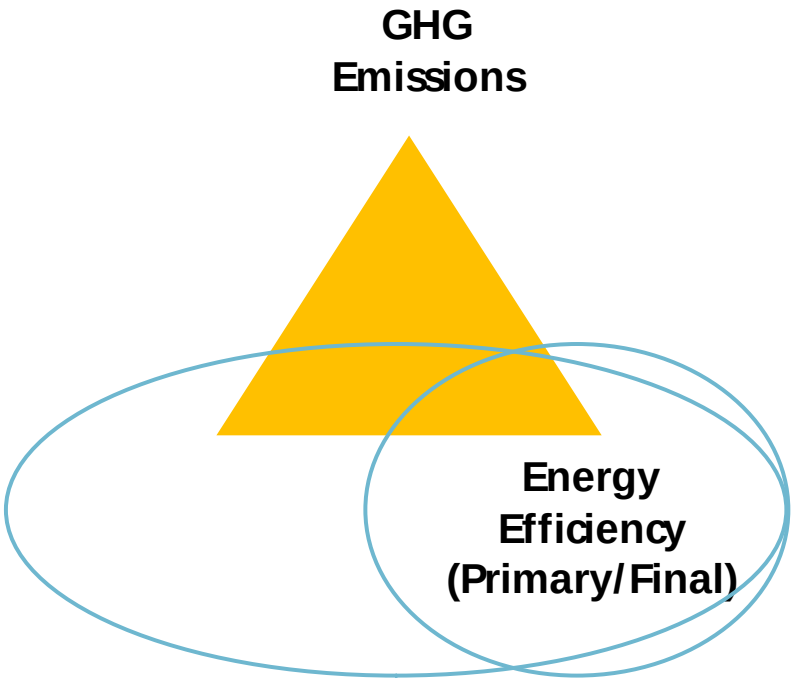
+ Insures consistency in the target system. The CO_2 target would be derived implicitly from the energy efficiency and renewables targets.
+ Strong policies (at least behind renewable). Much stronger emphasis on objectives for supply security and economic development which are equally important than the environment.
- Still weak policy on energy efficiency. Future of RES policy in times of tight budgets is uncertain
- Non-CO_2-emissions are neglected in such a system which may require separate targets for such type of emissions. Fuel shift is only recognized for renewable energy sources.

Option 4: Energy efficiency (primary energy) as the headline target

+ Insures consistency in the target system. Renewables are incentivized through the primary energy targets which includes the shift towards renewable. Specific incentives for more expensive options may be required through policies providing the required upfront investments.
+ Strong policy required for energy efficiency to achieve an efficient target system
- The incentives for renewable which are not accounted for with 100% in the transformation sector is weak. Specific incentives for such type of renewable may be required.
- Non-CO_2-emissions are neglected in such a system which may require separate targets for such type of emissions. Fuel shift towards renewable energy sources is not recognized unless there are specific mechanisms to take that into account in the target achievement.

The discussion around the formulation of the target system for energy efficiency beyond 2020 will further take up speed in 2013.

Figure 2-1: Options for the future target system for energy efficiency, renewable and greenhouse gas emissions



3 Energy Efficiency Policies in the EU Buildings Sector

3.1 Financing measures in the portfolio of energy efficiency policies in the building sector

3.1.1 Energy efficiency policies in the building sector

Several studies have shown that there exist large energy saving potentials especially in the building sector in all EU Member States, Norway and Croatia (Eichhammer et al. 2009; Ecofys/Fraunhofer ISI 2010; Boßmann/Eichhammer et al. 2012). In the Energy Efficiency Plan from 8 March 2011, the European Commission (2011) also states that the greatest energy saving potential lies in buildings. In addition, both the Energy Efficiency Plan and the new Energy Efficiency Directive EED (European Commission 2012) include several proposals for additional policies in order to better exploit the saving potential in the building sector, above all:

- the increase of the renovation rate of buildings (private and public),
- the improvement of components and appliances used in buildings,
- the emphasis on the outstanding (exemplary) role of public buildings,
- Article 7 of the forthcoming EED to introduce Energy Efficiency Obligations (EEO) obliging final energy suppliers or the distribution network operators to a certain amount of annual energy savings which would certainly also affect the building sector.

Already in the past, many energy efficiency policies addressing the building sector have been implemented all over Europe, both at the national level and for the EU as a whole. In April 2012, the MURE database included around 2000 energy efficiency policy measures for the 27 EU Member States, Norway and Croatia, and the EU itself. About half of them are assigned to the household and tertiary sector, i.e. are mainly related to residential and non-residential buildings.

A certain share of the policy measures addressing energy efficiency are based on EU legislation. With regard to the building sector, the most important regulations are

- the Energy Performance of Buildings Directive (EPBD) of 2002 (2002/91/EC) and the EPBD recast of 2010 (2010/31/EC),
- the Ecodesign Directive of 2005 (2005/32/EC) and it's recast of October 2009 (2009/125/EC), and
- the Energy Labelling Directive from 1992 and it's recast from May 2010 (2010/30/EU).

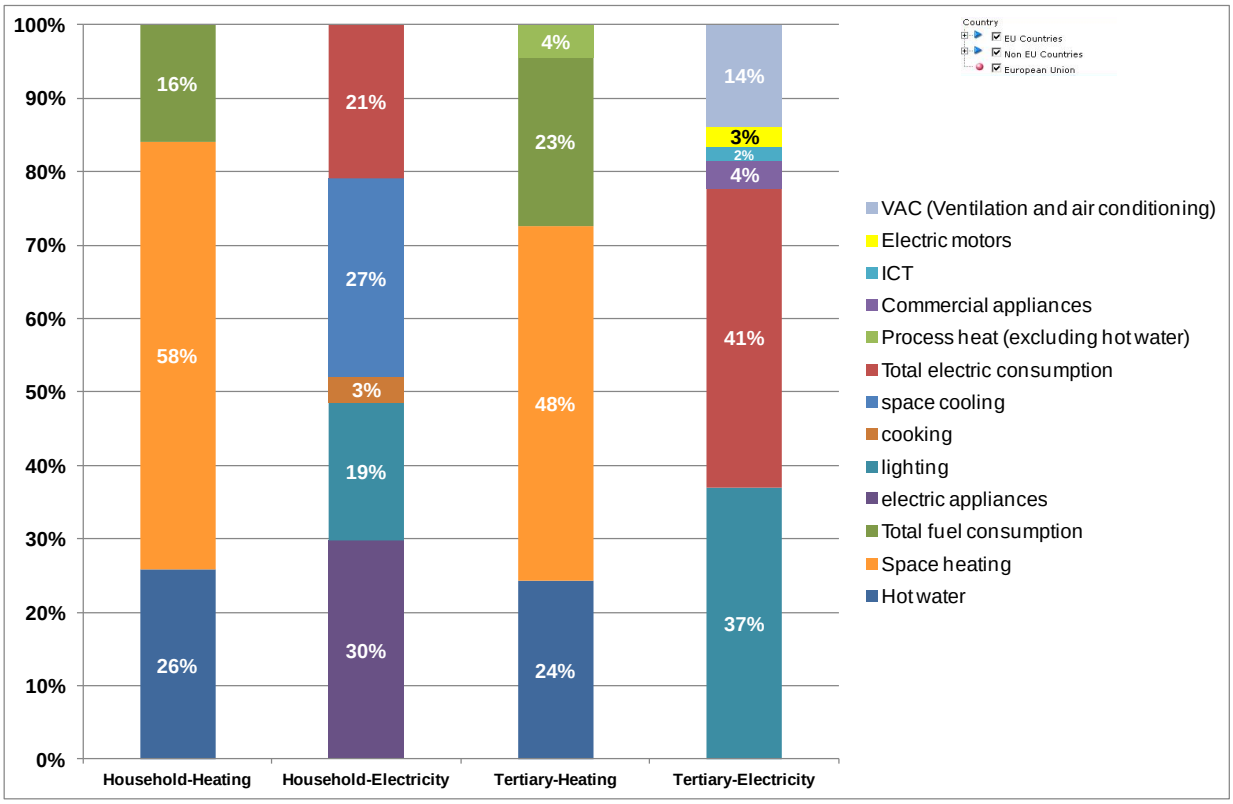
Another important piece of energy policy for the building sector is the Renewable Energy Directive of 2009 (RED, 2009/28/EC). The RED fosters the use of renewable for heat purposes (RES-H) in buildings by the regulatory introduction of a use obligation. Though renewable and energy efficiency imply different strategies, these two strategies are increasingly interlinked in the building sector as building regulations integrate the use of renewable in buildings as a trade-off for energy efficiency.

In order to ensure a more homogeneous representation of EU-wide measures across the countries, a set of EU measures common to all countries (mainly EU Directives) was defined

in the MURE database and separated from pure national measures. Around 130 policy measures in the residential sector and 70 measures in the tertiary sector in MURE are classified as EU measures. With a share of almost 25%, the importance of these policies is most important in the residential sector. In the other sectors (tertiary, industry, transport, cross-cutting), the share of EU measures in total measures compiled in MURE varies between 15 and 20%.

One important classifier in MURE is the **end-use** which is targeted by a policy measure. With regard to buildings, policies addressing space heating and hot water (both in the household and tertiary sector) should be separated from policies addressing electricity, where the diversity of targeted end-uses is considerably more pronounced (Figure 3-1). Electricity consumption in private households is dominated by the large household appliances, lighting, and space cooling), whereas in the tertiary sector, lighting and ventilation and air-conditioning are most important.

Figure 3-1: Energy efficiency policy measures in MURE in the residential and tertiary sector by targeted end-uses



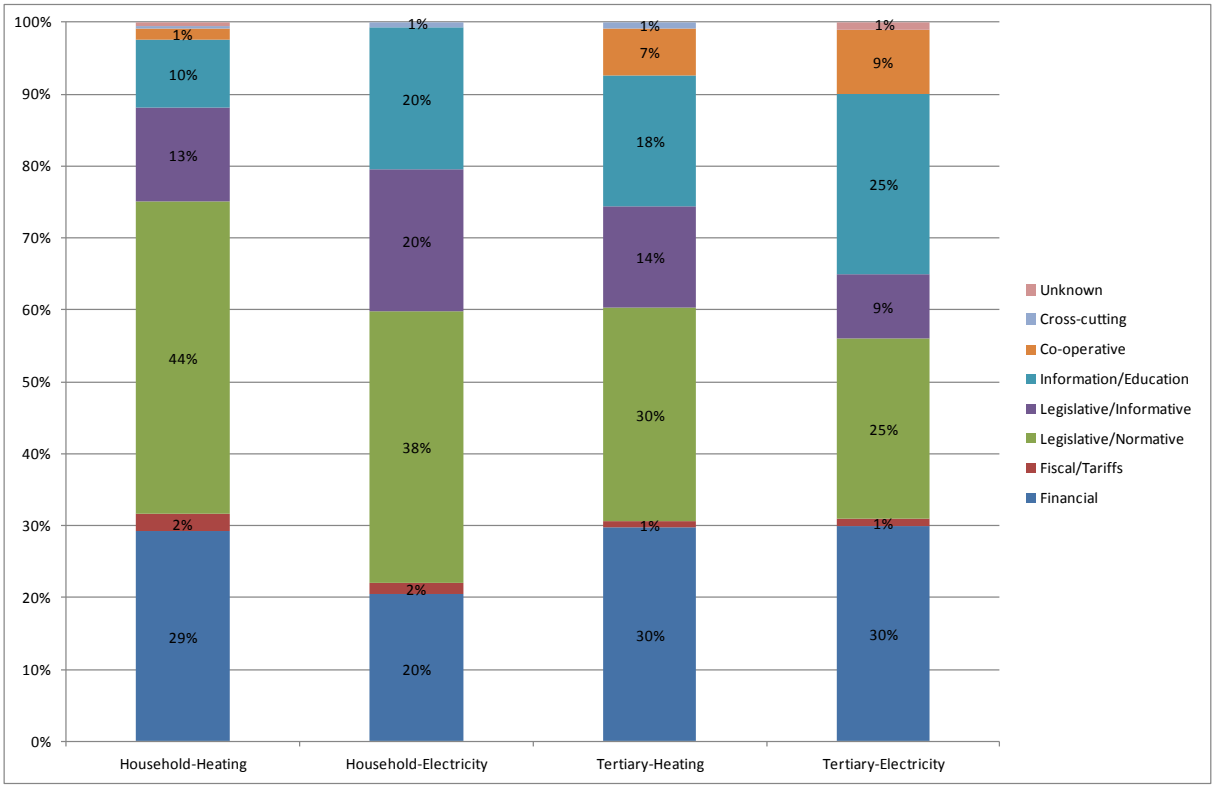
Source : MURE (as of April 2012)

3.1.2 The relevance of financing measures in the portfolio of measures to improve energy efficiency in buildings

The dominating measure types addressing heating consumption in residential buildings are legislative-normative measures (mainly building codes) with a share of around 44%. Financial measures with a share of 29% come second (Figure 3-2). When also taking into account legislative-informative measures (e.g. building certificates) with a share of 13%, the total share of legislative and financial measures adds up to 86%. Nevertheless, the role of information and education programs on a voluntary basis must not be underestimated. 10% of the policy measures described in MURE and addressing residential heating belong to this type (e.g. training for professionals in the building sector). Their role is even more important

with regard to tertiary buildings. According to the MURE database, almost 20% of the policy measures addressing heating consumption in tertiary buildings are assigned to this type.

Figure 3-2: Measures addressing residential and tertiary buildings by type



Source : MURE (as of April 2012; partly double-counting; some measures address more types)

With regard to electricity, the dominating measure types in the household sector are legislative-normative measures (mainly mandatory energy efficiency standards) with a share of 38%. Financial measures are less widespread than for heating, but also important. Mandatory and voluntary informative measures both have a share of 20 %. I.e. informative policies at a legislative (e.g. EU Energy Labelling) or voluntary basis are the most important measure type addressing residential electricity consumption. In the tertiary sector, the structure of measures by type is similar. But legislative measures are less important, whereas both voluntary information and co-operative measures are more relevant than in the household sector.

3.2 Energy efficiency policies addressing space and water heating in buildings

In this section we focus on individual policies addressing energy efficiency in the space and water heating uses focusing on financial instruments but presenting also other relevant instruments, in particular legislative-normative and legislative informative instruments.

3.2.1 Energy Performance Directive for Buildings EPBD

EPBD

The European Directive on Energy Performance of Buildings was enacted in its first instance on 2002/91/EC and came into force in January 2003. It was amended in 2010 and is in force in its current version since 8th June 2010. The directive requires the application of a methodological framework for calculating energy performance of buildings (Art. 3) in

accordance with the guidance given in its annex 1. The EPBD requires further that all new buildings to be nearly zero-energy buildings by the end of 2020, and all new buildings occupied and owned by public authorities are nearly zero-energy buildings by end 2018.

National plans to reach that target are required and need to include the definition of nearly zero-energy buildings according to local conditions and by giving a numerical value that indicates the primary energy use as well as intermediate targets for the energy use of new buildings to be set for 2015; and information on political and financial measures to achieve the target. Member states shall ensure that all accessible parts of the heating and air-conditioning systems are regularly inspected and that heating installations older than 15 years are assessed with respect to their energy performance. In addition, independent control systems for energy performance certificates and for inspection reports of heating and air-conditioning systems shall be established.

National Building Codes

Member States need to set minimum requirements for the energy performance of buildings and building elements. New buildings, existing buildings and building elements subject to major renovation as well as technical building systems that are installed, replaced or upgraded shall meet minimum energy performance requirements which are to be set at the cost optimal level or stricter. The cost optimal level is to be determined considering the investments and the energy costs saved throughout the lifetime of the building.

Building Certificates

Member States need to implement certification systems for the energy use of new and existing buildings. Certificates shall be no older than five years and those of public buildings shall be prominently displayed. Since the amendment in 2010 the EBPD requires the extension of the certificate system with indicators enabling the comparison of buildings and with recommendation for a cost optimal improvement of the building energy performance of.

The building certificates that have been implemented are different within the boundaries set by the EBPD. Most countries have chosen to include an energy efficiency class system in their certificates, which makes the figures more transparent to end users. These rankings can for example be used in real estate advertisements as it is done in France. Nevertheless the impact of the energy certification on investment decisions is still limited according to the latest barometer ADEME - TNS/Sofres[5]: In 2011, 16% of the households of the survey realized an energy certification compared to 12% in the year before. Only about one third took note of the recommendations of the certificate and only half of those realized the recommended improvements, frequently only partially. The certificate is considered as an informative document for the performance of the building but does not yet seem to have an impact on the decisions to improve the building. The certificate is even considered as a barrier to building transactions by three quarters of the households.

3.2.2 Financial and fiscal measures

Countries having introduced financial incentives mostly offer loans at low interest rates often combined with a grant system (also housing allowances and funding). Apart from the subsidy volumes available for the instruments the systems differ in the conditions that need to be fulfilled to receive support. The grants usually cover a percentage of the total investments for the energy saving measure with a coverage of 15-40 % for different countries (see Table 3-1). There are programs that require implementation of certain technical measures in order to qualify for a grant of a certain percentage. Different countries have applied different approaches to ensure the efficiency of the financial measure. Since financial measures are financed through the fiscal budget the governments want to make sure that the investment, as necessary as it is, returns as much fossil energy savings as possible.

[5] http://ademe.typepad.fr/files/synth%C3%A8se-barom%C3%A8tre_aout2012.pdf

Table 3-1: Comparison of European financial incentive systems

	Scope	Conditions	Volume	Impact
Austria	residential buildings, new buildings (75%) and renovations (25%)	differ by state	2.85 billion 2005-2009; of which about 0,5 billion for renovations	334.3 ktoe through building envelope; 243.6 ktoe through efficient heating systems (1996 – 2010).
Bulgaria	residential buildings	credit line; 20% grant max 850€	50 million for credit line + 10 million for grants	from 2000 until March 2011 4.1 ktoe per year
Estonia	residential buildings, renovation of envelope	grant 15-35% of renovation cost depending on energy savings (20-50%) and size, renovation loan	October 2010 – Nov 2011 6,28 Mio Euro	not assessed (33%)
Czech Republic	residential; thermal insulation; new construction in passive standard; use of RES heating; Bonus for combination of measures	not described	1000 million EUR from 2009 - 2010	25.8 ktoe in 2010; 103.9 ktoe in 2013
Germany	refurbishment of residential buildings	energy performance of 55% to 115% of the requirement for new buildings; support depending on performance	loans comprising 4.2 billion Euro; grants of 75 million Euro	396.4 ktoe in 2007 and additional 561.2 ktoe in 2016
Ireland	residential buildings, wall insulation, heating controls, efficient boilers	Building energy rating	not described	257.9 ktoe in 2016 and 515.8 ktoe in 2020
Italy	heating systems, building envelope, Existing buildings	meeting required u-values, renewable heating, more support for exceeding u-values by 20%	tax credit	not described
Latvia	privately owned flats in multi-apartment building	20% energy savings monitored ex –post to implementation; financial efficiency of at least 2 MWh/year per EURO of financing	30 million EUR up to 2011	expected 20.64 Mtoe in 2016
Poland	residential and tertiary buildings	energy audit specifying alternative options with economic and technical details; review of audit report by designated authorities	23 – 70 million EUR annually since 2007, decreasing	696.44 ktoe in 2016
Slovenia	residential renovation and new buildings, renewables and efficiency in heating	new buildings need to meet a defined standard	2011 to 2016 estimated volume of 161 million EUR	envelope: 37.83 ktoe in 2016 and 55.03 ktoe in 2020; heating: 54.17 ktoe in 2016 and 76.52 ktoe in 2020

3.2.3 Informational and educational measures

There are lots of different concepts of information and educational measures ranging from the pure publication of informational material over consulting offers via telephone or in person and mass media advertising campaigns through monitoring and advice services of independent experts. These measures are primarily intended to induce a change in the users' behaviour by creating awareness of energy use and interest in its reduction. The effect of these measures is comparably low and hard to assess due to the facts that it is essentially difficult to measure the change of a single users' behaviour. Further, when a change in user behaviour is identified and quantified it is hard to determine its origin. Lots of informational measures are combined with other types of measures, like financial incentives. This combination leaves the question of the allocation of the energy savings open.

There are many national and European programs affecting the behaviour of users concerning their heating and hot water demand, though few directly focus on heat supply within buildings. Guidelines and data to inform the user about the areas where energy can be saved and how are made available through numerous European and national projects and websites. Such a website is for example “Energyoffice” and ‘Build up’ at European level. A further step is to consult the user in person or via phone. This provides the opportunity to answer specific questions according to the users’ situation. Such programs are for example ‘The Power of One’ in Ireland, the ‘Tailored Energy Advice’ in the Netherlands, the ‘energy information helpline’ in Norway and the ‘Energy advice for private consumers’ in Germany. Other programs encourage single users and groups of users to compete in saving energy through behavioural changes examples for such European programs are the ‘European Citizens Climate Cup’ and the ‘Energy neighbourhoods’. Outstanding are programs that go further than just offering information and advice. The British government has fixed its plan to roll out ‘Smart Metering and Billing’ throughout the complete country and has supported early installations and ensured all necessary technology and systems are being build and tested until the mass roll out in 2014. Connected to this is the establishment of a Data and Communications Company that enables the data collection and transfer needed.

3.2.4 Energy efficiency obligations

Energy efficiency obligations are another important tool for financing energy saving measures as they broaden the basis by including energy companies as private investors into the scheme. Table 3-2 summarizes the design features of the present systems.

Table 3-2: Design features of present energy efficiency obligations schemes

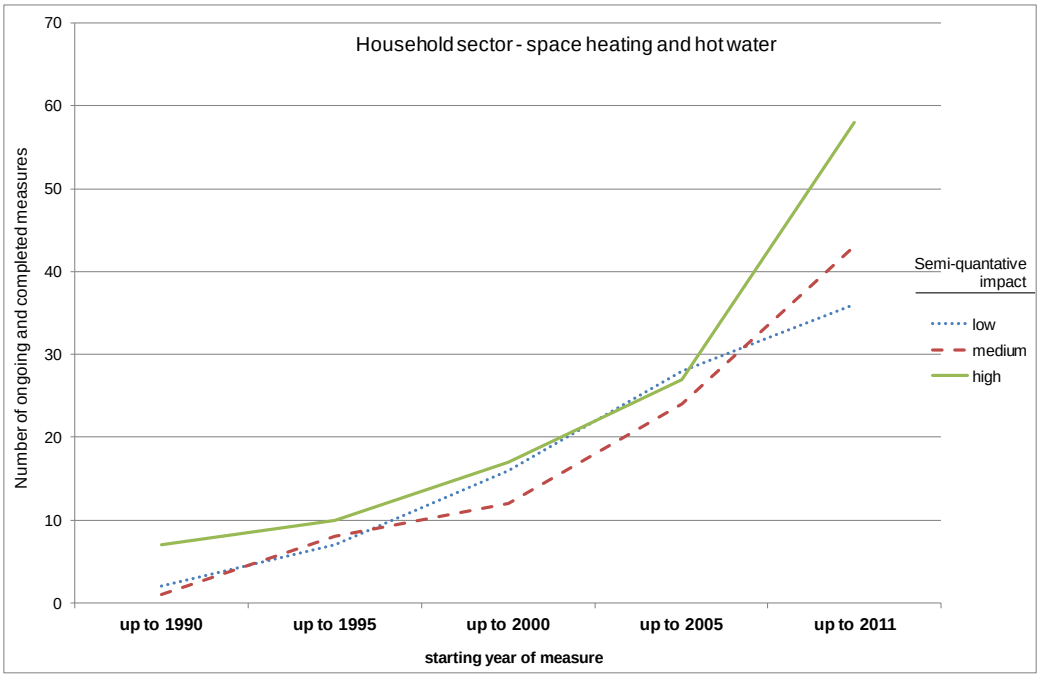
	UK	**France**	**Italy**	**Denmark**
Nature of saving target	Cumulative CO_2 emissions during the lifetime	Cumulated discounted final energy during the lifetime	Cumulative primary energy over 5 year period (buildings: 8 yr, CHP: 10 yr)	Final energy accounted only in the 1st year
Standardized saving target final energy ("Danish mode")	679.2 ktoe/a	971.6 ktoe/a	593.3 ktoe/a	146.2 ktoe/a
Standardized saving target final energy ("British mode")	20.4 Mtoe/a	9.9 Mtoe/a	6.3 Mtoe/a	1.5 Mtoe/a
Obligated companies	Energy suppliers	Energy suppliers	Energy distributors	Energy distributors
Actors authorized to realize saving measures	Participation of the obligated companies necessary	Participation of the obligated compa-nies necessary	No restriction	Participation of the obligated compa-nies necessary
Targeted sectors	Residential	Residential, tertiary, industry, transport	Residential, tertiary, industry,	Residential, tertiary, industry
Certificates trading	No, bilateral trading is possible	Yes (but limited trading activity)	Yes	No
Targeted end-uses of the energy-saving measures	62 % building refurbishment 25 % CFL	72 % heating systems 14 % building refurbishment 6 % transport 8 % industry	50 % electricity uses (also: energy-saving lamps) 25 % heating and hot water (also: shower heads) 20 % Industry	47 % industry 44 % residential
Quality of the induced saving measures	43 % of building mea-sures are cavity wall insulation; 57 % loft insulation. Distribution of 300 million energy-saving	Heating system measures: mainly exchange by condensing boilers (state of the art)	Distribution of 60 million energy-saving lamps (about 1 per inhabitant)	

	lamps (5 per inhab.)			

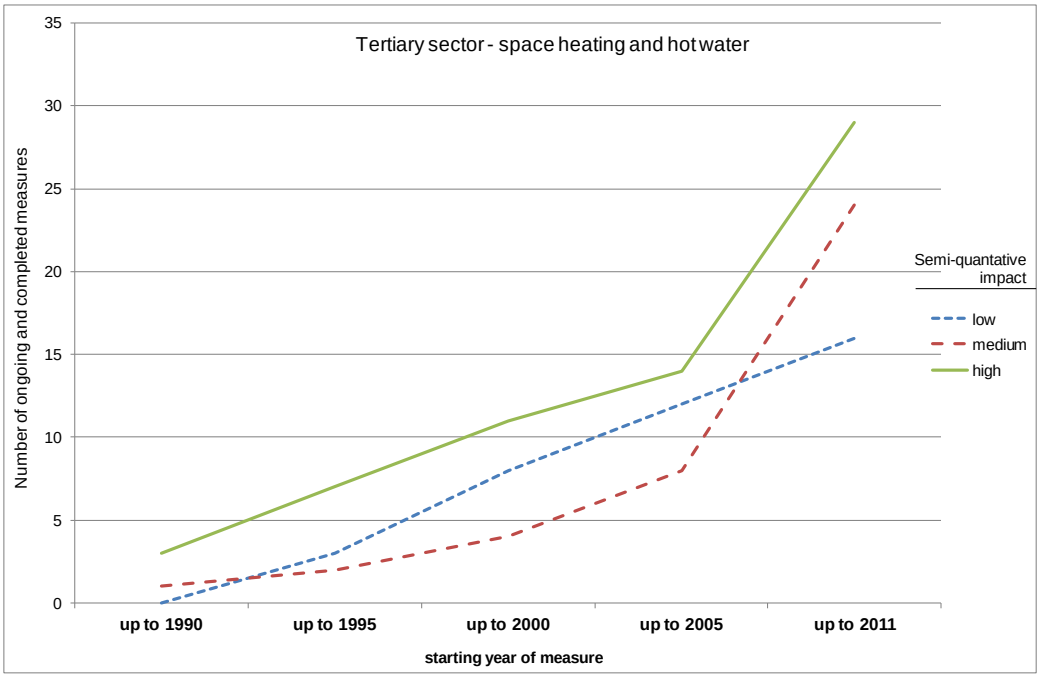
3.2.5 Impact of measures in the field of space heating and hot water

Though no full quantitative overview of impacts can be provided in this section, semi-quantitative impact categories[6] available in the MURE database show increasing impacts of the policy measures. This type of semi-quantitative evaluation provides useful information for screening the policy measures and establishing a first order estimate of the impact of policy measures. Figure 3-3 shows all measures addressing energy consumption for space heating and hot water in residential and non-residential buildings ordered by the semi-quantitative impact assessment since 1990. The share of high impact measures considerably increases for measures starting from 2005 or later, both in the household and tertiary sector.

Figure 3-3: Semi-quantitative measure impacts for space/water heating in buildings



[6] These semi-quantitative impact categories "low, medium or high" are linked to the energy or electricity consumption of the sector through a percentage range.



Source : MURE (as of April 2012)

3.3 Policies addressing electricity consumption in buildings

In this section we will focus on individual policies addressing energy efficiency in the field of electric uses in the residential and tertiary sector, focusing again on financial instruments but presenting also the full spectrum of other relevant instruments, in particular legislative-normative and legislative informative instruments.

Mandatory minimum energy efficiency requirement and mandatory energy labelling are the most important legislative measures addressing electricity consumption in residential and tertiary buildings. These are EU policies which have to be transposed into national law by the Member States and therefore also play an important role in the national mix of energy efficiency policies. In the following these EU policies are described more detailed.

3.3.1 Ecodesign Directive

The European Directive 2009/125/EC of 21 October 2009 establishes a framework for the setting of ecodesign requirements for energy-related products ("ErP"). The "ErP"creates a framework for the constitution of requirements to an ecologic design of products that are related to energy. It replaces the European Directive 2005/32/EC from 6 July 2005, better known as "Energy-using Products" ("EuP") Directive. The "EuP" which had to be transformed into national law by the member states until 11 August 2007 was related to energy efficiency and environmental compatibility of electronic devices only. The subsequent directive, "ErP", includes - besides products that actively need electricity - those which are relevant for energy consumption and influence energy efficiency such as insulating materials. It had to be translated into national law until 20 November 2010. The "EuP" respectively the "ErP" builds the basic of a variety of implementing regulations. In addition to the implementing regulations already in place, almost 40 energy-using product groups are in preparation as well as some energy-related product groups such as windows, insulation material or shower heads. Voluntary agreement instead of regulation is discussed too (as e.g. for complex set-top boxes or imaging equipment).[7] According to the impact assessment of the Directive, the first 12 implementing measures are estimated to allow yearly savings by 2020 equivalent to almost 14% of the EU final electricity consumption in 2009.

3.3.2 Energy Labelling Directive

Energy labels are thought as a complementary instrument for minimum energy efficiency requirements. Whereas efficiency standards shall remove the less energy-efficient products from the market, energy labels shall help consumers choosing the most energy-efficient products and also to provide incentives for the industry to develop and invest in these products. Directive 92/75/EEC of 22 September 1992 on the Indication by labelling and standard product information of the consumption of energy and other resources of household appliances has been substantially amended by Directive 2010/10/30 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. Where the scope of Directive 92/75/EEC is restricted to household appliances, an extension to energy-related products which have a significant direct or indirect impact on energy consumption during use is covered by the Revised Directive for Labelling of Energy-related Products (Directive 2010/30/EU), which entered into force on 19 June 2010. [8] Energy labelling requirements are already in force for a number of products and the Commission plans to adopt delegated regulations for energy labelling in parallel with the adoption of the Ecodesign regulations. It is estimated that energy labelling has contributed to annual energy savings in the order of 3 Mtoe in the period 1996-2004. According to the impact assessment, the recast Directive, when fully implemented as

[7] A comprehensive overview of the legislation process is also given on the eceee website (http://www.eceee.org/Eco_design).
[8] For detailed information on the EU legislation on energy labelling see : http://ec.europa.eu/energy/efficiency/labelling/labelling_en.htm

planned, is estimated to save 22 Mtoe by 2020 and some 5 Mtoe additional savings from the broadening on the scope.

3.3.3 Financial and fiscal measures

Compared to the financial support given for energy efficiency investment in the field of space heating and hot water, there are relatively few financial and fiscal policy measures promoting the spread of energy-efficient electrical appliances in the residential and tertiary sector. Many countries providing extended financial support programmes with regard to space heating do not have this kind of measures for electrical appliances (e.g. Germany or Austria). In addition, some of these programmes are included in a broader instrument, as e.g. energy efficiency obligation schemes.

Another broad financial instrument supporting energy efficiency investment is an energy efficiency fund. Such funds have been established in a considerable number of Member States. In the MURE database, these funds are mainly described in the cross-cutting section, since they usually address more than one sector. Nevertheless, many of them also include specific programs addressing electricity consumption in residential and tertiary buildings. Such funds are established e.g. in Bulgaria, Czech Republic, Denmark, Germany, Greece, Malta, Norway (at local level), Slovakia, Slovenia or UK.

Some countries have introduced subsidies or tax incentives to promote energy-efficient household appliances or lighting (Table 3-3).

Table 3-3: Financial/fiscal measures for electricity consumption in buildings

Country	Scope	Conditions	Budget	Impact
Bulgaria	Household appliances	Credits for purchasing energy-efficient electrical appliances.	276 million €	2016: 66 ktoe
Hungary	Household appliances	Max 225€ for Class A appliances, max 260€ for class A+ and A++ refrigerators (the last 10 percent of the subsidy was only paid after the successful termination)	3.7 million €	n.a.
Malta	Lighting in households	A number of energy saving lamps (CFLs) free of charge for every household	Not described	2010: 3.5 ktoe
Spain	Appliances	Mix of labelling, financial, training and informational measures to promote-efficient lighting in existing buildings. Target: substitution of 300000 appliances/yr	Public support 2011-2020: 500 million €	In 2020: 92 ktoe
Spain	Lighting in buildings	Mix of minimum efficiency standards, financial, training and informational measures to promote-efficient lighting in existing buildings. Target: replacement of 34 million incandescent light bulbs in households and acting on 200 million m2 of floor space area in buildings.	Public support 2011-2020: 192 million €	In 2020: 842 ktoe
Italy	Refrigerators and freezers, lighting in non-residential buildings	Incentive of up to 200 € for any A+ refrigerator and freezer purchased by 31.12.2007 and tax incentive of 36% for efficient lighting in non-residential buildings in 2009.		n.a.
Italy	Household appliances, standby, lighting	Campaigns addressing appliance labelling, reduction of standby consumption, and energy-efficient lighting.	Fund: 1 million €	n.a.
Luxem-bourg	Promotion of efficient refrigerators (A++)	Subsidies for the purchase of highly efficient electrical appliances	n.a.	2010: 0.25 ktoe

3.3.4 Informational and educational measure

There are many national programs in the Member States which aim to change consumer behaviour regarding his energy consumption and to be more concerned of energy efficiency in his purchasing decisions. The most common way for informational and educational measures is promoting more energy efficient usage through campaigns via print, internet and TV. Such campaigns were realized in many countries, like in Denmark, where a booklet with guidelines on energy consumption was given to all households in 2007. An example for a campaign via internet is the Austrian “topprodukte.at” web portal for consumers, which helps to find the most energy efficient products on the market. Another way to inform the consumer of energy efficient products is the introduction of voluntary labels like the “Blauer Engel” (Blue Angel) in Germany, which exists since 1977, or the Danish “Go’Energimærket” label, which is used on the market’s 20% most efficient products of a category.

A step further goes the “EFEKT” program in the Czech Republic. The purpose of this program is to assist in the organizing of exhibits, professional courses, seminars and conferences regarding energy saving and renewable energy sources and subsidies such events with up to 60% of the total cost.

Smart metering programs are used to reduce the energy consumption in many countries within the EU. The meters will record the actual consumption of the consumer and send the data to a central system of energy providers which will be collected and processed. Such programs exist in smaller or larger scale in Ireland, Greece, Spain and Austria. In Austria, where 24000 smart meters were installed in 2010, these programs also go along with an informative billing program like in Norway. The Norwegian informative billing program is estimated to save up to 3% of electricity consumption of participating households which results in 1.8 TWh/year.

The Austrian ongoing project “Wohnmodern” implements the direct consulting approach for modernization of large residential buildings. Advisers develop an analysis of the respective building, which involves important parameters in terms of efficiency as well as an inspection of the property. According to this information individual proposals for the refurbishment are offered. An assessment of the costs and the sponsorships helps the customer to make an objective decision.

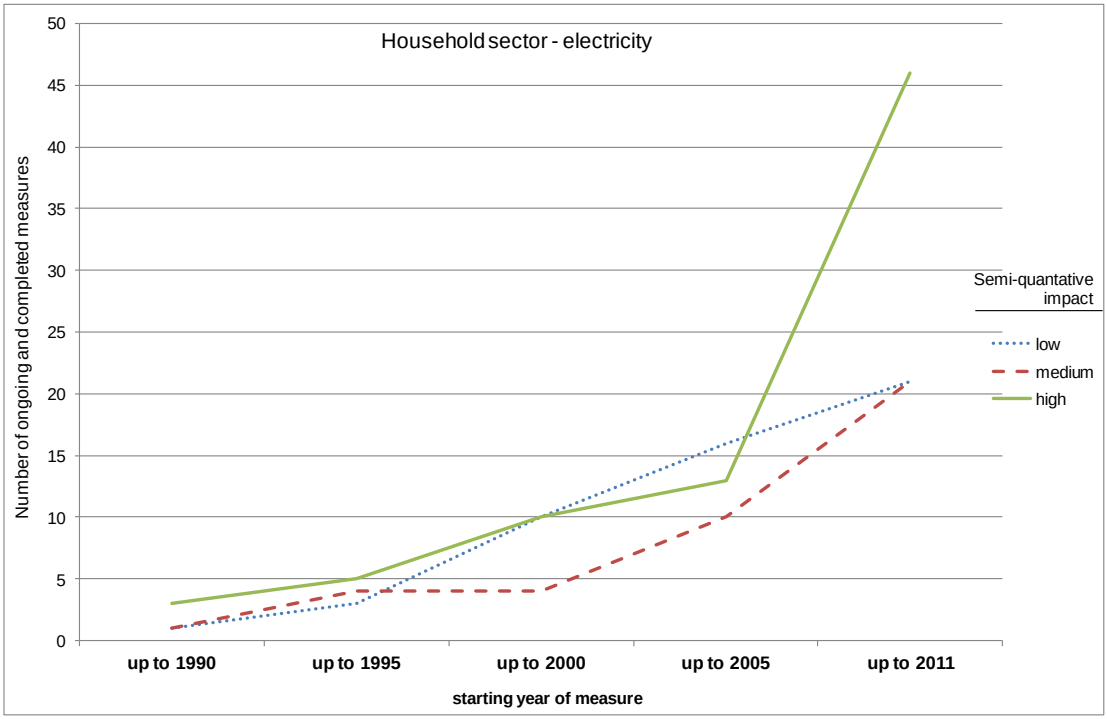
3.3.5 Energy efficiency obligations

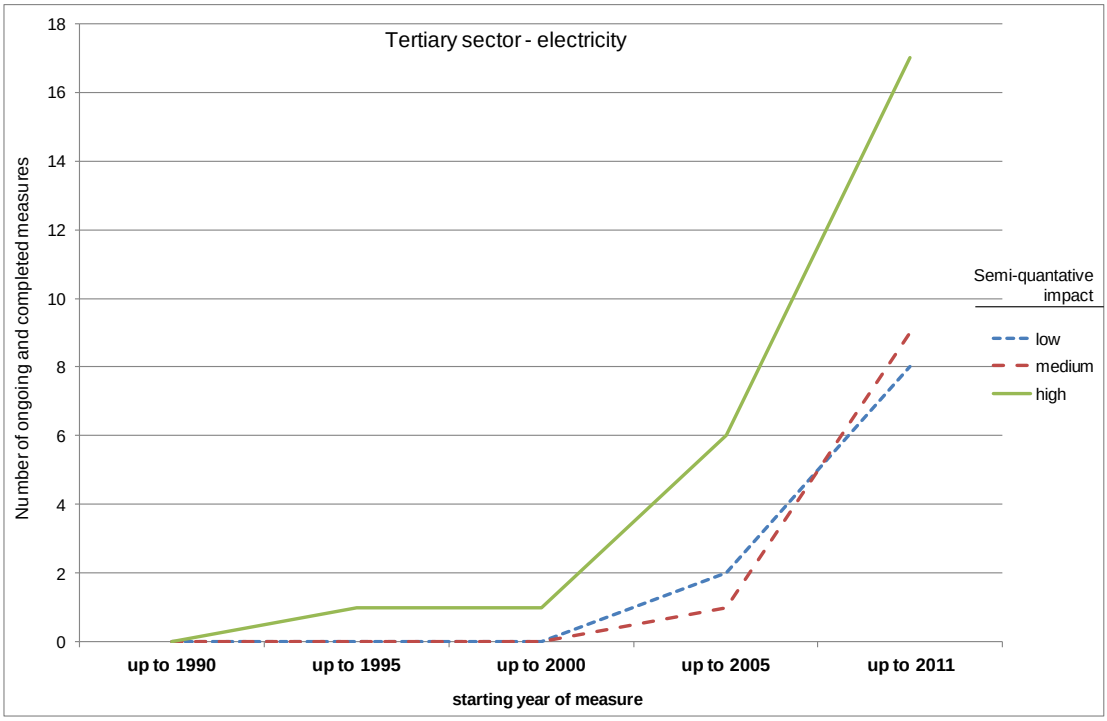
There is no energy saving obligation scheme with a special focus on appliances, likewise the British CERT scheme for buildings. Within this scheme, the eligibility of CFLs has ended, since every household in the UK has been delivered an average of 12 CFLs. Nevertheless except from this scheme, all the other saving obligation schemes also cover electricity use, nevertheless there are differences in the schemes’ design, which hinder the implementation of electricity targeted measures. In France, the accounting of the cumulated lifetime savings of final energy favours long-lasting measures in the fuel sector. In contrast the focus on primary energy in Italy and the accounting of first year savings in Denmark favour electricity savings. In Denmark a lot of appliances have been excluded from the obligation scheme, for these measures are covered well by other policies, so the accounting of these measures resulted in deadweight effects.

3.3.6 Impact of policy measures addressing electricity consumption

Figure 3-4 shows all measures addressing electricity consumption in residential and non-residential buildings ordered by the semi-quantitative impact assessment since 1990. The share of high impact measures considerably increases from 2005 or later, especially in the household sector. In the tertiary sector, the trend started earlier.

Figure 3-4: Semi-quantitative impact of measures addressing electricity in buildings





Source : MURE (as of April 2012)

3.4 Quantitative impact of NEEAP measures in buildings

In the building brochure, the energy efficiency measures of the NEEAPs of the EU Member States are analyzed at the aggregated level of EU-27. The focus of the analysis is on the building sector, including space heating consumption (plus sanitary hot water) and electricity consumption (without space heating and hot water). The measures included in the MURE database constitute the main analytical basis. In addition, savings reported in the 2nd NEEAPs[9] are also taken into account in order to get a more comprehensive picture of reported savings and also to include impacts of top-down calculated savings. MURE also provides a simulation tool to carry out calculations of final energy saving potentials covering all EU Member States. This tool was the methodological basis for the calculation of energy saving potentials in a study on behalf of the European Commission (Eichhammer et al. 2009).

Since the MURE Measure Database is structured by single energy efficiency policies, only the impact of bottom-up (BU) evaluated measures from the NEEAPs can be drawn from the MURE database. In addition, the energy savings reported in the 2nd NEEAPs are also taken into account directly from the NEEAPs[10] in order to get a more comprehensive picture of the reported savings and also to include the impact of top-down (TD) calculated savings. Top-down savings, however, were only taken into account for those Member States where no bottom-up calculations were available for the building sector. The top-down saving generally include the impact of autonomous progress and of energy efficiency policies previous to the period under consideration.

Table 3-4: Final energy saving in the building sector reported in the 2nd NEEAPs

	Residential sector			Tertiary (incl. Public) sector			Total Building Sector		
	Heating	Electricity	Total	Heating	Electricity	Total	Heating	Electricity	Total
Unit	Mtoe								
MURE: NEEAP measures	Based on information from 15 EU Member States			Based on information from 12 EU Member States					
2016	25	4	28	5	2	7	29	6	35
2020 (projection)	34	5	39	7	3	10	41	8	49
NEEAPs: only BU	Based on information from 19 EU Member States			Based on information from 18 EU Member States					
2016			33			7			40
2020 (projection)			46			10			56
NEEAPs: incl. TD	Based on information from 23 EU Member States			Based on information from 21 EU Member States					
2016			50			9			58
2020 (projection)			69			12			81
Saving Potentials (HPI)	All EU Member States (EU-27)			All EU Member States (EU-27)					
2016	51	5	56	18	7	24	69	12	81
2020	72	7	79	24	11	35	96	18	114

Sources: MURE Measure Database; National Energy Efficiency Action Plans of the EU Member States; Eichhammer et al. 2009; Ecofys & Fraunhofer ISI 2010; Boßmann et al. 2011; own calculations Fraunhofer ISI

An overview of the final energy savings calculated under these assumptions gives Table 3-4. In total, bottom-up calculated final energy savings in the residential and tertiary sector (including public sector, excl. agriculture) of around 40 Mtoe are calculated from the NEEAPs for the year 2016, the target year of the ESD. This result is based on bottom-up calculated

[9] All National Energy Efficiency Action Plans (NEEAPs) submitted by the Member States under the ESD can be found under http://ec.europa.eu/energy/efficiency/end-use_en.htm.
[10] http://ec.europa.eu/energy/efficiency/end-use_en.htm

energy savings in 19 NEEAPs, which provide bottom-up calculated energy savings at the level of end-use sectors. If also adding the top-down calculated savings for the residential and tertiary sector from 4 additional NEEAPs (Bulgaria, France, Greece, Netherlands)[11] , the total savings for the building sector in the year 2016 amount to around 58 Mtoe.

In order to compare these savings with the EU 20% saving target for 2020, a rough projection of the 2016 figures was also made for 2020, using a projection factor of 1.4.[12] This rough approach for projection may be justified in a first order, as the larger part of the measures address the buildings, where the build-up of the savings is rather linear over time well beyond the end of the ESD period in 2016. Based on bottom-up quantifications, total savings in the building sector of 56 Mtoe are projected for 2020 from the NEEAPs (based on 19 countries), which is not far from the savings of 49 Mtoe (based on 15 countries) projected from the information in the MURE database. When also taking into account top-down calculated savings from 4 additional Member States, the total final energy savings amount to in the building sector in 2020 amount to almost 81 Mtoe. This would be, only in the building sector, around 40 % of the total (primary) savings of 200 Mtoe which are still missing in order to achieve the EU 20% for 2020. However, it must be taken into account that all the calculations shown here are based on final energy, thus not taking into account the impact of renewable energies and the conversion sector, whereas the EU 20% saving target is based on primary energy. Furthermore, the missing energy savings for the EU 20% 2020 are by nature savings from 2006 additional to baseline projections, whereas the 81 Mtoe from the NEEAPs include a part of the baseline savings and some early energy savings before 2006 as explained below.

When comparing the reported savings with the saving potentials calculated in the High Policy Scenario, around 70 % of the estimated savings in the building sector are already exploited if both including bottom-up and top-down reported savings. When only taking into account BU measures, the exploitation rate is around 50%. However, an important point to note is that the NEEAPs also include so-called “Early Action”, that is policy measures but also often individual action initiated in the period 1995-2007 which still have an impact in 2016 (which is the case for example for most thermal building regulations from that period, the buildings built during that period according to this building regulation and which have a long-term impact). Only few NEEAPs provide enough information to separate clearly “Early Action” from new measures taken in the period since 2008. In addition, the top-down savings included do in general include also autonomous progress as the top-down indicators used are not corrected for such savings. This is evidenced by the comparatively large savings added by the four additional countries. They increase the savings from the 19 countries with BU approaches by around 64%. The bottom-up savings reported contain generally only policy measures; hence autonomous development is largely excluded (though it may in some measures be included to some degree in the form of free-rider effects, i.e. part of the impacts included are not a direct consequence of the measure but may have occurred anyhow). Previous estimates of the authors based on the first NEEAPs showed that on average up to one third of the measure impacts included in the NEEAPs may be due to Early Action. For example the German NEEAP comprises 45% energy savings from Early Action in the Residential/Tertiary sector (electricity conversion factor 1), the NEEAP of Luxembourg 41%, the NEEAP of the UK an estimated third of the savings, the NEEAP of Austria 42% (residential sector only), the NEEAP of Sweden 66%. The savings from the High Policy Scenario on the contrary do not include Early Action and are additional to a Business-As-Usual-Scenario which comprises autonomous progress.

[11] In 2 NEEAPs (Germany and Latvia), both bottom-up and top-down calculations are shown in the NEEAP; in that case, the BU-value was taken. For 4 EU Member States (Poland, Portugal, Romania, Slovakia), no impact evaluation could be taken into account since savings at the sectoral level were only quantified for interim years (2010 and/or 2013) or the NEEAP was not available in English.

[12] Only in a few NEEAPs (Denmark, Finland, France, UK) energy savings are also reported for 2020.

3.5 Designing efficient policy packages in the building sector addressing the financing needs and policy interactions

3.5.1 Financing energy efficiency policy measures in buildings

The study "The upfront investments required to double energy savings in the European Union in 2020" (Ecofys/Fraunhofer 2011) identified the additional investment costs to improving energy efficiency in the European Union with 200 Mtoe in 2020. Such an improvement would bridge the gap between current expectations of energy use in the European Union in 2020 and the targeted energy use, as derived from the EU's 20% energy savings targetAs a best estimate for the **total additional investment** the study finds a number of €900 billion over the period 2010 – 2020. The uncertainty range is from €800 – 1200 billion. This number was derived combining data from several bottom-up and top-down studies. The breakdown of the €900 billion is as follows:

- buildings: €400 billion (uncertainty range €350 – 650 billion);
- transportation: €400 billion (uncertainty range €300 – 500 billion);
- industry: €100 billion.

The uncertainty in the investments numbers is highest in the buildings sector because it has a big impact on costs whether retrofit is carried out in conjunction to regular refurbishment or not. The study assumed that most of the energy efficient retrofitting can be done in connection to refurbishment that will occur anyhow. If this is not the case, costs will become higher, in particular when renovation rates are enhanced beyond the present level as evidenced by Ecofys/Fraunhofer ISI 2011 (Table 3-5).

Those differential financing requirements of up to 100-110 billion Euro annually up to 2020 may be financed by different sources[13]:

- **State budgets:** this is for example the case of a number of subsidy programmes described in the MURE database such as the KfW programme in Germany. The large drawback of this type of financing is that in times of tight budgets it will be difficult to find the additional investments as the costs cannot be easily passed on to the tax payers although the energy savings will at the end relieve the pressure on the economy from reduced energy costs. It seems unlikely that through this path all the investment needs identified in the building sector could be covered. The advantage of this type of financing is that the means can be directed towards deep renovations.

Table 3-5: Cumulative energy efficiency investments (billion €2005) and energy savings

	Investments 2010-2020	HPI potential (final)	HPI potential (primary)
	€ billion	Mtoe	Mtoe
All sectors	**1633***	**166**	**216**
Households	**797**	**52.8**	**70.2**
Appliances	20	2.4	6.1
New Buildings	264	14.9	19.4
Existing buildings	481	33.2	40.7
Hot water	31	2.3	4
Tertiary sector	**284**	**23.2**	**34.4**
Appliances	59	7.5	18.6
New Buildings	17	0.8	0.8
Existing buildings	208	14.9	14.9

Note that the potentials mentioned are the remaining potentials for the period 2011-2020

[13] For much more complete overviews see in particular BPIE (2012) and Rezessy/Bertoldi (2010)

Source: Ecofys/Fraunhofer ISI 2011

- **Financing from state-like budgets**, e.g. the use of income from the emission trading scheme to finance energy efficiency investment. The drawback of this financing source is that it is heavily dependent on the CO_2 price, the advantage that is independent from the direct state budget. However, the temptation is large for governments to use such income not in a dedicated manner for energy efficiency options. In order to finance the large investment volumes required for building rehabilitation, the CO_2 price should be considerably higher than present levels in order to contribute substantially to the annual investment needs identified above.
- **Leveraging of private investments from companies in the energy sector** through energy saving obligations/White Certificates: This has the advantage in opening new, more stable, financing sources. At the end the cost will be passed on to the consumer. The advantage is that private investments are leveraged and that energy companies may possibly develop into energy service companies. The disadvantage is that, if no special provisions are taken, mainly shallow refurbishments are undertaken.
- **Leveraging of private investments from through energy service companies**: Here the charge is totally on the private sector. The investor gets his money from the reduced energy cost of the client. This has the advantage that markets are developed for energy services and that the energy consumer is (in principle) not charged additionally and may even get a (small) reduction in energy cost during the phase when the investment is paid off. At present, mainly energy conversion options or options that pay off rapidly are financed in such a way (boilers, HVAC systems, building control systems etc.) while deep renovations including the building envelope are rather rare due to the long payback time. An option may be to subsidise the payback to a rate interesting for the energy service companies. Also risk mitigation is an important aspect where the state generally plays a role.
- **Financing through a levy on energy consumption ("Feed-in tariff for energy efficiency"):** this is in principle similar to the promotion of renewable through feed-in tariffs – while energy saving obligations are the equivalent to quote systems for renewable - and has the substantial advantage of financing stability and risk-lowering. On the other hand, given the fact that renewable already charge heavily especially electricity prices in some countries, it may be difficult to levy in the same way the large investments for refurbishing existing buildings. However, in difference to renewable, where first the costs are positive and serve to pay their cost down along the cost degression curve, energy efficiency options provide after some time, benefits to the consumers due to lower energy bills. Also the energy consumption on which the costs for energy efficiency investments are charged should cover a much larger range than just electricity consumption but also fossil fuel use.
- **Combining different sources in an Energy Efficiency Fund:** one important possibility of generating the funds necessary for the large investments is combining different sources discussed in the previous point in a general energy efficiency funds, such as the EU Energy Efficiency fund but at a much larger level of volumes. Combining the sources would have the advantage of taking the largest basis possible, though, in most cases, the final consumer would carry the charges in some way. Energy efficiency funds offer more flexibility in promoting innovative technologies and solutions than other financing sources.

This discussion of pros and cons shows that in order to deal with the challenge of a large reduction in energy consumption of buildings a combination of financing instruments is necessary; otherwise the large investment needs could not be levied.

3.5.2 Financing energy efficiency in the public sector

Tight public budgets raise the question on how energy efficiency could be improved in the public sector and what role financing plays in that context. On the other hand, there could be at present an enormous push to building refurbishment exactly as a consequence of the economic crisis: first of all, as public money gets rare, public buildings could save large amounts on the budget. Second, through investments in buildings, based on public or private sources, the presently low running European economies could get a push that helps to emerge from the crisis.

Article 5 of the Energy Efficiency Directive EED advocates an ***exemplary role of public bodies' buildings***: By 1 January 2014, 3 % of the total floor area of heated and/or cooled buildings owned and occupied by central governments is to be renovated each year to meet at least the minimum energy performance requirements that are set up in application of Article 4 of the EPBD (Directive 2010/31/EU).

This exemplary role of the public sector requested by the EED need to be fulfilled by a combination of instruments, including financial instruments. Many of these examples imply public budgets to provide grants for investments. An extended discussion of these aspects in the main report on buildings makes appear three aspects:

- the large scope for low-cost measures in the public buildings and their large potential which is well-illustrated with the case of Ireland and the activities of the Office for Public Works in Ireland.
- the limits of the approach when it comes to investments, and in particular investments into the building envelope with comparatively large sums and longer periods of return, also illustrated with the example of Ireland.
- The emerging role of Energy Service Companies ESCOs to build the bridge beyond the public budgets but not without difficulties, especially when it comes to finance deep renovations including the building envelope with its long payback periods.

3.5.3 Social impact of policy measures in the building sector

Rising energy prices threaten the poorest households, and subsidizing the price increase, as done in some EU Member States in the past[14], is not a long-term option as public budgets will not allow for such subsidies at a large scale.

Energy efficiency improvement is an important long-term means to combat fuel poverty. Energy efficiency measures will finally pay off for the individual consumer, as well as for the whole economy. However, mobilising the upfront-investments has strong distributional aspects and may impact on the poorest part of the population. Energy efficiency policies have therefore to be designed to allow the poorest households to undertake the necessary investments or put the burden on stronger investors. This is the rational for policies like energy saving obligations with a special target for fuel pour households or the Green Deal in the UK.

For poor households the terms “fuel poverty”/“energy poverty” have become common. In the definition used by the UK, a household is said to be fuel poor if it spends more than 10 per cent of its income on fuel to maintain an adequate level of warmth. Although the emphasis in the definition is on heating the home, modelled fuel costs in the definition of fuel poverty also include spending on heating water, lights and appliance usage and cooking costs. The 10% threshold was criticised as not reflecting adequately all populations which suffer from high energy prices, and a twice-median threshold was therefore proposed more recently[15]. This

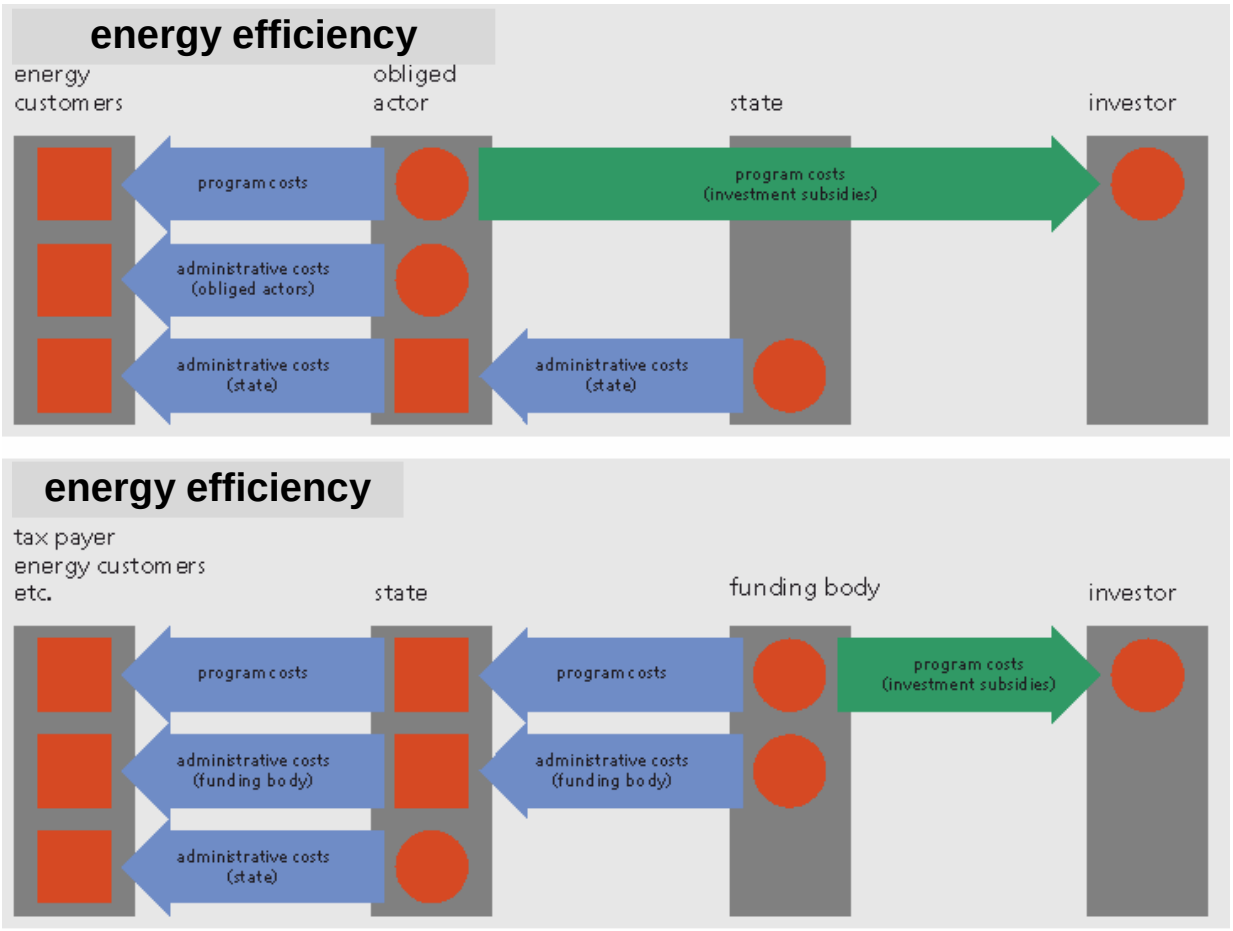
[14] For example, France had introduced a subsidy for the poorest households during 2007-2009 (“prime à la cuve”) which reached up to 200 Euros for households that do not pay taxes. The subsidy was not reconducted in 2010 with the effects of the financial and economic crises on state budgets.

[15] See the discussion of this threshold by Liddell et al. (2011). The paper emphasises that a national fuel poverty prevalence rate, based on a national twice-median, remains vital for ensuring parity across the regions, especially in the achievement of the long-term goal of eradicating fuel poverty wherever practical.

was taken up by the European Commission (2010a). The overview by the EU Commission shows that 27 million households or 65 million persons were concerned by fuel poverty with most of the data from 2005, i.e. before the strong rise in energy prices. This number is therefore to increase in the future.

The fuel poverty data may be used to help develop and target policies towards those most likely to be fuel poor, or those most at risk of falling into fuel poverty. Energy efficiency policies are thought to alleviate fuel poverty at the longer term but may also generate considerable distributional impacts due to the high upfront-investments. Such distributional effects need to be considered in the design of policy instruments in the building sectors. Figure 3-5 shows the general distribution effects of different instruments in the field of energy efficiency policy. The graphics concentrates on two major instruments and their distributional effects. The main report on buildings discusses the distributional effects of more policies.

Figure 3-5: Distributional effects of important energy efficiency policies



Those distributional effects may require actions to mitigate the strongest effects. One possible target group for energy efficiency measures which is increasingly discussed with regard to building renovations are low-income households:

- **Slovenia** has a special scheme of energy efficiency for low-income households. Also, in the other funding schemes of Slovenia the issue of fuel poverty is explicitly addressed.
- In **France**, a target has been set to renovate the 800 000 most energy hungry social dwellings by 2020.
- In the **UK**, besides the CERT-scheme, there are other funding schemes directly connected to fuel poverty, such as the warm front scheme.

- In **Germany** an energy check supports low-income households with a cost-free energy audit and direct support with instant technical measures.

3.5.4 Innovative financing measures in the building sector

In this section we will focus on innovative measures to finance building rehabilitation and in particular debate the idea of an energy efficiency levy or Energy Efficiency "Feed-in tariffs" (FiTs). This is in principle similar to the promotion of renewable through feed-in tariffs – while energy saving obligations are the equivalent to quote systems for renewable - and has the substantial advantage of financing stability and risk-lowering. On the other hand, given the fact that renewable already charge heavily especially electricity prices in some countries, it may be difficult to levy in the same way the large investments for refurbishing existing buildings. However, in difference to renewable, where first the costs are positive and serve to pay their cost down along the cost degression curve, energy efficiency options provide after some time, benefits to the consumers due to lower energy bills. Also the energy consumption on which the costs for energy efficiency investments are charged should cover a much larger range than just electricity consumption but also fossil fuel use.

A simple calculation, taking into account the financing needs of around 80 billion Euro annually for the built environment up to 2020, shows by much energy prices may need to be increased to cover those financing needs. The Primes projections from 2009 (European Commission 2010b) estimate the energy costs for the EU27 with 1220 billion Euro2005 in 2010 and 1729 billion Euro2005 in 2020. **Levying 6% annually would raise between 70 and 100 billion Euro annually, hence enough to cover the financing needs for the building investments.** However, in difference to the feed-in tariffs for renewables, this is not an extra cost to buy the cost of renewable down along the cost degression curve but would come back to the economy over time in the form of reduced energy costs and imports. Hence on average there would be net benefits to the consumers. For comparison: electricity is charged at present in Germany since 2012 with 5.3c/kWh under the feed-in tariffs, hence roughly at a level 20%. Naturally the more fuels and groups are exempted from such a levy, they higher gets the charge on the other consumers, as is the case for the feed-in tariff in Germany, which levies only on electricity and exempts industries mostly from the levy.

It is important to underline that energy levies are not new. For example Germany has put eco-taxes on different types of energy carriers. There are many other examples gathered in the MURE database under the category of fiscal measures. However, none of these levies have been used to a large degree and in a dedicated manner to cover investment needs for energy efficiency.

Several recent sources debate advantages and disadvantages of such a system:

- A recent report published by Neme and Cowart (2012) concludes that until an efficiency FiT is tested on a large scale, it is difficult to make definitive determinations as to how it compares to energy savings obligations and/or other policy mechanisms for generating energy savings.
- Green Alliance (2011) debates a demand reduction FiT for electricity in UK.
- New financing instruments for renewable heat are discussed at present in Germany. At present renewable heat in Germany is promoted with a subsidy programme ("Marktanreizprogramm MAP). Since 2011 part of the programme means are provided by the Energy and Climate Fund. The German "Energiewende" plan provides for an explicit mandate to investigate such budget independent promotion schemes for renewable heat, notely *premium or portfolio models* (Seefeldt, 2011; Nast et al., 2006; Seefeldt et al., 2012). In Germany the Ministry of Finance submitted in 2011 a proposal to switch climate protection measures in the heat sector, especially for thermal building rehabilitation to a market-based solution (BMF, 2011). The premium model is further discussed in detail in Küchler/Nestle (2012) for both renwables for heat and energy efficiency measures in the building sector.

3.6 Conclusions

The large financing needs identified earlier may require combining different financing instruments. In addition, to tackle the barriers hindering energy efficiency improvements in building a combination of several political instruments seems reasonable as none of the described policies alone delivers the desired savings with regard to the energy efficiency targets. Every policy package should comprise regulatory as well as incentivising instruments ("stick and carrot"), where the regulatory instruments define the technological baseline. Other instruments may either encourage investors to undertake measures complying with this baseline or may set incentives to exceed standards significantly. Especially for the building itself a regulatory instrument alone will not be able to target the existing building stock. Ambitious regulatory approaches are hampered by ownership rights and deep renovations may not be possible under such an approach. In contrast, regarding the replacement-driven market of household appliances, a regulatory approach may be highly successful. Nevertheless a combination with financial incentives to invest in even more energy efficient solutions still may enhance the impact of the instrument.

In the building report six coherent combinations of policy instruments are described which cover an increasing perimeter and could be able to provide in principle – with more or less barriers - the large upfront-investments specified earlier:

- ***Policy Path 1 - a combination of regulation and financial incentives based on state budgets:*** This policy path is a combination of financial incentives based on state budgets combined with regulation. The status of regulation reflects the actual situation in Europe, where buildings are subject to a broad regulation in accordance with the EPBD. The regulation of appliances does not (yet) includes all product groups and is therefore incomplete. Le limitations of this combination of instruments stem from the limitations on state budgets.
- ***Policy Path 2 - a combination of regulation, financial and fiscal incentives:*** This extends the instrument mix of path 1 by adding tax relief schemes to the instrument mix and assumes a broad extension of product regulation. Additionally the financial incentives may be extended to some appliance categories.
- ***Policy Path 3 - a combination of regulation, financial and fiscal incentives and saving obligation schemes:*** This path includes the experiences with saving obligation schemes and represents an even wider mix of instruments. The saving obligation schemes introduced in this path include appliances as well as some parts of measures related to the building itself but does not cover deep renovation due to the difficulties that such an instrument, whose main feature are standardised energy savings, may encounter for such applications.
- ***Policy Path 4 - a combination of regulation, fiscal incentives and an energy saving trust:*** This path is a reduction of the instrument set, preserving a broad range of application. The role of state funded support schemes is taken by an energy saving trust (which may of course be also funded by some tax money). Such a trust, possibly including a tender system, could cover all sectors. Still some tax relief schemes covering the buildings themselves seem reasonable due to rather high upfront costs.
- ***Policy Path 5 - a combination of regulation, fiscal incentives, energy saving trust and saving obligation schemes:*** The advantages of an energy saving trust and a saving obligation scheme are combined in this policy path. The saving obligations cover the measures suitable for deemed savings, the appliances. The saving trust thus covers the more complex measures with longer payback times covering the building structure.
- ***Policy Path 6 - a combination of regulation, financial and fiscal incentives, energy saving trust and saving obligation schemes:*** Finally path 6 is a combination of all the approaches mentioned before, including a saving trust, saving

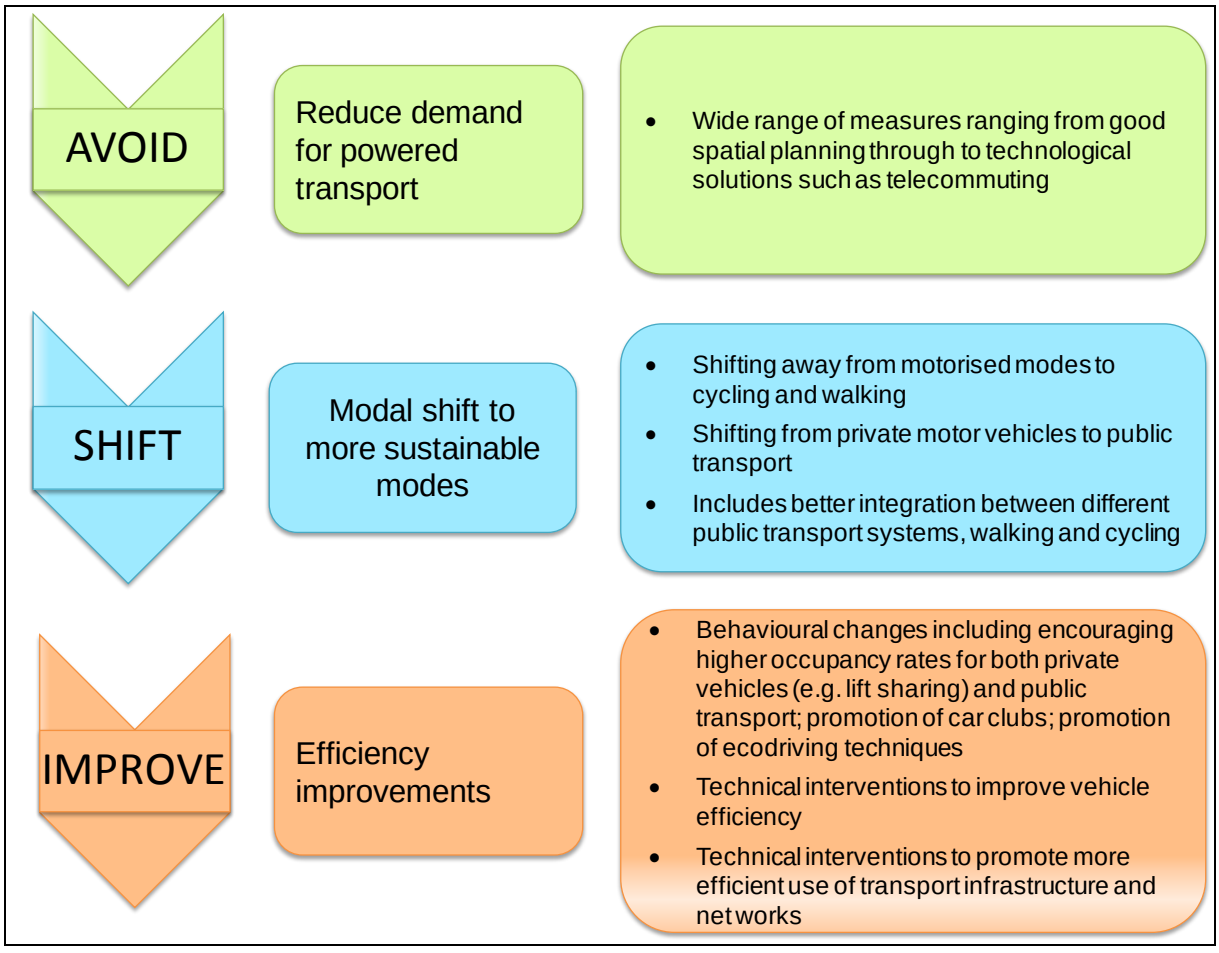
obligation schemes, financial and fiscal incentives and tightened regulation. In such a case the interaction between the instruments could be complex and a careful design of the individual instrument is necessary taking into account the overall objectives.

4 Energy Efficiency Policies in the EU Transport Sector

4.1 Sustainable hierarchy for transport measures

Globally transport is the sector with the highest final energy consumption and, without any significant policy changes, is likely to remain so. It is responsible for about one-fifth of CO_2 emissions in the EU, and emissions from the sector are still rising rapidly. The recent EU White Paper (EC, 2011) has however set a clear quantitative target for the reduction of GHG emissions from transport[i], of 60% by 2050 from 1990 levels (which is equivalent to about a 70% reduction from 2008 levels), with an interim goal of reducing emissions by around 20% below their 2008 level by 2030.

Figure 4-1 Sustainable Hierarchy for Transport Measures



It is widely recognised that the transport sector remains one of the most challenging areas for improving energy efficiency, and that while in the past, measures have focussed on technological improvements, there is the need to move towards a more holistic approach, which includes reduction of transport demand and shift of transport to more environmentally

friendly and energy efficient modes. A 'hierarchy' for sustainable transport policies has been identified (e.g. SDC, 2011; EEA, 2010) which prioritises demand reduction, and modal shift.

Historically there has been a tendency for measures to focus on technological solutions to improve vehicle efficiency, particularly of cars. A review of the first National Energy Efficiency Action Plans (NEEAPs) submitted by Member States[16], found that although there had been significant improvements over recent years in vehicle technology, particularly fuel efficiency, these were not sufficient to neutralize the effect of increases in traffic and car size. On the other hand the review also found that only a few Member States reported a clear and consistent strategy for modal shifts to more energy saving modes of transport.

The IEA has also recognised the need to tackle transport sector energy consumption in a more comprehensive way. In 2008 it made four key recommendations on transport, concerning tyre efficiency, fuel economy of light and heavy duty vehicles and ecodriving, In 2010, a review of implementation of these recommendations in Member States (which concluded that none of the recommendations had been fully implemented in all counties) recognised that the original recommendations mainly focused on vehicle and tyre efficiency and did not address driver behaviour (aside from the recommendations on eco-driving) or travel demand. Their recommendations have subsequently been expanded to include other aspects of vehicle efficiency and modal shift (Box 4-1).

Box 4-1 IEA Recommendations on Transport Energy Efficiency

As part of a set of 25 energy efficiency recommendations, the IEA has made the following five recommendations for measures to tap energy savings in the transport sector:

- Implement and periodically strengthen mandatory fuel-efficiency standards for light- and heavy-duty vehicles; for heavy duty vehicles this includes establishing testing procedures
- Adopt measures such as labelling, incentives and taxes to boost vehicle efficiency and accelerate the market penetration of new efficient vehicle technologies. This should include Infrastructure support and incentive schemes for very low CO2- emitting and fuel-efficient vehicles.
- Put in place policies to improve the performance of tyres, air conditioning, lighting and other non-engine components that affect a vehicle's fuel efficiency. This should include mandatory fitting of tyre-pressure monitoring systems on new road vehicles and the introduction of energy efficiency requirements for air-conditioning systems
- Promote eco-driving by making it a required element of driver's education programmes and requiring feedback instruments in new vehicles.
- Enable policies that increase the overall energy efficiency of national, regional and local transport systems, and promote shifts of passengers and freight to more efficient modes. Policies should ensure that users pay the economic, environmental and energy security-related costs of the transport system, that transport infrastructure is built to support the most energy efficient transport modes, and that urban and commercial development planning takes into account the likely implications for transport and energy demand.

Source: IEA, 2011.

A wide range of types of measures are discussed in the transport report, ranging from regulations, to fiscal measures to information type measures and voluntary agreements. Most of the measures discussed in the report are national measures, as the MURE database is not designed to include local or regional measures (unless the measure is particularly innovative and could be easily replicated in a number of regions or localities). Similarly, infrastructure developments (such as introduction of high speed rail lines) are not included.

[16] SEC(2009)889 final MOVING FORWARD TOGETHER ON SAVING ENERGY
Synthesis of the complete assessment of all 27 National Energy Efficiency Action Plans as required by Directive 2006/32/EC on energy end-use efficiency and energy services COMMISSION STAFF WORKING DOCUMENT

However both of these types of measures can have a role to play in developing programmes to reduce transport energy demand.

4.1.1 EU wide policies

Within the EU, policies to improve transport energy efficiency have been focussed on passenger cars, but have more recently been expanded to include vans and, through its inclusion in the ETS, aviation. Specific policies include:

- Regulations setting CO_2 limits for new passenger cars and vans from 2012
- Regulations requiring gear shift indicators in new passenger cars from 2012
- Regulations requiring tyre pressure monitoring systems in new cars from 2012, the use of low rolling resistance tyres on new cars from November 2014, and the introduction of a labelling scheme specifying the rolling resistance of tyres in 2012.
- Inclusion of the aviation sector in the EU ETS from 2012

More details of these policies and discussions of how some of these policies have been implemented in Member States are included in the relevant sections of the report.

Looking forward, the recent EU White Paper on transport (EC, 2011) has set a target for the reduction of GHG emissions from transport[ii], of 60% by 2050 from 1990 levels (which is equivalent to about a 70% reduction from 2008 levels), with an interim goal of reducing emissions by around 20% below their 2008 level by 2030. In addition to this there are specific targets for reducing CO_2 emissions from maritime bunker fuel use (40% reduction by 2050). On the passenger side, a key aim is to phase out the use of 'conventionally-fuelled cars in urban transport, and on the freight side, The paper proposes 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.

4.1.2 Policy Measures in Member States

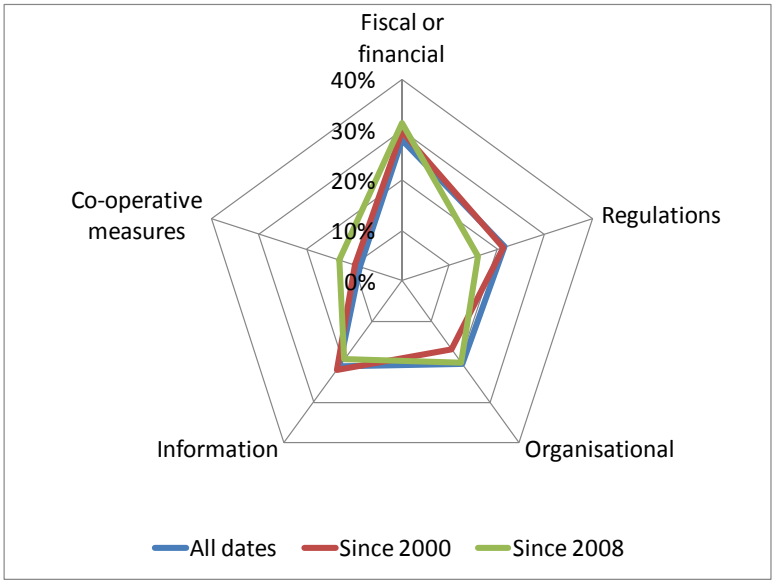
Member States have implemented a wide range of policy measures in the transport sector. The MURE database contains examples of 427 measures in the MURE database in the EU, Norway and Croatia, of which just over three-quarters (333) are ongoing. 30% of the reported measures have been implemented in the three years since 2008[17].

A wide range of policy instruments are used; the most common is fiscal measures, which now account for 28% of all measures, and are used in almost every Member State. In recent years (since 2008) there is a trend towards using fewer regulatory or normative measures, and more co-operative measures such as voluntary agreements (Figure 4-2).

The most common aim of measures (Figure 4-3) is improving the efficiency of passenger transport, predominantly through improvements to the efficiency of cars or measures to increase the uptake of cleaner vehicles, but also through promoting modal shift. Measures are however also beginning to tackle improving the efficiency of other modes, and encouraging modal shift of freight from road to other less energy intensive modes such as sea and rail.

[17] Measures were extracted from the database in November 2011.

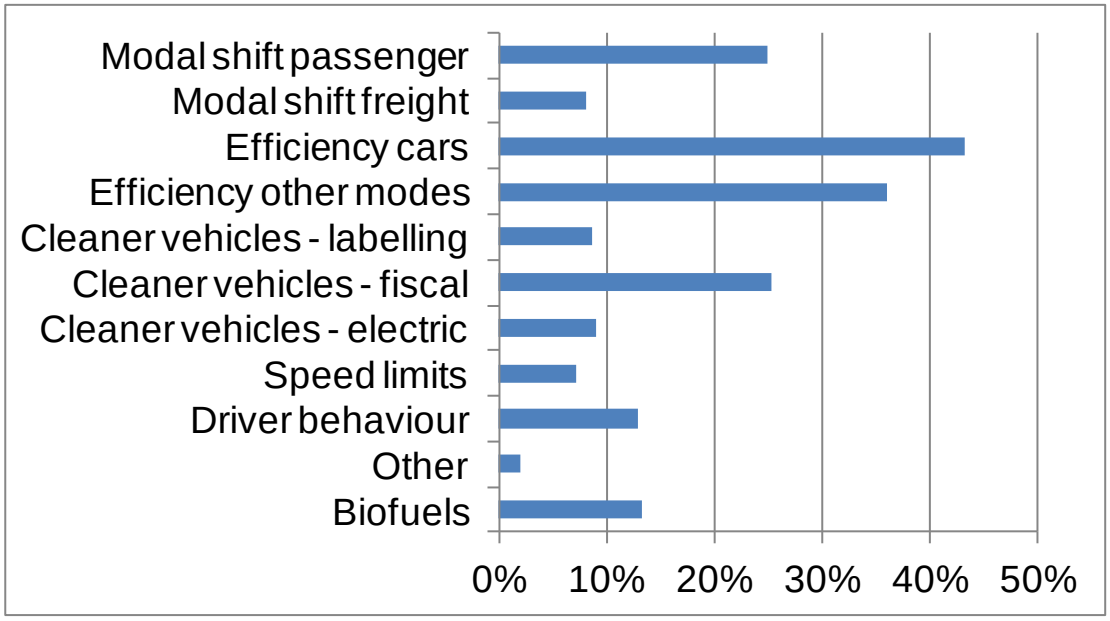
Figure 4-2: Types of measures implemented



Note: Regulations includes measures categorised in MURE database normative and organisational measures includes infrastructure and social planning measures

Source: MURE database

Figure 4-3: Main aims of ongoing measures



Note: adds to >100% as measures may target more than one aspect

Source: Derived from the MURE database

4.1.3 Transport Measures in the NEEAPs

A review by the Commission of the National Energy Efficiency Action Plans (NEEAPS) found a similar pattern in terms of types of measures and aim of measures. A large number included technological measures to improve vehicle efficiency and fiscal incentives and subsides to encourage cleaner vehicles, but fewer had policies on other strategies such as modal shift and mobility management (Table 4-1). Overall the Commission concluded that

while the increasing importance of energy use in the transport sector called for a more comprehensive and strategic approach that captured technological, infrastructural, financial, behavioural and spatial planning measures, only a few Member States had presented clear and consistent strategies in transport. In particular it found that well-described and sound packages of transport measures targeting behaviour change, including modal shift were rare and/or had been introduced as separate fragments that did not seem to form part of a coherent strategy encompassing other measures. In addition very few Member States included spatial planning aspects, although it was acknowledged that spatial and urban planning measures are related to local policies and hence may be only broadly sketched out at central level in the NEEAPS. Similarly, the wide variety of issues which need to be tackled in the transport sector, are often decided at different levels of government (central, regional and local) and fall within the competence of a number of departments and ministries.

Table 4-1: Member States identified as having 'good practices' in NEEAPs

Type of measure	No. of Member States
Tax incentives and disincentives: passenger vehicles	15
Support for public transport	13
Tax incentives and disincentives: freight vehicles	13
Eco-driving	12
Modal shift	9
Comprehensive strategies in transport	8
Mobility management	6
Tele-commuting	4
Car-sharing	3
Spatial planning provisions	2

Source: Derived from EC, 2009

4.2 Modal Shift

Energy savings for road transport can be achieved indirectly by reducing traffic whilst increasing the use of public transport (such as rail, metro and buses), cycling and walking, as well as the use of more sustainable modes for the transport of goods (such as shipping and rail). Moving to alternative modes of transport does not in itself contribute to energy savings in the road transport sector but is nevertheless an important measure to achieve the 60% GHG emission reduction target by 2050 set in the 2011 White Paper on Transport. Thus, this section will discuss the uptake of policies that aim to reduce traffic across EU countries by modal shift, either between motorised modes (e.g. private cars to public transport, heavy duty vehicles to rail) or to non-motorised (e.g. cars to bicycles).

It is interesting to note that more than half of the measures in the MURE database include an infrastructure element, i.e. involving the development, extension or improvement of the transport infrastructure, although a quarter of these also include an information / education / training element to maximise the efficiency of the initiative. Furthermore, nearly a third of the measures aim to promote or provide information, education and training, although this is once again often combined with other types of action (e.g. infrastructure, financial, fiscal, social planning / organisational and co-operative elements).

Overall, from the 27 EU countries, Norway and Croatia, all but Romania, Portugal and Lithuania have implemented national or local modal shift measures (122 measures[18]) that

[18] The MURE Transport brochure is based on measures entered in the MURE database as of December 2011.

aim to change traffic patterns and reduce the use of cars. Nearly a third of these measures were put in place since 2008, of which, three quarters are still on-going and most of the remaining ones are proposed. Two of the most active countries putting in place modal shift measures recently are Spain and France, whilst overall, Estonia, Germany, Ireland, Italy and the Netherlands have also been very active in putting in place modal shift measures.

With regards to the impact of modal shift measures, approximatelly half of the measures are expected to have a low impact, whilst nearly a quarter are expected to have a medium impact and even fewer than that are expected to have a high impact.

It should be noted that measures that have been categorised under “modal shift” and are included in the analysis in this section may also be relevant and included in the analysis of other sections. For instance, a measure may promote modal shift between motorised modes by extending / improving the transport infrastructure, whilst at the same time encouraging the uptake of cleaner vehicles. The same applies for the sub-sections on modal shift, i.e. a measure may include actions that promote both a shift between motorised modes and to non-motorised modes, thus, will be considered in both categories.

4.2.1 Shift between motorised modes

Modal shift between motorised modes has been considered separately for the transport of passengers and for that of goods. The first primarily targets private cars, shifting passengers towards the use of public transport, whilst the latter targets vans and heavy duty vehicles, shifting the transport of goods to more sustainable modes.

Modal shift for passengers

A total of 88 modal shift measures have been implemented or have been proposed, in order to encourage passengers to use more energy efficient transport modes across the EU27 countries. These can be split into the three following categories:

- To **develop and / or improve public transport services to encourage and incentivise passengers to use public transport services**, a number of countries have implemented or proposed measures that further develop, extend or improve public transport services and infrastructure such as increase transportation links between cities and airports (Cyprus), improve and extend existing metro lines with construction of organized parking near suburban bus and metro stations (Greece), build new metro lines (Greece, Hungary), improvements in the connections and effectiveness of the existing network (Greece, Ireland) and interventions in the traffic network of buses (Greece).
- To **provide financial incentives or disincentives** a number of countries have implemented or proposed measures that encourage and incentivise passengers to use public transport services. A number of countries have implemented or proposed measures that either increase the cost of travelling by car / air (using a tax, or penalties) (Germany, Denmark, Hungary) or subsidise the use of public transport (Germany, Slovenia, France).
- To **provide information and promote behavioural change** to encourage and incentivise passengers to use public transport services, a number of countries have implemented or proposed measures that provide information, raise awareness (Slovenia, Spain) and promote behavioural change, for instance by establishing information centres or developing website tools (Estonia) that facilitate the use of public transport as well as through campaigns or education programmes raising awareness on the benefits of using public transport.

The majority of measures are complementary and not implemented in isolation, thus combining, improving and extending the existing infrastructure with providing information and incentives to get passenger to switch from using their cars to public transport.

Modal shift for freight

A total of 43 modal shift measures have been implemented or have been proposed that encourage a shift for the transport of goods to more energy efficient modes by further developing (and / or improving) the transport infrastructure such as the French Sea motorways measure that supports sea motorway routes between France, Spain and Portugal and the Spanish measure to encourage the larger participation of railways in passenger and goods transport aiming to internalise the real road costs and improve the quality of both the railway service and infrastructure.

Other measures focus on financial incentives or disincentives for moving goods from road to other modes of transport, such as the French measure on developing the infrastructure for combined transport: road/rail, road/river, short sea shipping by providing grants, or cost savings for acquiring high-performance combined transport equipment. The German Heavy goods vehicle toll charge measure sets a distance-based toll, for all vehicles or vehicle combinations, using the German toll-road network, with a gross vehicle weight of 12 tonnes or more and designed or used exclusively for goods transport (See Section 0 for more details). Slovenia introduced a measure promoting sustainable freight transport that provides direct subsidies from the national budget to increase inter-modality and rail freight transport.

It should be noted that some measures described in the section focusing on modal shift for passengers also promote modal shift for freight, for instance, the Operational Programme on Transport 2007-2013 in Bulgaria, as well as other measures that aim to improve and / or extend the existing railway network (e.g. in Spain, Greece and Ireland).. In particular most measures that introduce a toll on roads, highways, motorways etc. or that introduce a tax on fuels used by road vehicles, for instance the German Ecological Tax Reform, encourage a shift for the transport of goods to more energy efficient and cheaper modes.

4.2.2 Shift to non-motorised modes

A total of 61 modal shift measures have been implemented or have been proposed that encourage passengers to walk or cycle instead of using a car, by improving and developing new transport infrastructures and / or by promoting cycling or walking.

To encourage and incentivise passengers to cycle or walk instead of using a car, a number of countries have implemented or proposed measures that either develop or improve cycling and walking infrastructures (e.g. Germany, Finland, Belgium) in order to increase the attractiveness of cycling and walking and minimise any safety considerations, or make it increasingly difficult / expensive for people to use cars (e.g. Malta, Austria). It should be noted that the latter types of measures may also promote the use of public transport.

To encourage passengers to cycle or walk instead of using a car, a number of countries have also implemented or proposed measures that promote cycling and walking, either by raising awareness of the benefits of cycling and walking, through information programmes or campaigns (e.g. car free day campaigns in various cities in Finland, France, Ireland etc.) or by making bicycles readily available. For example, under the Barclays Cycle Hire scheme, 8,300 bicycles are available from 567 docking stations across the city. Casual users can buy daily or weekly access at a docking station terminal, online or by phone with a credit or debit card (available for non-UK residents as well). Alternatively, regular users can become a member of the scheme (for €3.6), which allows a cheaper annual access fee, and a card key to release bikes from the docking station. The scheme is intended for short journeys. In addition to the access and usage charges, there is a late return charge (€180 if the cycle is kept for more than 24 hours or the access period runs out), a damage charge (up to €360) and a non-return charge (€360). There have been over 14 million cycle hires in the first two years of the scheme, which launched at the end of July 2010. The scheme is intended for relatively short term hire, with charges increasing substantially for longer periods, and average hire times are less than half an hour (19 minutes on week days and 29 minutes for weekend journeys).

In most cases these measures may also promote the use of public transport, in a few cases the use of more energy efficient modes for transport of goods as well.

4.2.3 Mobility plans

A sustainable mobility plan aims to promote the use of different modes of transport by implementing several of the measures described in the previous sections. Key characteristics of a mobility plan include (IDAE, 2006):

- It is applicable at a local or metropolitan / urban level;
- It covers all applicable modes of transport for both freight and passengers
- It reduces adverse effects from transport, reduces traffic in roads, promotes modal shifts to cleaner and more energy efficient modes
- It guarantees the accessibility and demand for municipal mobility
- It is linked to national and regional plans

Examples of measures that may be included in such a plan include

- Promoting modal shift through campaigns and information programmes (such as walking, cycling and public transport);
- Promoting more sustainable behaviour and practices (e.g. introducing car-pooling, car sharing, parking management, congestion charges);
- Improving public transport (e.g. optimising public traffic, changing bus routes to more efficient ones, creating mobility centres, creating bus lanes and tramways, eco-driving for public transport drivers etc.)
- Improving existing transport infrastructures (e.g. developing new cycling paths, bicycle parking, pedestrian zoneseg motorways of the sea .)

A few countries, such as Spain and France, have introduced sustainable urban mobility plans. Other countries have proposed to introduce mobility plans, such as Greece and Bulgaria (in Bulgaria it is called municipal programmes for public transport optimization).

Mobility management can be incorporated in mobility plans. The European Platform on Mobility Management (EPOMM) is an international partnership that aims to promote and further develop mobility management in Europe. According to EPOMM mobility management is "*a concept to promote sustainable transport and manage the demand for car use by changing travellers' attitudes and behaviour. At the core of Mobility Management are "soft" measures like information and communication, organising services and coordinating activities of different partners*."[19]

Some countries have introduced urban mobility plans at a local level targeting specific groups or area, e.g. schools and companies in France to promote the use of public or collective transport either through information provision or grants and subsidies. In Malta proposed Green travel plans for the public sector target specifically government employees and large employers in the Valletta / Floriana area. In Belgium, the Flemish government intends to develop cross-network collection services for the transport of schoolchildren, In Spain, the Action Plan 2011-2020, includes a measure on "Transport Plans in firms and activity centres" that aims to establish transport plans for all firms and activity centres (such as industrial estates, leisure centres, hospitals, educational centres), to reduce the number of journeys from low-occupancy private cars from and to the workplace / study place.

[19] http://www.epomm.eu/index.php

4.3 Vehicle Efficiency

4.3.1 Cars

Measures to improve the efficiency of cars, are generally undertaken at the EU level. As discussed in section 2, the key EU policy to improve the efficiency of cars is a 2009 regulation[20] which sets **CO_2 limits for new passenger cars** from passenger cars from 2012. By 2015 the fleet average (for each manufacturer) for new passenger cars must be less than or equal to 130 g CO_2/km with a long term target of 95 g CO_2/km in 2020. Intermediate targets are also set, by 2012, 65% of each manufacturer's cars must comply with the 130 g CO_2 limit value, 75% in 2013 and 80% in 2014. Manufacturers who exceed the limit will have to pay an excess emissions premium for each car registered. This premium amounts to €5 for the first g/km of exceedance, €15 for the second g/km, €25 for the third g/km, and €95 for each subsequent g/km. From 2019, the first g/km of exceedance will cost €95. The Directive was brought in after a target (of an average emission of 140 g CO_2/km for new cars sold in 2008), set in an earlier voluntary agreement with the three main car manufacturers' associations for Europe, Japan and Korea[21] was not achieved.

Incentives to encourage the uptake of more fuel efficient cars, such as graduating car purchase tax and road tax on the basis of fuel consumption or CO_2 emissions, and raising consumer awareness through the labelling of cars with their fuel efficiency and CO_2 emissions are discussed in Section 4.4.

Other EU measures to improve the efficiency of cars as driven in the real world include legislation on tyres and gear shift indicators. A 2009 regulation[4] requires all new car models to be fitted with **tyre pressure monitoring systems** by November 2012 and all new cars by November 2014. The systems will alert the driver when the tyre pressure falls by 20% from its normal warm running pressure, as under-inflated tyres can increase fuel consumption. Tyre pressure monitoring systems are estimated to reduce CO_2 emissions by around 2.5% for a typical car (Álvarez**,** 2008). The same Regulation requires all new car models to be equipped with **low rolling resistance tyres** by November 2013, and all new cars by November 2014. A second phase, with stricter rolling resistance limits, will apply for new car models from November 2017 and all new cars from November 2018. Additional consumer information will be provided by a **tyre labelling scheme** which will enter into force in 2012[225]. The fuel efficiency (rolling resistance), wet grip and external rolling noise performances of tyres will be displayed by means of a grading (A-G scale). Expected fuel savings from the increased use of fuel efficient tyres are estimated at between 2.4 and 6.6 Mtoe (million tonnes of oil equivalent) in 2020 depending on the speed of market transformation.

The technical CO_2 reduction potential of **gear shift indicators** is estimated at 6%; real reductions will be lower than this, depending on the degree to which drivers respond to the indicator. New car models should have gear shift indicators by 2012, all new cars by 2014[23]

4.3.2 Vans and HGVs

Vans

A similar regulation to that setting a limit for CO_2 emissions from cars was adopted for vans in May 2011[24] (new vans: on average 175 g CO_2/km by 2017 and 147g CO_2/km by 2020, with the reduction phased in from 2014). Similar penalties as for passenger cars apply to

[20] Regulation (EC) No 443/2009 of the European Parliament and of the Council of 23 April 2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO2 emissions from light-duty vehicles

[21] European Automobile Manufacturers Association (ACEA), Japan Automobile Manufacturers association (JAMA) and Korean Automobile Manufacturers Association

[22] Regulation (EC) No 1222/2009 of the European Parliament and Council of 25 November 2009 on the labelling of tyres with respect to fuel efficiency and other essential parameters

[23] Regulation (EC) No 661/2009 of the European Parliament and Council of 13 July 2009 concerning type-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units intended therefore

[24] Regulation (EU) No 510/2011 of the European Parliament and of the Council of 11 May 2011 setting emission performance standards for new light commercial vehicles as part of the Union's integrated approach to reduce CO2 emissions from light-duty vehicles

manufacturers exceeding the limit. The Vans Regulation gives manufacturers additional incentives to produce vehicles with extremely low emissions (below 50g/km). Each low-emitting van will be counted as 3.5/2.5/1.5 vehicles in 2014-15/16/17 respectively.

HGVs

In the case of heavy goods vehicles (HGVs), there is no EU wide legislation to improve fuel efficiency. This is partly because agreeing emissions standards for HGVs is much more complex for HGVs than cars, as the HGV fleet is much more heterogeneous than the car fleet. There is a diversity of body types, and several types of gross weight class, axle numbers and variations in the nature of auxiliary equipment, meaning that there is a large degree of variety, particularly for articulated vehicles. Such vehicles typically combine sub-systems (engines, vehicle body, trailers and ancillary equipment such as refrigeration) produced by different manufacturers, and individual manufacturers therefore, have much less control over the fuel performance of the final lorry than their counterparts in the car sector (McKinnon, 2008).

A number of countries have sought to improve the energy efficiency of HGVs and the efficiency with which they are operated however, using a variety of policies and measures.

- Denmark has a subsidy scheme to improve the aerodynamic performance of trailers.
- In the UK there is a competition run to bring the developers of some of the most promising technologies for improving fuel efficiency to the attention of key vehicle and component manufacturers and fleet operators.
- An approach being trialled in Denmark and the Netherlands focuses on improving the overall efficiency of freight transport is the use of longer road trains.
- While European legislation controls the maximum dimensions of vehicles, and the maximum weight that guarantees free circulation within the EU, it permits trials and the use of longer, heavier vehicles under certain strict conditions within national boundaries. Long road trains of 25 m are permitted on the major part of the road network in Finland and Sweden, where transport distances are often large, and are also used in Germany. The trial in Denmark, which began in 2008, has allowed longer road trains on a limited road network consisting mainly of motorways and other intercity roads, but also a number of roads connecting company sites to the designated road network. The longer road trains offer fuel savings of 15% per tkm. In the Netherlands, a large scale five year trial, which will end in November 2012 has been assessing, fuel savings and impacts on traffic safety, infrastructure and modal split. To date, experience has been positive and if the final evaluation confirms this, then longer heavier vehicles will become the normal combination in the Netherlands.
- Another approach taken to improving the overall fuel efficiency of freight transport is the use of voluntary agreements. In **France**, a voluntary agreement charter, drawn up in partnership with the trade associations, the National Federation of Road Carriers (FNTR) and the Federation of the Haulage Companies and Logistics of France (TLF) was launched in 2007. The number of companies signing the charter has risen significantly each year, and by the end of 2010, 233 road transport companies running more than 44 000 vehicles had signed up. Companies make a commitment for 3 years, developing a plan with concrete actions to decrease their fuel consumption. The target reductions agreed by the end of 2010 equate to a reduction of around 8% in fuel consumption per unit of activity. In **Finland**, the Government has an Energy Efficiency Agreement for Freight Transport and Logistics, with the Finnish Transport and Logistics (SKAL) and its member associations, the Association of Logistic Enterprises in Finland (LL) and the rail company VR. The agreement which covers the period 2008-2016 is a continuation of former agreements and programmes in the sector; and is intended to realise about one-third of the total savings target for the transport sector set in the NEEAP. It sets a numerical target for participants of a 1% annual improvement from 2008 to 2016 in the specific energy consumption (MJ/tonne-km) of freight transport, and the aim is for 60% of the companies or

registered vehicles in the sector to be covered by the agreement. Rather than signing an agreements, companies register by joining EMISTRA (Use of the Energy and Environmental Accounting and Reporting System for Transport and Logistics Sector), a nationwide energy and environmental accounting and reporting system for transport and logistics businesses.

- In **Denmark** businesses and municipalities and can commit to a reduction in fuel consumption though the green certification scheme of the Danish Transport Authority. To achieve certification, participants, must map their fleet and fuel consumption and set a CO_2 reduction target to be achieved within the following year, with an action plan detailing the CO_2 reducing projects to be implemented e.g. by introducing more energy efficient vehicles and making more efficient use of existing fleet. They must evaluate and report progress after one year, after which they can be recertified if they achieve their goal and set a new CO_2 reduction target for the following year.

4.3.3 Public transport

In Finland, the voluntary agreements approach used in the freight sector is also being used to improve energy efficiency in the public transport sector. In Finland, there is a voluntary agreement between the Government and the Finnish Bus and Coach Association (LAL) and the VR rail company (long-distance transport), which individual companies join by signing an Association Agreement. The aim is for 80% of public transport in 2016 to be covered by the agreement and for signatories to achieve a 1% annual reduction in energy consumption in the public transport covered by the Agreement during the 2008–2016 period. Participants must adopt a recognised environmental management system, such as ISO 14001, EMAS or BAK, must report their fuel consumption and other energy consumption data into a database, to allow monitoring of energy efficiency. Annual monitoring reports will be prepared, and after every three years, the scheme will be evaluated to establish whether it needs to be reviewed. France is also planning to extend the scheme where road transport companies make a commitment to reduce CO_2 emissions to road passenger transport.

More generally, in the longer term improvements in the energy efficiency of public transport fleet should be aided by the European Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles. This requires that public authorities and some other operators, take into account the impact of energy consumption, CO_2 emissions and other pollutant emissions during the operational lifetime of the vehicles, either by setting technical specifications for energy and environmental or including energy and environmental impacts in the purchasing decision. This could be of particular importance in some of the newer Member states, where public transport has a relatively high share of passenger mobility, but the fleet is relatively old and inefficient. In Estonia, renewal of the public transport sale has been aided by revenue from the sale of assigned amount units (AAU) to Spain under a green investment system (GIS). From the first sale in July 2010, €21million were invested in about 100 energy efficient and environment friendly buses which will replacing the most out-of-date vehicles in use on regional and outlying urban routes. €45 million from the second sale in May 2011 will be invested in about 15 modern city trams, for the city of Tallinn which will use electricity generated from renewable energy sources. Currently, the average age of trams in Tallinn is 25 years.

4.4 Encouraging Uptake of Cleaner Vehicles

4.4.1 Labelling

The majority of labelling policies are aimed at passenger cars, however there are a few policies that are aimed at tyres, road freight vehicles, and France has a labelling policy for aviation. There are 34 transport-related labelling policies in the MURE database, 80% are related to new vehicles and 70% are aimed at cars or passenger vehicles.

Car Labelling

The EU vehicle labelling Directive[25], requires for new passenger cars that:

- information on fuel economy and CO_2 emissions is shown on a **fuel economy label** to be displayed at the point of sale;
- a **guide on fuel economy** and CO_2 emissions should be available at the point of sale and from designated bodies;
- a **poster (or a display)** showing the official fuel consumption and CO_2 emissions data of all new passenger car models displayed or offered for sale or lease at, or through, the respective point of sale;
- all **promotional literature** must contain the official fuel consumption and specific CO_2 emission data for the passenger car model to which it refers.

These minimum requirements have been implemented in all Member States, but some have gone beyond the Directive in terms of additional legislative and voluntary requirements for the information tools.

In addition some countries have extended the car labelling scheme. For example, Denmark has extended the scheme to Light Goods Vehicles and introduction of a similar scheme is planned for France from early 2012. The UK enables a label for **used cars** to be generated on a voluntary basis including the same information as the required label for new passenger cars (data are available for cars registered from 2001). An online database was initially developed by the Low Carbon Vehicle Partnership (LowCVP) with support from the Retail Motor Industry Federation, the Society of Motor Manufacturers and Traders and the UK government; the scheme was originally run by the Vehicle Certification Agency (VCA), but is now provided by two external organisations. Dealers register with the organisation, and can them submit registration details for the used vehicle online to receive a label; participation is free. Finland also has a scheme for labelling used cars, and France is considering introducing a mandatory label for used car registered from 2004. France is also considering introducing mandatory labelling for car rentals longer than three months.

In Finland, a revised CO_2 label, which more closely resembled the energy efficiency labels for consumer appliances, was introduced in 2010. Use of the new label, which makes comparison between cars of different sizes easier as ratings also take into account the vehicle weight, is voluntary. As well as fuel efficiency data, the EU CO_2 emission limit for the same weight category is given, together with emissions of pollutants and fuel costs based on an assumed annual mileage (of 18 000 km mileage per year).

4.4.2 Taxation

Road transport

One of the most common fiscal instruments used to encourage the uptake of more energy efficient vehicles or modal shift is taxation. In the case of road transport, a wide range of taxes apply, including:

- annual circulation tax (road tax),
- vehicle purchase tax,
- infrastructure charge (tolls on specific parts of the network, e.g. motorways, tunnels, bridges),
- parking fees,
- congestion charge,
- company car taxation
- fuel excise tax

[25] Directive 1999/94/EC on)Passenger Car Labelling on fuel economy rating

- insurance tax

Car Purchase and Circulation Taxes: The two most commonly used tax related policies to encourage the uptake of cleaner vehicles are differentiation of car registration taxes paid on purchasing a car, and annual circulation tax on the basis of energy efficiency. Historically, car purchase taxes in most countries were usually linked to the type of fuel, size of car and status (private versus company). However 16 Member States and Norway have now introduced registration taxes which are dependent on the fuel efficiency or CO_2 emissions of the vehicle. These vary from systems offering rebates for cars with low CO_2 emissions and surcharges for high CO_2 emissions to simple banding systems based on CO_2 emissions, and to systems where tax is calculated as the product of CO_2 emissions per km and a value per g of CO_2, which increases the higher the CO_2 emissions rate. There are also hybrid systems which also take into account engine size or the classification of the car for other emissions. In the case of Austria, which was the first Member State to introduce a differentiated, scheme based on fuel consumption in 1992, the tax was reformed in 2008 to a bonus/malus system where cars with relative low CO_2-emissions get tax breaks and cars with higher CO_2-emissions have to pay a higher tax. Fewer Member States (seven) have a differentiated system for annual road tax.

Table 4-2: Date of introduction of differentiated tax rates

Year	Member States
Car Purchase Tax	
1992	Austria
2000	Denmark
2002	UK (company cars)
2006	Cyprus, France, Netherlands, Portugal
2007	Luxembourg, Norway
2008	Spain, Finland, Ireland
2009	Germany
2010	Greece, Latvia, Slovenia, UK (private cars)
2012	Belgium
Annual tax	
1997	Denmark
1998	UK
2006	France (company cars only), Sweden
2008	Netherlands, Ireland
2010	Finland

Infrastructure Charges: While a number of countries have some toll roads where a charge is made for all vehicles using the road, a number have introduced tolls specifically aimed at heavy goods vehicles, with the aim of encouraging the use of less polluting vehicles, maximising the efficiency of freight distribution, and encouraging modal shift of freight. Examples of such schemes in the New Member States are planned or exist in Latvia or Poland.

One of the most innovative schemes, which is much more targeted, is the distance based HGV toll system in Germany which uses GPS satellite systems, rather than conventional toll booths, and links charges to the vehicles emissions category. Revenue from the system is intended to be used to subsidise rail and water transport infrastructure.

France is also introducing a levy on HGVs to encourage modal shift for long distances transport and improvements in freight logistics. Legislation in 2009 paved the way for the introduction of a charge on a per kilometre basis for HGVs using the national road network (where tolls are not already in place). The levy collected will be allocated to the Agency responsible for the national road network to finance improvements in the road infrastructure. It is planned that implementation and operation of the scheme will be carried out by a third party, under a public-private partnership contract, but due to legal challenges in the process of appointing a supplier, the scheme has not yet begun. It is hoped that these issues will be resolved in time to introduce the charge in 2013.

Company car taxation: Company cars are frequently a means for the user to have less expenses for his car; the cars therefore tend to be more powerful and more wasteful in energy. Some countries undertake measures to encounter the impacts, see for example the company car CO_2 taxation in UK: Employees provided with a company car by their employer must pay tax on the value of the benefit of having that car. In April 2002, the UK Company Car Tax system which determines the tax that must be paid was revised to make it carbon-based. The aim was to incentivise the purchase of energy efficient vehicles and to remove a perverse incentive in the previous system which led to unnecessary business miles being driven in order to reach the threshold mileage for obtaining a reduction in tax. It was reformed again in 2009 to set new rates of company car taxation for 2011/12 onwards.

Aviation

Only a few countries have taxes on air travel. The UK introduced the UK Air Passenger Duty, as an environmental tax in 1994, with current charges depending on the distance travelled ranging from €30 for short haul to €218 for long haul[26]. More recently Germany and Austria have both introduced levies. Germany introduced an "Ecological" levy from 1st January 2011 for all flights from German airports as part of a budget package in June 2010. The levy is differentiated according to noise and fuel consumption levels, and distance of the flight and ranges from between €8 for short-haul flight, €25 for medium-haul flights, and €45 for long-haul flights. The levy is to be phased out once the aviation sector joins the EU ETS at the start of 2012 (see below). The Austrian "Aviation Tax" (Luftverkehrsteuer) was introduced in April 2011. The tax is levied on all departing flights in Austria operated by commercial airlines. The charges per passenger are €8 for short-haul, €20 for mid-haul and €35 for long-haul flights. France also has a flight tax but it is relatively low at only €2 per person and is not differentiated by distance.

Aviation taxes were introduced in the Netherlands in July 2008, resulting in ticket price increases ranging from €11.25 to €45 per ticket. However the tax was withdrawn from July 2009 due to doubts over its efficacy, as instead of reducing the number of flights taken, there was evidence that travellers were using airports in neighbouring countries (Belgium and Germany) where there was no tax[27].

From the start of 2012, emissions from all domestic and international flights that arrive at or depart from an EU airport will be covered by the EU Emissions Trading System. In addition to the 27 EU Member States, the EU ETS for aviation covers three EEA-EFTA States (Iceland, Liechtenstein and Norway) and will extend to Croatia by 1 January 2014 due to the country's planned accession to the EU on 1 July 2013. Like industrial installations, airlines will receive tradeable allowances covering a certain level of CO_2 emissions from their flights per year. After each year operators must surrender a number of allowances equal to their actual emissions in that year.

[26] £26 for short haul to £188 for long haul converted at €1=£0.86
[27] Egmond, and de Jong, 2010. Aviation Taxes, Capgemini Nederland B.V, Utrecht

4.4.3 Electric vehicles

The range and magnitude of incentives for the uptake of electric vehicles is particularly wide and may consist of grants, reductions in taxes and exemptions from taxes and other charges (e.g. parking charges). Some countries use a combination of different measures; for example Portugal awards a premium for purchase of electric vehicles, as well as exempting them from circulation and registration taxes.

There are over 40 policies spread across 16 EU countries aimed at increasing the uptake of electric vehicles, nearly half of which were put in place since 2008. Of the total policies, three quarters are still ongoing and more are planned to start in 2012.

A definition of the different types of electric vehicle is set out in Box 5.6.

Studies[28] indicate that the most significant barriers to the uptake of electric vehicles relate to:

- **High upfront cost**: the premium is currently around €15,000 to €40,000, per vehicle, potentially decreasing to €5,000 in the longer term (ETC, 2009). The cost of charging an electric car is lower than the cost of refuelling a petrol vehicle; however, there is extensive evidence that consumers are more influenced by purchase prices and do not take into account savings over the lifetime of the vehicle (Ecolane, 2011).
- **Issues related to charging**: limited range, inconvenient charging and lack of charging infrastructure. "Range anxiety" is the fear of being stranded due to insufficient battery capacity. Electric vehicles will usually meet the daily needs of most users, however, typical home charging points take 7-8 hours to charge a battery, which can be inconvenient.

Box 4-2 Definition of electric vehicles

The term "electric vehicles" may encompass several different types of configuration including:

- • Battery electric vehicles (BEV): run on the battery alone, and have no auxiliary on-board power.
- Extended-range electric vehicles (EREV): the battery is the main energy source, but a combustion engine driven range-extender running on hydrocarbons is used to sustain the battery where distances exceed the electric range.
- Plug-in hybrid electric vehicles (PHEV): the battery is the main energy source, but a combustion engine running on hydrocarbons is used after batteries are depleted.

Conventional hybrid electric vehicles (HEVs), where the drive comes from the internal combustion engine as opposed to the electric motor, are not in this study considered to be electric vehicles, but may still be included in the scope of some EU policies.

Grants

To address the high upfront costs of electric vehicles, the most frequently used financial incentives are:

1. Reductions in car registration tax (covered in section 5.2 above)
2. Reductions in annual circulation tax (covered in section 5.2 above)
3. Grants at the point of purchase.

Grants for the purchase of electric vehicles have 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

[28] Studies include: Element Energy , 2009; ARUP, 2008 and FIA, 2011.

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.

The UK implemented its Plug-in Car grant scheme in January 2011 to encourage the uptake of ultra low emissions vehicles (ULEVs). Spain has implemented a grant scheme to encourage the uptake of EV and PHEV, allowing grants of up to €6,000 per electric vehicle This action is funded with an M€240 budget (M€ 80 in 2011 & M€160 in 2012).

Infrastructure

Public charging infrastructure is an important means of counteracting “range anxiety”, which is the fear of being stranded due to insufficient battery capacity. Although most trips can easily be accommodated by modern electric cars, consumers prefer to buy cars that are capable of much longer distances. For instance, over 80% of car journeys are below 20km, and most Europeans drive less than 40km per day (ETC, 2009). **Vehicle range** and **inconvenient charging**, are starting to be addressed by improvements in technology, for example extended range vehicles, fast charging 3-4 hours and rapid charging 30 minutes as opposed to 7-8 hours slow charging, and new business models such as battery hire combined with battery swapping stations reducing charging time to several minutes.

Lack of charging infrastructure is being addressed by a number of EU countries by implementing regional policies and programmes to increase access to charging points along strategic transport routes and in major cities, as uptake of electric vehicles is likely to be higher in cities compared to rural areas. For example schemes to increase the availability of charging points have been implemented in Amsterdam, Berlin, London, Paris, Switzerland, and Denmark. City programmes serve as demonstration projects to gather data on consumer behaviour which can be used to improve subsequent projects. City authorities may partner with a private firm to ensure consistency and compatibility across all charging points. In many cases, access is controlled by cards which enable users to be billed on a subscription or pay-per-use basis.

Standardisation is a particular concern in terms of battery layouts and plug design, as a harmonised standard will likely need to be in place before significant rollout. The European Standardisation Organisation has been mandated to develop a common charging system. A further issue is related to the use of a common billing system in order to ensure interoperability between different areas.

4.4.4 Scrappage schemes

Scrappage schemes have been introduced in several Member States to further drive the replacement of old inefficient vehicles with new more fuel efficient vehicles and cover primarily passenger cars. (Table 4-3) shows a comparison of the different car scrappage schemes in place in early 2010. Some countries have also introduced scrappage schemes for HGVs and buses; for example Croatia has a subsidy programme to encourage the scrapping of older , less efficient HGVs and school buses (Euro 0,1,2 or3) and replacement with Euro 5 compliant vehicles.

In the majority of countries, scrappage schemes for older inefficient cars have been combined with incentives for purchasing new, efficient or low CO_2 emitting cars, thus making it an integrated measure. The scheme in France, the ‘Bonus-Malus’ scheme includes a penalty for purchase of cars with the highest CO_2 emissions, which is intended to make the scheme revenue neutral.

Table 4-3 Summary of existing scrappage schemes

Country	Main characteristics of scheme	Incentives
Austria	Purchase a new car minimum Euro-4 and scrapping a vehicle >13 years old.	€1,500
Cyprus	Scrapping car >15 years old only, or scrap and purchase a new car with fuel economy max 7 litres/100km or max 5 litres/100km.	€675–€1,700
France	Scrap car > 10 years, new car with CO_2 <160g/km, or LCV.	€1,000 plus + rebate up to €5,000, and bonus in new if low CO_2
Germany	Scrap car >9 years, purchase new car minimum Euro-4, and <1 year old.	€2,500, + tax rebate if Euro-5/6
Greece	Scrapping a car registered pre-2005, not necessary to purchase new car. Or purchase new car or LCV, minimum Euro-4 or Euro-5.	€500–€3,200 Cars €500–€3,700 LCVs
Italy	Scrap car or LCV > 9 years, new car CO_2 max 130g/km—diesel or 140g/km—gasoline (petrol).	€1,500–€3,000 Cars €2,500–€6,000 LCVs
Ireland	Scrapping car>10 years old and buying new car CO_2 <140g/km gives relief on Vehicle Registration Tax.	up to €1,500
Luxembourg	Scrapping car >10 years old, and purchase new car CO_2<120g/km, (diesel PM<5mg) or new car CO_2 <150g/km.	€1,500–€1,750
Netherlands	Buying a new vehicle and scrapping gasoline (petrol) vehicle >13 years, or buying a new vehicle and scrapping a diesel vehicle >9 years old.	€750–€1,000 €1,000–€1,750
Portugal	Scrap a car >10 years old, or >15 years old and buy new car CO_2 <140g/km.From August 2009, scrap a car >8 years old, or >13 years old and buy new car CO_2 <140g/km.	€1,000–€1,250 purchase incentive €1,250–€1,500 purchase incentive
Romania	Scrapping a car >10 years old	Approx €900
Slovakia	Purchase new car maximum €25,000 price, scrapping car >10 years old.	€1,000–€1,500 €2,000
Spain	Vive plan, 0% loan to €10,000, new or used car < 5 years, max 140g/km, and LCV max 160g/km Scrap > 10 years, fitted with seat belt sensors and ESC. Plan2000e—scrap >10 years or >250,000km, and buy new car max CO_2 140g/km car, lower threshold of <120g/km or LCV max 160g/km.	€2,000 equivalent €2,000 purchase incentive
UK	Scrap car > 10 years, purchase new car.	£2,000

Source: MURE Database and IHS Global Insight, March 2010

4.5 Driver Behaviour

4.5.1 Traffic management/speed limits

The specific fuel consumption of cars (l/100 km) is generally at a minimum at speeds of around 90 km[29] per hour, and decreases as speeds rise above this. The idea of using more stringent speed limits to reduce travelling speeds on motorways and thereby cut fuel consumption and transport emissions has received much attention recently, as it could have an immediate effect on fuel consumption and emissions. Current motorway speed limits differ across EU Member States, varying from 110 to 130 km/h; with some countries also apply variable speed limits related to traffic and weather conditions. Modelling of a reduction in

[29] http://www.guardian.co.uk/environment/green-living-blog/2011/mar/25/hypermiling-tips

motorway speed limits from 120 km/h to 110 km/h suggest that in practice this might reduce the fuel consumption of cars by 2% for diesel cars and 3% for petrol cars[30]. In 2011, as part of an effort to reduce the national energy bill in the face of the oil price spike caused by the unrest in Libya and elsewhere in the Arab world, Spain reduced speed limits on its motorways from 120 to 110 km/h. Stickers with the new speed limit were applied to 6,150 signs, at a cost of €230,000. The temporary restriction was lifted at the end of June, with the Spanish Government reporting that it saved €450 million on fuel costs[31], although this was disputed.

Several other countries have legislative measures in place to reduce and/or regulate speed limits for various different vehicle classes (ie Bulgaria, Estonia, Finland, France, Hungary, Ireland, Luxembourg, Malta, Netherlands, Norway, Poland, Romania, Sweden, and United Kingdom). However these measures are typically driven by other factors such as safety concerns rather than their contribution to improved fuel economy and fuel savings., and cannot really be considered as energy efficiency measures.

Reducing speed limits on motorways or ensuring more stringent enforcement of existing limits, will mainly deliver fuel savings from cars, as the speed of HGVs and buses (with more than 8 passenger seats) is set by a European Directive (2002/85/EC) which requires that speed limiters are fitted to restrict the speed of HGVs to 90 km per hour and buses to 100 km/h, which is close to the optimum speed for fuel efficiency.

4.5.2 Eco-driving

Eco-driving often refers to driving techniques (training courses, awareness raising campaigns) that enable drivers to optimise their car fuel economy. Several countries have on-going measures in place.

Examples of schemes to encourage Eco-driving, in the passenger, freight and rail sectors are:

- Austria: Eco-drive campaign and competition
- Netherlands (Het Nieuwe Rijden,): This programme promotes more efficient driving methods for car drivers and professional drivers including freight.
- Germany: Rail eco-driving scheme (Activities of Deutsche Bahn): The Deutsche Bahn set specific CO_2 reduction targets for the period 2002 to 2006 for their passenger transport, rail freight transport, and logistics business areas. The business areas themselves can choose the measures to meet their respective targets.
- United Kingdom (SAFED): This programme was specifically aimed at vans, HGVs, bus and coach drivers. It consisted of a one day complimentary driver development course combining driver training and assessment.
- Spain (Action Plan 2011-2020)

Apart from country specific initiatives there are also European wide eco-driving initiatives such as ECO DRIVEN, a eco-driving campaign that covers 9 countries and is aimed at drivers of passenger cars, delivery vans, HGVs and buses. Another example would be the ECoWILL project[32] focusing on reducing carbon emissions by 8Mt by 2015 through implementing more fuel efficient driving across Europe.

[30] http://www.eea.europa.eu/themes/transport/speed-limits
[31] http://suite101.com/article/confusion-over-spain-speed-limit-u-turn-a377305
[32] http://www.ecodrive.org/en/home/ecowill_the_project/

4.5.1 Optimised logistics

Freight logistics

Another approach taken by countries to improving the overall fuel efficiency of freight transport is through fleet management/fleet logistics, such as voluntary agreements which are already covered in section 0. An example is the management of road transport fleets in Spain: As part of the basket of measures on “More Efficient Use of the Means in the Transport Sector” within the Action Plan 2011-2020, Spain introduced a measure to improve the management of the road transport fleet in order to achieve a reduction in the specific consumption per ton or transported passenger. This includes for example the establishment of minimum criteria in terms of efficient fleet management so as to grant licences to collective passenger and goods transport companies, economic incentives for audits and the conduction of training campaigns aimed at professionals of transport fleets, as well as the definition and grant of the suitable accreditation to all those firms having an efficient fleet system management in their organisation.

Car Sharing

Energy efficiency of passenger transport can also be improved through soft measures such as limiting the number of trips made or making car journeys more efficiency by utilising the maximising the capacity of passengers by car journey, i.e. car sharing.

Belgium is trying to incentivise car sharing through measures such as reserving a lane of traffic to make car sharing more attractive (commuters travelling by car represent 20 to 30% of road traffic). The highway code was modified in 2003 to allow the road system manager to reserve a lane of traffic not only to public transport vehicles, but also to private vehicles occupied by more than one passenger.

France introduced the ‘car club’, which is defined as making a fleet of motorised land transport vehicles available to subscribing users on a shared basis. Each subscriber may have access to a vehicle, without a driver, for the journey of his or her choice and for a limited period. A ‘car club’ label is currently being defined at national level and will be the subject of a decree stating the terms of its award and use. Town hall authorities may reserve parking spaces for vehicles with this label. A CERTU study concerns mechanisms for encouraging the use of alternatives to private cars in European countries, including car clubs. The study has been finalised but has not yet been made public. Similar measures are in place in the United Kingdom (e.g. Streetcar, City Car Club).

Horizontal cross cutting measures

Horizontal cross cutting measures are defined as measures that have successfully been implemented in other sectors than transport and are now introduced to the transport sector to improve energy efficiency. One example is White Certificates Scheme for Transport in France: The White Certificates Scheme was launched in France in 2005, with the first obligation period running from 2006 to 2009, and placing obligations for energy suppliers the tertiary and residential sectors to achieve energy savings by promoting energy efficiency measures to their customers. In 2010 the scheme was expanded to include transport fuel suppliers whose annual sales exceed a certain threshold. They will be required to achieve savings of 30 TWh cumac per year, or a total of 90TWh over the second obligation period January 2011 to December 2013). The obligation is shared between suppliers according to their sales. 15TWh per year is to come from professional vehicle fleets, 10 TWh from private vehicles and 5 TWh from freight. Actions which can lead to the issue of certificates include contributing towards programmes to reduce the energy consumption of the least well-off households or towards programmes offering information, training and innovation in support of demand-side management, in particular aimed at developing vehicles with low carbon dioxide emissions. It has been suggested however that fuel retailers may comply with their obligations by achieving savings in other sectors; for example, supermarkets with petrol stations could gain certificates by selling energy efficient appliances.

4.6 Conclusions

There is a growing realisation that a focus on improving the efficiency of vehicles is only part of the solution in the transport sector. A more holistic approach involving the reduction of transport demand and the shift of transport to more environmentally friendly and energy efficient modes is needed if the European Union is to meet its 2030 and 2050 targets.

Few EU Member States presented a comprehensive package of transport measures in their National Energy Efficiency Action Plans (NEEAPs) covering technological, infrastructural, financial, behavioural and special planning measures. One of the key barriers to the development of such a package of measures is that decisions are often taken at different levels of government (central, regional, local) and by a range of departments and ministries.

The MURE database developed and maintained by the ODYSSEE-MURE project contains 427 measures in the transport sector. The most commonly implemented policies at Member State level are those that seek to improve the efficiency of vehicles or encourage the purchase of cleaner vehicles. Other measures described in the MURE database seek to encourage modal shift or change driver behaviour. Biofuels policies are not within the scope of the ODYSSEE-MURE project although some Member States have chosen to include biofuels policies in the MURE database for completeness.

The majority of policies focus on cars: improving the efficiency of cars, encouraging the take-up of energy efficient cars and changing the behaviour of car drivers. This focus on cars may be partly due to the homogeneous nature of cars. However, cross-cutting measures such as voluntary agreements and white certificates are now being applied to other vehicle types. Such measures are likely to be more appropriate than codes and standards when dealing with heterogeneous technologies like heavy goods vehicles (HGVs).

Modal shift can play an important role in reducing energy consumption and greenhouse gas (GHG) emissions from transport. However modal shift is not an energy efficiency measure and so not a focus for the MURE database and the ODYSSEE-MURE project more generally. Nevertheless, there are a range of modal shift measures described in the MURE database and the NEEAPs including enhancements to public transport provision, fiscal incentives to encourage the use of public transport or non-motorised modes, differential toll charges, the promotion of walking and cycling, and urban mobility planning.

Vehicle efficiency improvement measures are predominantly implemented at EU level through regulations targeted at vehicle manufacturers. There are also some novel policies at the national level, particularly on HGVs and public transport vehicles, which are not regulated at EU level. HGV measures include the introduction of longer road trains that offer fuel savings of ~15% per tonne km and voluntary agreements with freight logistics companies.

Measures to encourage the uptake of cleaner vehicles include labelling, taxation and infrastructure charges, grants and subsidies and scrappage schemes. Labelling of new cars has been implemented at the EU level, but several Member States expanded the scheme at the national level, for example to cover used vehicles, or LGVs. Differentiation of car purchase tax by fuel efficiency/CO_2 emissions have now been introduced in almost two-thirds of Member States, but differentiation of annual circulation taxes is less common. Infrastructure charging schemes are focussed on HGVs and range from simple time based usage charges to an innovative distance based scheme, using GPS satellite systems implemented in Germany. Scrappage schemes for older inefficient cars, have been introduced quite widely across the EU, although often for relatively limited periods. Many of the schemes also provide incentives for the purchase of new cars, often stipulating CO_2 performance standards which must be met. The last few years have seen many countries introducing specific policies to encourage the uptake of electric vehicles. Measures generally seek to combat the most common barriers towards electric vehicle use: high capital cost, through grants towards purchase cost, and lack of charging infrastructure through regional programmes designed to increase access along strategic transport routes and in major cities.

Changing driver behaviour to encourage more fuel efficient driving is widely recognised as potentially offering significant savings. Several countries have introduced training courses and awareness raising campaigns on the benefits of 'eco-driving', both for car drivers and for freight, and bus and coach and drivers of off-road vehicles. Increasing the utilisation of vehicles, e.g. through car sharing, can also contribute to improving the overall efficiency of passenger transport, and is typically encouraged though a range of 'soft' measures to change driver and passenger behaviour. As with modal shift, these softer measures are not the focus of the MURE database, but nevertheless it does include examples of measures to facilitate and incentivise car sharing, e.g. through priority access to car parking or reducing journey times, by allowing car sharers access to reserved lanes on roads.

5 Energy Efficiency Policies in the EU Industry Sector

5.1 The portfolio of industrial energy efficiency measures

5.1.1 Policy context for energy efficiency in industry in Europe

At the end of 2006, the EU pledged to cut its annual consumption of primary energy by 20% by 2020. Despite substantial steps taken towards this objective, recent Commission estimates suggest that the EU may only achieve half of the 20% objective. In June 2011, a new set of measures for increased energy efficiency, namely the Energy Efficiency Directive, was proposed by the European Commission to fill the gap. The proposed directive brings forward measures to step up Member States efforts to use energy more efficiently at all stages of the energy chain.

At the EU level energy efficiency in industry is seen as a matter of competitiveness as substantiated in EU's Energy Efficiency Plan 2011 which preceded the proposed Energy Efficiency Directive. The Plan proposes the following measures for industry: energy efficiency requirements for industrial equipment, improved information provision for SMEs, energy audits and energy management systems. In energy for industry, the whole energy supply chain is addressed. Research and innovation are seen as catalysts for cost-effective energy efficient technologies in industry. (European Commission 2011a)

The 25 IEA recommendations (2011) for energy efficiency include actions also in industry (see section **Erreur ! Source du renvoi introuvable.**). Recent IEA analysis concludes that substantial opportunities to improve industrial energy efficiency exist (OECD/IEA 2011). According to the IEA, much of this potential can be captured through policies for promoting use and optimisation of energy-efficient industrial equipment and systems, and improving overall efficiency through energy management.

The European Commission has not yet published analyses of the second National Energy Efficiency Action Plans (NEEAPs), which each of the Member States is required to issue by the Energy Services Directive. The first NEEAPs were to be submitted to the Commission by June 2007 and the second NEEAPs by June 2011. The analysis of the first NEEAPs and information collected on their implementation status in 2010 shows that while most NEEAPs have focused on the building sector, also the number of measures implemented to trigger energy savings in industry and industrial buildings has been relatively high (European Commission 2011c). The European Commission (2009) points out that particularly three Member States, namely Hungary, Malta and the Slovak Republic, place a strong focus on energy efficiency in industry, and expect the highest share of savings to come from industry measures.

5.1.2 Overview of energy efficiency measures for industry

As of January 2012, the MURE database contained a total of 289 industry measures, out of which 183 were in operation; the others (106) were either not active any more or were being planned.

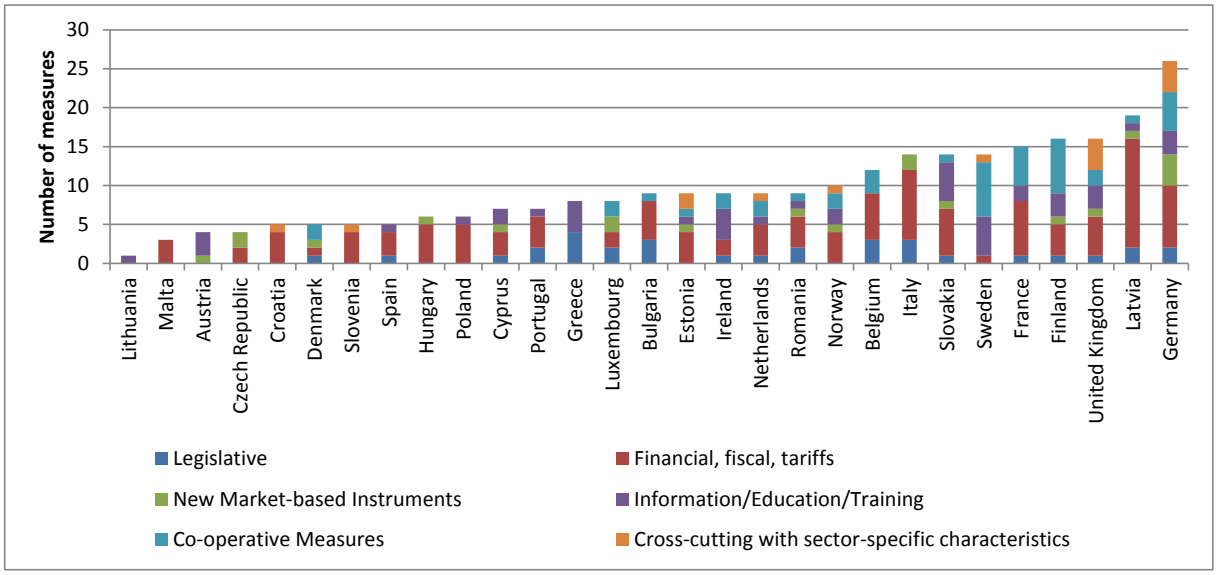
Financial measures have been in the core of the policy mix for industry over the last two decades. While co-operative measures (principally voluntary agreements) were introduced frequently in the early 1990s and they have remained in the policy mix, new schemes have been introduced less frequently in the past decade. Information measures are diverse

measures ranging from information campaigns to energy audits and training. Their role has grown. Legislative and fiscal measures are less often implemented in industry. However, when cross-sectoral measures in industry are analysed in more detail, energy and environmental taxes and pollution charges listed within this group of measures augment the relative importance of fiscal measures. EU Emissions Trading is an important market-based instrument applied in industry in all EU Member Countries.

If we look only at measures introduced during the period of the on-going economic and financial turmoil, i.e., starting from 2009, there is not much change in the dispersion of measure types among the 41 measures launched thereafter. Financial measures still dominate and informative measures have a significant role. There is a slight increase in legislative measures, driven both by national implementation of EU measures and by new national measures. It is plausible that countries did not cut financial support immediately after the start of the recession in order to stimulate the economy. However, more recent signals indicate that reductions are starting to take place.

Energy efficiency improvements are hindered by various barriers, each of which need to be addressed by different types of measures. This is done best by developing a balanced policy mix which includes several types of measures. The adopted policy mix varies significantly from country to country (Figure 5-1).

Figure 5-1: On-going Measures by Type and by Country



Note: Some caution is needed while analysing the figure because there is some variety in how countries package their measures. Some countries have reported lager packages of measures as one measure while others split them into several independent measures. EU policies and measures for energy efficiency in industry

Source: MURE database, January 2012

5.1.3 EU energy efficiency policies for industry

In addition to national measures, the MURE database also includes common European measures for industry (Table 5-1). However, the voluntary labelling of electric motors has been replaced by the Eco-design Directive.

Only the CHP Directive has been classified as a high-impact measure[33] and emissions trading as a medium-impact measure. Other measures are expected to have low impact or their impact is unknown.

Table 5-1: EU Measures for Industry in the MURE Database

Code	Title	Status	Type	Starting Year	Semi-quantitative Impact
EU2	Voluntary labelling of electric motors (CEMEP/EU Agreement)	Completed	Co-operative Measures, Information/Education/ Training	2000	Low
EU1	Motor Challenge Programme	Ongoing	Information/Education/ Training	2002	Low
EU3	E2MAS	Unknown	Legislative/Informative	2003	Low
EU9	Combined Heat and Power (Cogeneration) Directive (2004/8/EC)	Ongoing	Legislative/Normative	2004	High
EU14	Community framework for the taxation of energy products and electricity (2003/96/EC)	Ongoing	Fiscal/Tariffs	2004	Low
EU4	EU Emissions Trading Scheme (2003/87/EC)	Ongoing	New Market-based Instruments	2005	
EU10	Efficiency reference values for electricity and heat production	Ongoing	Legislative/Normative	2007	
EU11	European Green Light Programme	Ongoing	Co-operative Measures	2007	Low
EU13	Integrated Pollution Prevention and Control Directive IPPC (2008/1/EC)	Ongoing	Legislative/Informative	2008	Low
EU12	Amended EU Emissions Trading Scheme (2009/29/EC)	Ongoing	New Market-based Instruments	2012	Medium

Source: MURE database, January 2012

Also some cross-sectoral measures have considerable industry relevance. Of particular interest is the Eco-design Directive for Energy-using Products (Directive 2005/32/EC) and its recast for energy-related products (Directive 2009/125/EC). The Eco-design Directive is discussed in more detail in section 0. Furthermore, the cross-sectoral measures include those for renewable energy and taxation as well as the Energy Services Directive.

Emissions trading

The European Emission Trading Scheme (EU ETS) was launched in January 2005. The EU ETS covers around 11 000 large greenhouse gas emitting installations in the energy and industry sectors: combustion installations with a rated thermal input capacity of at least 20 MW, as well as refineries, coke ovens, steel plants, and installations producing cement clinker, lime, bricks, glass, pulp and paper provided that they exceed the threshold production levels given in Annex 1 of the ETS Directive. In total, the EU ETS covers about

[33] In MURE, each measure is classified with a qualitative impact label: 'high', 'medium', 'low' or 'unknown' (if no qualitative impact evaluation has been done). The impact of a measure is high if the corresponding savings are equal to or higher than 0.5% of the final energy consumption of the entire sector. The impact is medium if the savings are between 0.1% and 0.5%, and low if they are less than 0.1% of the final energy consumption of the entire sector. The classification is made by national teams for national measure and by the MURE management team for European measures.

50% of Europe's CO_2 emissions and 40% of its total greenhouse gas emissions. The ETS now operates in 30 countries (the 27 EU Member States plus Iceland, Liechtenstein and Norway).

The EU ETS was governed by the EU ETS Directive (2003/87/EC). It was substantially revised in 2009 (2009/29/EC) and the provisions of the Directive are required to be transposed into national law by 31 December 2012.

The new regulations describe the revised operation of the EU ETS from 2013 onwards, i.e., the third trading period. Specifically, the regulations mandate the national authorities to collect duly substantiated and verified emissions data from installations that will only be covered by the EU ETS starting from 2013. The exclusion of certain small installations may be considered which are subject to measures that will achieve an equivalent contribution to emission reductions. Furthermore, the European Environmental Agency has been appointed as an auctioneer, which is required under the Commission's regulation.

For phases 1 (2005-2007) and 2 (2008-2012) individual Member States developed country-specific National Allocation Plans (NAPs). NAPs will no longer be required in the third trading period which introduces a European wide scheme. The main allocation principles are auctioning for the energy supply sectors and benchmarking for industrial companies.

Energy taxation

Environmental taxes can be divided into four broad categories: energy, transport, pollution and resource taxes. Energy taxes are by far the most significant, representing around three quarters of environmental tax receipts in Europe. (Eurostat 2011)

According to Eurostat (2011) environmental taxes have not been growing in recent years at the EU average level. A steady fall in the level of environmental taxes can be observed from 2003 onwards up to around 2008, after which there was an upturn following excise duty increases in several countries namely Bulgaria, Czech Republic, Denmark, Estonia, Greece, Hungary, Latvia, Lithuania, Romania, Slovenia, Spain. Only Italy, Poland and Slovak Republic cut the excise duties on energy. There has been real value erosion in energy taxes while the level of other environmental taxes (on transport and resources/pollution) has remained relatively constant. This, however, concerns all energy using sectors together, not just that in industry. (Eurostat 2011)

Community framework for the taxation of energy products and electricity (Directive 2003/96/EC) sets minimum rates of taxation, including those for industry (Table 5-2). However, energy products and electricity are only taxed when they are used as motor or heating fuel, and not when they are used as raw materials or for the purposes of chemical reduction or in electrolytic and metallurgical processes.

Table 5-2: The Minimum Levels of Taxation Applicable to Fuels for Industrial Use

Fuel	Current minimum excise rates
Diesel (€/1000 litres)	21
Kerosene (€/1000 litres)	21
Liquefied petroleum gas LPG (€/1000 kg)	41
Natural gas (€/gigajoule)	0.3

Source: MURE database

IPPC Directive

The IPPC Directive (Integrated Pollution Prevention and Control Directive; latest amendment 2008/1/EC) requires industrial and agricultural activities with a high pollution potential to have an environmental permit. This permit can only be issued if certain environmental conditions

are met, so that the companies themselves bear responsibility for preventing and reducing any pollution they may cause.

Integrated pollution prevention and control concerns new or existing industrial and agricultural activities with a high pollution potential, as defined in Annex I to the Directive (energy industries, production and processing of metals, mineral industry, chemical industry, waste management, livestock farming, etc.).

In order to receive a permit, the installation must use energy efficiently. Among other requirements, it also has to use the “best available techniques” (BAT) which reduce environmental impact as a whole, however, taking into account local considerations such as the technical characteristics of the installation and any special needs of the local environment.

The requirement for efficient use of energy is reinforced by Directive 2010/75/EC on industrial emissions, which the Member States shall transpose to national legislation by November 2012. The Industrial Emissions Directive makes the requirements for best available technologies described in so-called BREF documents binding.

Eco-Design Directive

The Eco-design directive for energy-related products (Directive 2009/125/EC) has direct impact on the efficiency through regulation on the efficiency of industrial process equipment such as electric motors, pumps, compressors and industrial ovens. Furthermore, it has significant indirect impact because the manufacturing industries must consider the energy efficiency and other environmental qualities of their energy-related products over their lifecycle.

Only a couple of countries have introduced national minimum energy performance standards for industrial equipment. German Large-Scale Combustion Plant Ordinance (1983, last revised in 2009) caps the major emissions components of combustion plants with at least 50 MW of heating capacity. By capping the carbon dioxide emissions, energy consumption is curbed. Latvia issued energy efficiency requirements in 2010 for district heating systems. The requirements concern heat production boilers and CHP units feeding district heating systems as well as heat losses in district heat network.

Energy Efficiency Directive EED

The Energy Efficiency Plan 2011 is a strategic document issued by the EU in March 2011 (European Commission 2011a). In June 2011, it was translated into a proposal of a new directive, provisionally known as the Energy Efficiency Directive (EED) which, after long discussions with the Member States, was adopted on 25 October 2012 as Directive 2012/27/EU on Energy Efficiency. The directive repeals both the Energy Services Directive (2006/32/EC) and the CHP Directive (2004/8/EC). The new directive addresses industry in several different ways. It introduce measures for energy efficiency in the manufacturing industry; for energy transformation including CHP; for energy transmission and distribution; and it mandates energy suppliers to help customers to save energy (Box 5-1). (European Commission 2011b, DECC 2012)

Box 5-1 Industry-relevant Provisions in the Energy Efficiency Directive 2012/27/EU

Provisions for industry:

- Member States must establish an energy efficiency obligation scheme requiring all energy suppliers (or distributors) to meet an annual energy-saving target equal to 1.5% of their energy sales by volume in the previous year. Alternatively, Member States may opt to take other measures to achieve energy savings amongst final customers as long as they deliver equivalent energy savings. Such alternative approaches must be approved by the Commission. (Article 7)
- Member States must promote the availability of energy audits and encourage SMEs to undergo an audit. (Article 8)
- Member States must ensure that large companies undertake an independent audit by 5 December 2015 and every four years thereafter. These audits may be conducted under existing energy management systems or voluntary agreements between stakeholder organisations and Government. (Article 8)

Energy transformation and CHP:

- Member States shall produce a National Heating and Cooling Plan to develop the national potential for co-generation. The Plan must be submitted to the Commission by 31 December 2015 and then updated every five years. (Article 14)
- All new thermal electricity plant above 20 MW should be high efficiency co-generation units and is sited where waste heat can be used, subject to cost-benefit analysis. When an existing thermal electricity plant above 20 MW is significantly refurbished or its permit is updated, it must be converted to allow operation as a high-efficiency co-generation installation provided it is sited where waste heat can be used. (Article 14)
- Authorisation criteria must be adopted whereby other new or substantially refurbished industrial installations above 20 MW thermal input capture and make use of their waste heat. (Article 14)
- Member States may lay down exemptions from these requirements on the basis of availability of heat load or a negative cost/benefit analysis, though these conditions for exemption must be approved by the Commission. (Article 14)
- Member States must draw up and update every 3 years an inventory detailing the energy performance for all combustion installations and refineries with a total rated thermal input of 50 MW or more. The Commission will use this information to assess the energy efficiency potential of these installations and, if necessary, may propose requirements to improve their efficiency when new installations are permitted or re-permitted after periodic review. (Article 15)

Energy transmission and distribution:

- Member States must ensure that energy regulators pay due regard to energy efficiency in their decisions relating to the operation of gas and electricity transmission and distribution infrastructure. (Article 15)
- By 30 June 2015, Member States must adopt plans which assess the energy efficiency of their gas, electricity and heating and cooling infrastructure and identify concrete measures and investments to deliver cost-effective improvements. (Article 15)
- Member States must guarantee transmission and distribution of electricity from high efficiency CHP, as well as priority access to the grid and priority dispatch for CHP electricity. (Article 15)

Cross-cutting provisions with industry relevance:

- Availability of Certification Schemes: Member States must ensure that by 31 December 2014 certification and qualification schemes are available for providers of energy services, energy audits and energy efficiency improvement measures. (Article 16)
- Energy Services: Member States must promote the energy service market through making available lists of providers, model contracts, and disseminating a range of information on incentives to support energy service projects. (Article 17)
- Member States may set up an Energy Efficiency National Fund. The Commission shall, where appropriate, directly or via the European financial institutions, assist Member States in setting up financing facilities and technical support schemes with the aim of increasing energy efficiency in different sectors. (Article 20)

Source: European Commission 2012

The proposed measures for industry have already been implemented in varying degree in the Member States. However, the current overall implementation status is quite long way off the level of ambition in the EED requiring massive additional effort from the Member States.

Implementation status of energy obligation schemes

Five countries have already got an energy savings obligations scheme, also known as white certificates. These countries are Belgium (Flanders Region), Denmark, France, Italy and the UK (**Erreur ! Source du renvoi introuvable.**). In UK, only the household sector is targeted. In the other countries, savings can be obtained in industry - although some countries exclude establishments under the ETS (e.g. France and Belgium-Flanders). However, in general the industry sector is weekly targeted in energy obligation schemes except for industry.

Implementation status of energy audits

All countries but Cyprus report in the MURE Database that they run either voluntary or mandatory energy audit schemes or provide audit subsidies. Nineteen countries state that at least some of the measures advancing energy audits cover also the SMEs but as many as ten countries do not promote them for the SMEs. Furthermore, it is not clear how well the generic audit schemes reach the SME audience, particularly, when in-depth audits are the only option. Bulgaria, Finland, Germany, Ireland and Sweden have implemented tailored audit and energy advice programmes for the SMEs. In Finland, the SMEs benefit of 10 per cent points higher audit subsidies than other companies.

A notable number of countries have introduced mandatory energy audits but the implementation of these schemes varies considerably. Also the certification and qualification schemes included in the Energy Efficiency Directive relate to the matter. More details on different approaches and case examples from Bulgaria, Portugal and Romania can be found in the sector report on industry.

Information on certification and qualification schemes for providers of energy services, energy audits and energy efficiency improvement measures in the MURE Database is somewhat fragmented making it difficult to form a comprehensive view of the situation. However, some information is available on the appointment of energy managers. In Hungary, Romania and in the Slovak Republic the appointment of energy managers is mandatory among large energy users and training and formal certification schemes are in place. Some other countries, e.g., Greece and Italy, also require the appointment of energy managers but they do not need a specific certificate.

In Finland, undertaking an energy audit is voluntary but those making subsidized energy audits must pass a qualification scheme. Certification of auditors is also required in other countries, e.g., in Bulgaria, the Czech Republic and Romania.

Mandatory energy audit schemes may include various different elements beyond the site examination and reporting the results. The elements identified by WEC (2010) were:

- Obligation to carry out audits at regular intervals (generally companies above certain threshold of energy consumption)
- Reporting obligations to governmental organisations and communication of audit results to the public (energy consumption reporting, reporting on saving measures, reporting on implemented measures)
- Obligation to propose action plans to implement the energy savings measures identified in audits
- Obligation to carry out certain types of measures
- Obligation to appoint an energy manager
- Mandatory certification of auditors

- Mandatory comparison to reference values (benchmarking)

Implementation status of other provisions

Some measures, particularly financial, have already been in place to advance the use of CHP. While financial support may be justified to open the market for CHP and speed up the adoption of new technologies, care should be taken to avoid excessive support to inefficient CHP and market distortions which have occurred in some cases. Another financial mechanism is third party financing, which has been used to a significant decree in Spain. However, the take-up of cogeneration was generally quite stagnated in the early 2000s when the CHP Directive (2004/8/EC) was issued. The Member States were to implement it by February 2006. The objective of the Directive was to overcome some barriers which the European Commission had identified, namely lack of coherent policies in some Member States, market uncertainties, higher fuel prices for small producers, relatively low prices for generated electricity, barriers to grid access to sell surplus electricity, and relatively high start-up costs. The Energy Efficiency Directive, which repeals the CHP directive, addresses the still existing barriers. According to the MURE Database, there is little evidence that measures in line with the new provisions would already have been implemented in the Member States.

There are few measures in place to promote the use of waste heat from industrial thermal generation units. However, the Dutch programme 'Heat at Full Steam' advances the use of industrial waste heat by subsidising regional heat maps which visualise availability of industrial waste heat and options for the use of geothermal heat.

Energy efficiency measures in transmission and distribution which are addressed by the Energy Efficiency Directive are not included in the MURE Database. Therefore these measures are not discussed here.

5.2 Industry measures in the NEEAPs

The MURE database contains 132 "NEEAP-measures" for industry in the EU Member States. Also Croatia's two and Norway's six on-going industrial measures are included in the analysis. The NEEAP-measures are those described in the first (2007) or second (2011) National Energy Efficiency Action Plan issued by each Member State to conform to the requirements of the Energy Services Directive.

In section **Erreur ! Source du renvoi introuvable.**, NEEAP measures are discussed according to the categorization used in the MURE database. An insight is given to the role of various measures in the overall policy mix, evaluation methods and evaluation results. Case studies are given on certain measures which are considered to have considerable impact, to be innovative or representative in their respective policy type.

In addition to individual instruments, attention should be paid to packaging of policies and measures (see section 5.3). Quite often measures are implemented in isolation instead of combining them with other policy instruments. Given the variety of prevailing energy efficiency barriers and drivers, different types of policy instruments should be packaged.

Despite NEEAPs having been developed to implement the Energy Services Directive which excludes energy use in the emissions trading sector, 81 of the totality of 132 industry measures in the NEEAPs also address 'large enterprises' according to the MURE database. 'Large enterprises' do not equal the emissions trading sector but, given the significant share of such measures, it can be concluded that quite often the industry measures in the NEEAPs address the whole industry.

Measures classified as "New Market-Based Instruments" in the MURE database are all related to EU Emission Trading and its flexible mechanisms, i.e., Joint Implementation and

Clean Development Mechanism, and therefore not NEEAP measures. Hence, they are not discussed here but already in section 5.1.2.

5.2.1 Co-operative measures appear to be effective but are preferred by a limited number of countries

Co-operative measures in the MURE database belong to the following three categories: voluntary/negotiated agreements to reduce energy consumption or CO_2 emissions of industrial processes, voluntary/negotiated agreements for cross-cutting technologies (e.g. industrial motors) and technology procurement for energy efficient equipment.

Co-operative measures are implemented by a somewhat limited number of countries. Thirteen countries have implemented 31 co-operative measures whereas the majority of countries have not introduced any co-operative measures. According to analyses by WEC (2011), the reason for country differences may lie in differences in administrative cultures and public-private relations. In some contexts, close relations between industry and government support voluntary and negotiated agreements. In other contexts, where leaner government and individual stakeholder integrity are highly prized, similar schemes may be problematic due to perceptions of regulatory intrusiveness.

The long-running voluntary agreements in Europe, namely those in Denmark, Finland, Luxembourg, the Netherlands, Sweden, the UK, have been introduced well before the Energy Services Directive entered into force reflecting national energy and climate policy goals. In Finland, the scheme was adjusted to the ESD as all its major provisions were incorporated into the new set of voluntary agreements introduced for the period 2008-2016. Some Member States (e.g. Sweden) have introduced agreements with implicit or explicit reference to the directive on minimum taxation of electricity. (JRC 2010)

Voluntary and negotiated agreements aimed at reducing energy consumption or CO_2 emissions are the most common type of co-operative measures. Various incentives are used to attract companies to enter the agreements, typically tax benefits (four countries) and subsidies but also easier access to environmental permits (the Netherlands, Finland).

Tax benefits are available, e.g., in Denmark, Norway, Sweden and UK. The financial incentives to participate in the agreements programme are two-fold: the tax exemption and financial gains from energy savings. In addition, long-term competitiveness is enhanced. In Norway, pulp and paper companies may apply for participation in a programme for energy efficiency and the approved companies will be given a full exemption from the electricity tax. In Sweden, all energy intensive companies have the opportunity to avoid the electricity tax by participating in the voluntary agreement. In UK, joining the Climate Change Agreements gives a possibility to avoid part of the Climate Change Levy. In Denmark, the Danish Energy Agency pledges payment of subsidies for partial coverage of a company's CO_2 tax liabilities when it signs a voluntary agreement. The agreement obligates a company to undertake a number of energy-saving measures and to implement a certified energy management system.

In some cases, subsidy schemes have been tailored to attract companies to join voluntary agreements. For example, in Finland subsidies for energy efficiency investments may be given for investment projects using conventional technologies if the company has joined the agreement scheme whereas in other cases only new technology is subsidised.

While most voluntary or negotiated agreements tend to address the whole energy use of a given sector, the German voluntary agreement for CHP is a rare example of a pure voluntary or negotiated agreement for cross-cutting technologies. Another cross-cutting co-operative measure in Germany is contracting (i.e. third-party financing) of compressed air technology. The industrial facility which wishes to use compressed air concludes an agreement with a contractor, according to which the latter plans, finances, constructs, operates and maintains the compressed air installation. The compressed air user only pays for the compressed air

which it has received. The standardisation of contracting models speeds up the development of markets for these energy services.

According to the MURE database, only the Swedish NEEAP includes a couple of measures for technology procurement for energy efficient equipment. Since the beginning of the 1990s, the Swedish Energy Agency has partly financed and initiated nearly 60 different technology procurements. In industry, the applications have covered factory doors, energy-efficient mine ventilation fans, large industrial fans, refrigeration compressors in the food industry, control systems for pumps, load and energy management systems for foundries, filters for harmonics and motors. The voluntary industry-related sector networks were established in Sweden in 2009 to save energy in various sectors over the next few years. The Network for Energy Efficiency, (ENIG), consists of a network of experts, industries, energy offices and energy and climate consultants to improve energy efficiency. The focus is on casting, surface treatment, heat treatment, sheet metal forming and plastics processing. The purpose of such networks is to increase know-how and provide tools to increase energy efficiency at every level of industrial firms through the exchange of information and knowledge.

Approximately two thirds of the co-operative measures have been evaluated according to the MURE database. Fifteen of the measures are in the high-impact category and eight in the medium-impact category. The evaluation methods vary from enhanced engineering estimates using monitoring results to a mix of top-down and bottom-up methods. However, there are too few evaluations to draw any conclusions on typical methods, the level of results or the degree of achievement of the targets established in the agreements. The results should also be compared to the energy use of the branch/branches involved but this is not possible based on MURE data. More detailed data can be found e.g. from a recent report by the Joint Research Centre (JRC 2010).

The introduction of the EU Emissions Trading places new complexity to the evaluation of the voluntary agreements since there is sometimes a risk of double counting between these schemes. Countries have responded to this challenge by either revising their agreements so as to not interfere with the ETS, by adjusting the calculation methods or by gradually abandoning the agreements (e.g. France). (JRC 2010)

5.2.2 Financial measures dominate in energy efficiency promotion in industry

The financial measures in the MURE database are grants/subsidies (for CHP investments; energy audits, training and benchmarking activities; energy efficiency investment or investment in renewables or clean fuels) and soft loans with preferential loan guarantee conditions or reduced interest rates (for investments in energy efficiency, renewables and CHP). 49 financial measures have been implemented in 21 countries. Fiscal/tariff measures are tax exemptions or possibility for accelerated depreciation. Eight fiscal/tariff measures have been implemented in four countries.

Eco-taxes have been reported in five NEEAPs (Estonia, Germany, the Netherlands, Sweden and UK), in Norway and in Croatia.

Financial feasibility is one of the key parameters a company weights when considering an energy efficiency investment or another investment entailing energy efficiency benefits. Pay-back periods are often used as criteria for smaller investments and internal-rate-of-return (IRR) for larger ones. CPI & Climate Strategies conducted a survey in 2011 amongst almost 800 manufacturing firms in six European countries which revealed an average four year pay-back time for energy savings measures. 10% of the firms only accept a maximum pay-back period of one and a half years while 10% accept pay-back times up to seven years. Pay-back times also vary systematically among sectors and countries. For larger investments, companies typically demand IRR values to be higher than 10% but sometimes up to 25%. When commitment to energy efficiency is lacking, firms will have a natural tendency to

prioritise other, more financially appealing investments. (IEA 2011 ref. CPI & Climate Strategies 2011)

While the investment and operation costs are taken into consideration in the financial analyses, energy efficiency improvements are often hindered by various hidden costs. For example, because energy efficiency projects are typically small in the industry scale, they may result in disproportionately high transaction costs. (IEA 2011)

Subsidies directly influence the financial driver of investments in energy efficiency. The impact of the subsidy depends on the proportion of subsidy on the total project cost: by how much are costs for energy efficiency measures reduced, and their effect on pay-back periods and IRR. In case of technology specific subsidies, the more the list is targeted and updated, the higher the chance that these will create additional investments and lessen "free rider" behaviour (IEA 2011). The Dutch measure Green Investment and Finance employs an annually updated list of eligible technologies. The free rider issue is addressed in some subsidy schemes (e.g. Finland) by giving subsidies only to projects exceeding certain pay-back time. In a Latvian joint implementation project cost-effectiveness criteria are applied to the subsidy part of the CO_2 reductions. The Latvian measure is also innovative by requiring the application of green purchasing principles and public visibility of the results achieved.

The introduction of environmental tax reforms gained increasing support during the 1990s. The basic idea was to shift the tax burden from labour towards the use of natural resources and environmentally harmful goods and activities. In the Member States the ideas of green tax reforms have met varying success. Among others, Denmark, Finland, Germany, the Netherlands, Sweden and the United Kingdom have introduced the elements of green tax reforms over the last decade. Some new Member States, too, have followed suit. One example is Slovenia, where a CO_2 tax has been applied on all energy products since 1997. In Estonia the increases in excise duties have been used to finance substantial cuts of personal income taxes up to 2008. The Czech Republic introduced an environmental tax reform in 2008, which would increase the tax rates of most energy products over the period 2008–2012. Despite this interest, environmental tax revenues have not been growing in recent years at the EU average level. The share of environmental taxation out of total taxation has increased since 1995 in a number of the EU Member States (Austria, Bulgaria, Denmark, Estonia, Latvia, Lithuania, the Netherlands, Poland, Romania, Sweden and Slovakia), but remained stagnant or decreased in the others, including most of the big Member States. (Eurostat 2011)

The qualitative impact assessment of financial and fiscal NEEAP measures in the MURE database ranks them in quite equal proportions between high, medium and low impact categories.

Among the 26 measures which actually have been subject to quantitative evaluation, the results are equally mixed. It appears that a common factor for most low impact measures is that they are purely financial measures, whereas most high impact measures feature a combination of several different measure types in a package of measures.

It is not straightforward to summarise the evaluation methods used in quantitative evaluation. However, it appears that enhanced engineering estimates are oftentimes used to evaluate subsidies; input information is collected from subsidy applications or via monitoring systems. The evaluation of tax rebate schemes, when implemented as part of voluntary agreements, is based on the commitments and reporting. The impact of taxation is more difficult to evaluate and requires modelling. In Germany, the impact of the ecological tax reform has been evaluated by using a combination of three different models: an econometric input-output-model, a macro-level simulation model and micro-level simulation model.

5.2.3 The role of information and training is increasing

In the MURE database this group combines quite heterogeneous instruments from information campaigns, informing top level management and training energy managers to establishment of information centres, voluntary labelling of cross-cutting technologies and voluntary energy audits. In this group of measures, energy audits are a bit different from other information measures because, unlike the other more generic measures, they provide detailed company specific information on cost-effective possibilities to improve energy efficiency. Yet, they are an instrument based on information.

Both the number and significance of this group of measures has been growing. At present, there are 22 NEEAP measures in this category in 13 countries and one in Norway in the MURE database. One of the countries which has visibly stepped up the information activities in the second NEEAP is Estonia which announced three new measures, namely organising training events to build energy management competence, increasing the number of energy auditors and developing and disseminating informational materials for company employees.

The whole span of activities can be found in terms of target groups, technologies and information instruments used. While some measures are highly focused on certain technology (motors, compressed air or lighting) others address all process and building technologies in industry. There are measures concentrating only on SMEs (e.g., in Germany, Ireland and Malta), solely on the large or energy-intensive industries (e.g., in Ireland, Romania and Sweden) as well as those which cover the whole industry (in most countries implementing information measures). Information instruments used range from written materials (brochures, manuals and web-info) and dissemination of energy management tools (web-based tools, audits and screening, benchmarking) to personalised advice (helplines and other advisory services) and events (training, seminars). In addition, energy awards (e.g. in Ireland) are used for motivation.

Some of the information measures aim at strengthening energy management capabilities. Energy audits, assessments and site surveys are energy management tools which are promoted in about half of the countries. One of the longest-running schemes is the Energy Audit Programme in Finland which was launched in 1992. Other voluntary audit schemes can be found, e.g., in Croatia, France, Ireland, Latvia, Luxembourg, Malta, Spain, Sweden and UK - and Estonia is planning to start one. Energy management training and tools are not usually provided in stand-alone measures but rather as part of others, typically voluntary agreements or other programmes for larger industries and SME programmes for smaller ones. An exception can be found in Estonia, which plans to start training events on energy conservation to increase energy management competences of enterprises as an independent measure. Benchmarking also enhances energy management. Norway runs a measure called “Energy Consumption – Industry” which is basically a subsidy scheme, but it uses reporting results from the recipients in an innovative way. The scheme operator Enova gathers energy consumption and production figures in a database via a web-based reporting scheme, calculates specific energy consumption for different industrial branches and presents the anonymous benchmarking data on the web.

Although not a NEEAP measure due to its focus on energy intensive industry, the long-running Irish networking programme (LIEN) is notable for its innovative approach of using networking for sharing information and experiences in the area of energy management. Networks were launched in Sweden in 2009 for the mining and steel industries, sawmills and energy efficiency in various industrial processes. Although not in the MURE database, also Denmark has set up a number of local dialogue networks across the country involving companies working with energy management and activities in this area also take place in Finland.

At the EU level there has been one initiative on voluntary labelling, namely that of electric motors (CEMEP/EU Agreement). The only national labelling example in the MURE database is the German Environmental Label Blue Angel, which covers numerous energy using

consumer products. The labelling of consumer products triggers the knowledge of mainly "downstream" firms, i.e., ones operating close to the consumer market (IEA 2011).

Apart from energy auditing, information measures are rarely evaluated. A rare example are the enhanced engineering estimates made by Sustainable Energy Ireland in the SME programme based on reports and billing data received from the participating companies.

5.2.4 Scarce use of regulation to address energy efficiency in industry

Legislative measures can be normative (mandatory demand side management or other mandatory standards) or informative (mandatory appointment of an energy manager or mandatory audits for industrial processes/buildings) in the MURE database. The database contains seven national legislative NEEAP measures working through informative instruments and nine national normative legislative measures.

National legislation has already been issued or has been announced in the NEEAPs to cover the following topics in industry. Examples of implementing countries are given in brackets for each target for legislation.

- Mandatory audits (e.g., Bulgaria, Czech Republic, Portugal, Romania)
- Mandatory energy efficiency plans (e.g., Hungary, Portugal)
- Mandatory energy managers (e.g., Hungary, Czech Republic, Italy, Romania)
- Mandatory energy management systems (e.g., Greece, Spain)
- Mandatory reporting of energy consumption data and energy efficiency measures (e.g., Hungary and Portugal)
- White certificates (Belgium/Flanders, Denmark, France, Italy, Poland, UK)

Bulgaria, Czech Republic, Portugal and Romania have issued mandatory energy audits for large energy users. The Czech and Romanian measures also involve mandatory appointment of energy managers. In Portugal energy audits have been part of a long-running regulation for energy-intensive companies. In Greece, mandatory audits are part of the Energy Management Systems obligation in industry. In Hungary, large energy users are obliged to deliver a report on their energy use and energy efficiency improvements, to prepare a work plan for energy efficiency improvements and to report the achievements. In practice, energy audits are necessary to implement this.

A few other countries, namely Belgium, Latvia and Luxembourg, refer to environmental permit procedures necessitating energy audits. In permit renewal in Belgium, companies have to submit a plan for performing all profitable investments to improve energy efficiency over the next three years. In Romania, as an alternative to appointing an energy manager, large energy users can enter an energy services contract with authorized bodies.

According to qualitative impact evaluations, legislative measures fall into different impact categories (low, medium, high) in equal amounts. About half of the legislative measures have been subject to quantitative evaluation. It appears to be most typical to use the enhanced engineering estimate method but also direct measurement, deemed savings, top-down calculations based on changes in specific consumption and integrated top-down and bottom-up methods have been used.

5.3 Packages of measures

There appears to be quite wide general consensus in the international energy efficiency *fora* on the importance of using multiple policy instruments in order to address the variable

barriers for energy efficiency (e.g., WEC 2011, IEA 2011). Yet, it is not uncommon that countries rely on a rather limited mix of policies and measures.

The IEA (2011) recognises that the relationships between the characteristics and design of a policy (policy instrument characteristics), a country's policy mix (policy package), and what drives a business to make the investments (driving forces) are critical in analysing the effectiveness of a policy package. It has recognised that the driving forces that decision makers within a large industrial company take into account when deciding to make new investments can be classified in five categories, namely:

- The financial imperatives of a company.
- The policy obligations placed on the company to achieve environmental compliance.
- The knowledge of energy-savings opportunities within the company.
- The commitment of the company to the environment and energy efficiency.
- The demands of the public and market to improve the company's environmental or energy performance.

Table 5-3 illustrates the relationship between these driving forces and various types of policies and measures (IEA 2011). According to the matrix, various types of measures are applicable for most types of driving forces, but only negotiated and voluntary agreements enhance commitment. This raises a number of questions. Is commitment the lacking driving force slowing down energy efficiency improvements? Is the level of commitment so difficult to be increased that almost the entire palette of policies and measures is powerless? If commitment cannot be improved, are there other alternatives but to increase obligation?

While the importance of different drivers varies by country and by branch, one would expect to see measures addressing each type of drivers in place in each country. However, this does not seem to be the case according to the MURE database.

Table 5-3: Interaction between Driving Forces and Different Types of Policies

Type of policy	Policy (below) Driving force (to the right)	Financial	Policy obligation	Knowledge	Commitment	Public and market demands
Prescriptive	Norms/standards		**High**	Medium		
	Negotiated agreements			**High**	Medium	Medium
	Obligations/commitments e.g. mandatory energy audits		**High**	Medium		
Economic	Taxes	**High**				
	Incentives and subsidies	**High**		Medium		
	Tradable permits	**High**	Medium			Medium
Information	Labelling			**High**		**High**
	Other information measures			**High**		Medium

Source: IEA 2011

The summaries of policies and measures in section 5.1.2 show that economic incentives are frequently used to address financial drivers. Negotiated and voluntary agreements have a significant policy status on some countries. Norms and standards as well as various obligations have not been used extensively. Use of information measures has grown but not as much as could be expected given the need to further energy management.

Two types of measure packages can be identified from the MURE database and the NEEAPs. Sometimes several independent measures also work together. In other cases different types of instruments have been included in one overarching measure. Both approaches are common.

Examples of the first packaging method can be found, e.g., from Spain and Finland. Spain has a long history of comprehensive Action Plans which establish the policies and measures for energy efficiency. The Action Plan 2005-2007 advanced voluntary agreements and energy audits and subsidies were provided for energy efficiency investments. The Action Plan 2011-2020 continues to promote energy audits, but it also envisages the establishment of energy management systems and improvements in the technologies of equipment and processes by implementation of best available technologies (BAT). In Finland, the impact of coexisting Energy Audit Programme, voluntary agreements (Energy Efficiency Agreements) and investment subsidies has been measurable and considerable energy savings have been achieved.

Examples of the second packaging method can be found, e.g. from Norway. In Norway, the Energy Efficiency in Industry Programme is currently open mainly for the pulp and paper industry but may be extended to other branches in the future. The Programme uses a variety of instruments. The structure of the programme is that of a negotiated agreement with voluntary participation but requiring very high level of commitment.

5.4 High-impact measures

In MURE, the semi-qualitative impact of each measure is classified as 'high', 'medium' or 'low'. The impact of a measure is high if the corresponding savings are equal to or higher than 0.5% of the final energy consumption of the entire sector. The impact is medium if the savings are between 0.1% and 0.5%, and low if they are less than 0.1% of the final energy consumption of the entire sector.

42 industry measures are reported to have a high impact[34]. Seven EU Member States and Croatia do not have high-impact measures in industry. Almost half of the measures claimed to have high impact, have not been subject to quantitative evaluation. The lower the expected impact, the rarer are evaluation activities; evaluation results are given only for four low-impact measures.

High-impact measures are a very mixed group. About one third of them are not NEEAP measures, because they address industries that participate in the emissions trading. There is no clear correlation between the impact of the measure and its type, indicating that both high-impact and low-impact measures belong to various measure types. This finding is in line with the discussion on energy efficiency drivers in section 5.3. Because the needs to stimulate each driver vary by country and branch, the relative impact of different types of measures varies accordingly.

Given the relative importance of the EU emissions trading scheme among industrial measures, few countries rank it high in impact which is, however, not a surprise at the present levels of carbon pricing. Five countries report EU Emissions Trading to have high-

[34] This section only deals with measures that are presently active.

impact and six countries rank it in the medium-impact category. Seven countries have not been able to make the ranking but nobody ranked it as a low-impact measure. The rest of the countries have not reported the measure in the database.

5.5 Conclusions

5.5.1 Recommendations for energy efficiency in industry

This section identifies possible gaps in the implementation of energy efficiency measures in industry by comparing energy efficiency measure recommended by the International Energy Agency (IEA) and the G8 summit for industrial energy efficiency.

The IEA recommended the adoption of specific energy efficiency policy measures to the G8 summits in 2006, 2007 and 2008. The consolidated set of recommendations to these summits covers 25 fields of action across seven priority areas: cross-sectoral activities, buildings, appliances, lighting, transport, industry and electric utilities. (IEA/OECD 2011). Later in 2011 the IEA published an updated list of the 25 recommendations (OECD/IEA 2011). The new list includes the following four recommendations for industry (Erreur ! Source du renvoi introuvable.):

- Energy management
- High-efficiency industrial equipment and systems
- Energy efficiency services for SMEs
- Complementary policies to support industrial energy efficiency

5.5.2 Gap analysis according to the MURE database

Energy management in industry (Recommendation 21)

The European standard for energy management, EN 16001:2009, was issued by CEN and CENELEC in July 2009. It has been replaced by ISO 50001:2011 which is the new global standard, released in June 2011. Denmark, Ireland, Norway and Sweden use energy management standards to underpin their energy-savings agreements.

Energy management measures need to be investigated from MURE by some of its components, such as voluntary and mandatory energy audits or appointment and training of energy managers. The application of these measures is described in sections 5.1.3 and **Erreur ! Source du renvoi introuvable.**. Furthermore, improved energy management is the core of most voluntary agreements. One example is the Danish agreement scheme.

High-efficiency industrial equipment and systems (Recommendation 22)

As discussed in section 5.1.3 (Eco-design), European countries do not establish minimum energy performance standards (MEPS). Instead, efficiency requirements are established for the EU as whole by the Eco-design Directive.

The IEA recommendation also calls for comprehensive policy portfolios to address barriers to the optimisation of energy efficiency in the design and operation of industrial processes. These could include measures providing information on equipment energy performance, training initiatives, audits, technical advice and documentation, and system-assessment protocols. As discussed in other parts of this report, energy auditing is already used extensively in Europe, however, with varying details of implementation. Networks for information exchange within the industry have been established in, e.g., Denmark, Finland, Ireland and Sweden. Also some advice activities have been reported. In Denmark, efficient design of production facilities is considered to be one of the elements in energy management. Savings exceeding 15% and pay-back times of under four year are reported. Toolboxes for efficient design were provided by the Danish Energy Agency already in the 1990s.

Box 5-2 IEA Recommendations for Industry Energy Efficiency (2011)

21 Energy management in industry

Governments should require large, energy-intensive industry, and encourage other industrial energy users, to conform to ISO 50001 or an equivalent energy management protocol. Actions to deliver cost-effective energy savings should be implemented, and industry should periodically report on their efforts. Energy management measures should include:

- Identifying and assessing energy saving opportunities by benchmarking, measuring and documenting energy consumption.
- Implementing actions to capture identified energy-saving opportunities.
- Publicly reporting the energy-saving opportunities identified and the actions taken to capture them.

22 High-efficiency industrial equipment and systems

Governments should adopt MEPS [Minimum Energy Performance Standards] for electric motors and other categories of industrial equipment, and implement portfolios of measures to address barriers to the optimisation of energy efficiency in the design and operation of industrial systems and processes. Policies should include:

- Mandatory MEPS for electric motors and other categories of industrial equipment such as distribution transformers, compressors, pumps and boilers.
- Comprehensive policy portfolios to address barriers to the optimisation of energy efficiency in the design and operation of industrial processes such as electric motor-driven, hot water and steam, and cogeneration systems. Measures could include providing information on equipment energy performance, training initiatives, audits, technical advice and documentation, and system-assessment protocols.

23 Energy efficiency services for small and medium-sized enterprises (SMEs)

Governments should develop and implement a package of specially designed policies and measures to promote energy efficiency in SMEs. Measures directed at improved energy efficiency in SMEs should include:

- A system for ensuring that energy audits, carried out by qualified engineers, are widely promoted and easily accessible for all SMEs.
- Provision of high-quality and relevant information on proven practice for energy efficiency that is appropriate to each industrial sector.
- Energy performance benchmarking information that can be easily used by SMEs and structured to allow international and within economy comparisons.

24 Complementary policies to support industrial energy efficiency

Governments should support improvements in industrial energy efficiency by removing energy subsidies, internalising environmental costs, providing targeted incentives and ensuring ready access to financing. To promote economically efficient investment in energy efficiency improvements, governments should:

- Remove energy subsidies and internalise the external costs of energy through policies such as carbon pricing.
- Encourage investment in energy-efficient industrial equipment and processes by putting in place targeted financial incentives such as tax incentives for energy-efficient investments in industry (in particular in SMEs). Foster private finance of energy efficiency upgrades in industry through risk-sharing or loan guarantees with private financial institutions and enabling the market for energy performance contracting.

Source: OECDE/IEA (2011)

Energy efficiency services for small and medium-sized enterprises (SMEs) (Recommendation 23)

MURE data shows that quite many measures address energy efficiency in the SMEs. However, seemingly only few have been tailored to address the specific needs of SMEs. Bulgaria, Finland, Germany, Ireland, Malta and Spain run programmes aimed specifically at SMEs to help them to undergo energy audits or other energy assessments and to implement energy efficiency measures. Most other countries have programmes which target industries of all sizes.

Complementary policies to support industrial energy efficiency (Recommendation 24)

As discussed in section **Erreur ! Source du renvoi introuvable.**, fiscal measures proposed by the IEA such as carbon taxes, eco-taxes and tax incentives are already used in considerable extent. Additional examples of the use of the taxation policy can be found, e.g., from the UK, where the Enhanced Capital Allowances scheme provides businesses with a first year 100% tax allowance on designated energy efficient equipment investments. In Estonia, corporate income tax exemption is given to profit that is re-invested within the company. The scheme has not been created only for energy efficiency but for all types of investments. However, energy efficiency is improved because new technologies usually are more energy efficient than old ones.

The MURE database contains only three examples of preferential loan guarantees proposed by the IEA. The Sofergie scheme has been running a long time in France but it is not considered to be among the key measures in the country. The Czech Republic mentions Word Bank's energy savings programme (FINESA) in Central and Eastern Europe which provides bank loans with up to a 50% loan guarantees, repayment period of seven years and an interest rate of 3%. The energy priority line of the Operational Programme "Competitiveness and Economic Growth" in the Slovak Republic is mentioned to provide loan guarantees but the details are unclear.

Energy performance contracting (EPC) is implemented in different ways. The typical example is the classic Energy Service Company (ESCO) concept which is promoted in several countries in Europe, e.g., in Austria, Belgium, Finland, Germany, Hungary, Poland, Spain and UK. In UK, the Green Deal has been developed to expand the concept beyond the largest energy consumers. In Romania, there is an obligation for industrial companies to appoint an energy manager or alternatively, large energy users can enter to an energy services contract with authorized bodies.

6 References

Buildings

BMF (Federal Ministry of Finance) (2011): Umstellung der Klimaschutzmaßnahmen im Wärmebereich (insbesondere Gebäudesanierung) auf eine marktbasierte Förderung (Marktlösung). Bundesministerium für Finanzen BMF, Berlin 19 May 2011.

Boßmann, T., Eichhammer, W., Elsland, R. (2011): Technical and economical potential analysis for the reduction of final energy demand by increased energy efficiency and energy savings. 2nd Interim Report. Scientific support on the EU Energy Roadmap 2050 funded by the German Federal Ministry for the Environment. Karlsruhe: Fraunhofer ISI, 15 August 2011 (unpublished)

Boßmann, T., Eichhammer, W., Elsland, R. (2012): Policy Report. Contribution of Energy Efficiency Measures to Climate Protection within the European Union until 2050. Report of Fraunhofer ISI on behalf of the German Federal Ministry for the Environment. 2012 (forthcoming)

DECC (2012): Which energy efficiency improvements qualify for Green Deal Finance?. Department of Energy and Climate DECC, 2012

Ecofys, Fraunhofer ISI (2011): The upfront investments required to double energy savings in the European Union in 2020. On behalf of the Regulatory Assistance Project. Utrecht/Karlsruhe, July 2011.

Ecofys, Fraunhofer ISI (2010): Energy Savings 2020. How to triple the impact of energy saving policies in Europe. Final report. On behalf of the European Climate Foundation & Regulatory Assistance Project. September 2010. http://roadmap2050.eu/contributing_studies

Eichhammer W. et al. (2009): Study on the Energy Savings Potentials in EU Member States, Candidate Countries and EEA Countries. Report funded by the European Commission. Karlsruhe, Grenoble, Rome, Vienna, Wuppertal: Fraunhofer ISI, Enerdata, ISIS, Technical University Vienna, Wuppertal Institute, March 2009. http://ec.europa.eu/energy/efficiency/studies/efficiency_en.htm

Enerdata (2012): Energy Efficiency Trends in Buildings in the EU. Lessons from the ODYSSEE/MURE project. Publication within the project „Monitoring of EU and national energy efficiency targets" (ODYSSEE-MURE 2010)" supported by Intelligent Energy Europe. ADEME editions: Paris. http://www.odyssee-indicators.org

European Commission (2010a): Commission Staff Working Paper An Energy Policy For Consumers, Brussels, 11.11.2010, SEC(2010) 1407 final.

http://ec.europa.eu/energy/gas_electricity/doc/forum_citizen_energy/sec%282010%291407.pdf

European Commission (2010b): EU energy trends to 2030 — Update 2009. Luxembourg: Publications Office of the European Union, 2010.

European Commission (2011a): Energy Efficiency Plan 2011. Brussels, 8 March 2011. COM(2011) 109final

European Commission (2011b): Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the

Committee of the Regions. A Roadmap for moving to a competitive low carbon economy in 2050. COM(2011) 112 final, Brussels, 8.3.2011

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52011DC0112:EN:NOT

European Union (2012a): Directive of the European Parliament and of the Council on Energy Efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC. Common Guidelines. Brussels, 21 September 2012

European Union (2012b): 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. Official Journal of the European Union L 315/1, 14.11.2012

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:315:0001:0056:EN:PDF

Green Alliance (2011): Decarbonisation on the cheap. How an electricity efficiency feed-in tariff can cut energy costs. October 2011

http://www.green-alliance.org.uk/uploadedFiles/Publications/reports/ Decarbonisation_on _the_cheap_dble.pdf

Heinzle, S., Wüstenhagen, R. (2010): Disimproving the European Energy Label's value for consumers? Results from a consumer survey. University of St. Gallen. St. Gallen: February 2010. http://www.unisg.ch/en/NewsConfig/HsgNews/2010/Februar/Energy-Labelling-18Februar2010.aspx

IEA (International Energy Agency) (2012): World Energy Outlook 2012. OECD/IEA 2012.

http://www.oecd-ilibrary.org/energy/world-energy-outlook-2012_weo-2012-en

Küchler, S. And Nestle, U. (2012): Strategien zur Modernisierung I: Neue Finanzierungsmodelle für einen klimaneutralen Gebäudebestand. Band 23 der Schriftenreihe Ökologie. Study on behalf oft he Heinrich Böll Foundation (Editor). Berlin, Juni 2012

http://www.foes.de/pdf/2012-HBS-Marktbasierte-Finanzierungsmodelle-Gebaeude.pdf

Lees, E. (2012): Energy efficiency obligations – the EU experience. Report commis-sioned by eceee under a contract from the European Commission's DG Energy. European Council for an Energy Efficient Economy: March 2012. http://www.eceee.org/EED

Liddell, Ch., Morris, Ch., McKenzie, S. J. P. and Rae, G. (2011): Measuring and monitoring fuel poverty in the UK : national and regional perspectives.

http://eprints.ulster.ac.uk/20254/1/Measuring_and_monitoring_fuel_poverty_in_the_UK.pdf

Nast, M.; Bürger, V.; Klinski, S.; Leprich, U.; Ragwitz, M. (2006): Eckpunkte für die Entwicklung und Einführung budgetunabhängiger zur Marktdurchdringung erneuerbarer Energien im Wärmemarkt. Project on behalf of the German Federal Ministry of the Environment,

http://www.erneuerbare-energien.de/erneuerbare_energien/downloads/doc/ 43282.php

Neme, Ch. and Cowart, R. (2012): Energy Efficiency Feed-in-Tariffs: Key Policy and Design Considerations, Regulatory Assistance Project RAP, April 2012.

OPW (2011): The particular needs and issues for central government buildings. Presentation at the Conference Financing Retrofit: Public Sector: New Instruments for Delivering Energy Efficiency Targets. Sustainable Energy Authority of Ireland SEAI, May 2011.

http://www.seai.ie/News_Events/Previous_SEAI_events/Financing_Retrofit_in_Public_ Sector_conference/Financing_Retrofit_Public_Sector.html

Oxley, S. (2011): The Green Deal "A game changer for energy efficiency", Paper presented at the ODYSSEE-MURE Workshop in Warsaw, October 6-7, 2011. http://www.odyssee-indicators.org/publications/workshops/warsaw/polish_experiences.php

RAP (The Regulatory Assistance Project) (2012): Best Practices in Designing and Implementing Energy Efficiency Obligation Schemes. Research Report Task XXII of the International Energy Agency Demand Side Management Programme. June 2012. http://www.ieadsm.org/Files/EXCO File Library/Key Publications/RAP_IEADSM_BestPracticesinDesigningandImplementingEnergyEfficiencyObligationSchemes_2012_June.pdf

Rezessy, S. and Bertoldi, P. (2010): Financing energy efficiency: Forging the link between financing and project implementation. Report prepared by the Joint Research Centre of the European Commission JRC, Ispra, May 2010.

http://ec.europa.eu/energy/efficiency/doc/financing_energy_efficiency.pdf

Schlomann, B., Eichhammer, W. (2011): Guidelines for the measure descriptions in the MURE database. Version 3.1. Guidelines for the IEE project „Monitoring of EU and National Energy Efficiency Targets (ODYSSEE-MURE 2010)". October 2011. http://www.muredatabase.org/dbmanagement.asp

Schlomann, B., Eichhammer, W., Rohde, C., Kockat, J., Becker, D., Bürger, V. (2012) : Kosten-/Nutzen-Analyse der Einführung marktorientierter Instrumente zur Realisierung von Endenergieeinsparungen in Deutschland. Report by Fraunhofer ISI, Ecofys Germany and Oeko Institute on behalf of the Federal Ministry of Economics and Technology. Karlsruhe, Berlin, Freiburg, March 2012 (English summary available). http://www.isi.fraunhofer.de/isi-de/x/projekte/bmwi_weisse-zertifikate_31-517-6_sm.php

Seefeldt et al. (Seefeldt, F.; Struwe, J.; Ragwitz, M.; Steinbach, J.; Jacobshagen, U.; Kachel, M.; Brandt, E.; Nast, M.; Simon, S.; Bürger, V.) 2012: Fachliche und juristische Konzeption eines haushaltsunabhängigen Instruments für erneuerbare Wärme; Zwischenbericht (unpublished)

Staniaszek, D. & Lees, E. (2012): Determining Energy Savings for Energy Efficiency Obligation Schemes. Report commissioned by RAP and eceee. April 2012. http://www.eceee.org/EED

UK Department of Energy & Climate Change (2012): Annual Report on Fuel Poverty Statistics 2012.

http://www.decc.gov.uk/en/content/cms/statistics/fuelpov_stats/fuelpov_stats.aspx

Transport

ACE, 2011. National energy efficiency and energy saving targets – further detail on Member States, 24 May 2011; Dr Joanne Wade, and Pedro Guertler, Darryl Croft and Louise Sunderland, from the Association for the Conservation of Energy

ADEME (2012) Energy Efficiency Trends in the Transport Sector in the EU: Lessons from the ODYSSEE MURE project, March 2012

AEA and TEPR, 2011. Report on the implementation of Directive 1999/94/EC relating to the availability of consumer information on fuel economy and CO2 emissions in respect of the marketing of new passenger cars. Report for DG Clima Action, European Commission

Álvarez, E 2008. Type approval requirements for the general safety of motor vehicles, Report for the Department Economic and Scientific Policy European Parliament

ARUP (2008) 'Investigation into the scope for the transport sector to switch to electric vehicles and plug-in hybrid vehicles' Department for Business Enterprise & Regulatory Reform & Department for Transport. http://www.bis.gov.uk/files/file48653.pdf

BMWi (Federal Ministry of Economics and Technology) (2011) 2nd. National Energy Efficiency Action Plan (NEEAP) of the Federal Republic of Germany - Methodological Accompanying Document -in accordance with the EU Directive on Energy End-use Efficiency and Energy Services (2006/32/EC) and the Act on Energy Services and other Energy Efficiency Measures (Energiedienstleistungsgesetz, EDL-G). July 2011 http://ec.europa.eu/energy/efficiency/enduse_en.htm

DG TREN (2009): Energy Savings Potentials in EU Member States, Candidate Countries and EEA Countries

EC (2009). "Moving forward together on saving energy" Synthesis of the complete assessment of all 27 National Energy Efficiency Action Plans as required by Directive 2006/32/EC on energy end-use efficiency and energy services. SEC(2009)889 final

EC (2011). White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system COM(2011) 144 final

Ecolane (2011) 'Ultra-low carbon vehicles in the UK.' RAC Foundation. http://design.open.ac.uk/documents/Market_delivery_of_ULCVs_in_the_UK-Ecolane.pdf

EEA (2010) 'Towards a resource-efficient transport system: TERM 2009: indicators tracking transport and environment in the European Union, EEA Report No 2/2010

Element Energy (2009) 'Strategies for the uptake of electric vehicles and associated infrastructure implications.' Committee on Climate Change. http://hmccc.s3.amazonaws.com/Element_Energy_-_EV_infrastructure_report_for_CCC_2009_final.pdf

ETC (2009) 'Environmental impacts and impact on the electricity market of a large scale introduction of electric cars in Europe.' European Topic Centre on Air and Climate Change. http://acm.eionet.europa.eu/docs/ETCACC_TP_2009_4_electromobility.pdf

FIA (2011) 'Towards e-mobility and the challenges ahead.' Federation Internationale de L'Automobile http://www.lowcvp.org.uk/assets/reports/emobility_full_text_fia.pdf

http://www.eceee.org/Policy/Targets/Targets_Country_Specific_Information.pdf

IDEA, 2006. Guia para la implementacion de Planes de Movilidad Urbana Sostenible (PMUS), Madrid.

IEA (2011)*'* 25 Energy Efficiency Policy Recommendations: 2011 Update.

IEA, (2010) 'Transport Energy Efficiency :*Implementation of IEA Recommendations since 2009 and next steps'*

IHS Global Insight, Assessment of the Effectiveness of Scrapping Schemes for Vehicles, March 2010

Kfz-Auskunft (2008): Lkw-Maut Erhöhung ab 01. Januar 2009. Aktuelle Auto News from 7 November 2008. http://www.kfz-auskunft.de/news/4630.html

Leinekugel, T, 2012. "The French white certificates scheme: Second target period :key issues and expectations" IEA Workshop, Policies for Energy Provider Delivery of Energy Efficiency, Brussels, January 2012, Presentation by Thibaut Leinekugel Le Cocq, Ministère de L'Ecologie, du Development durable, des Transports et du Logement.

McKinnon, A, 2008. Advice on CO2 Emissions from the UK Freight Transport Sector, Prepared for the Shadow Committee on Climate Change

MURE database, http://www.muredatabase.org/

ODYSSEE, http://www.odyssee-indicators.org/

Öko-Institut, IFE-STE, DIW, Fraunhofer ISI (2008): Politikszenarien für den Klimaschutz IV. Szenarien bis 2030. On behalf of the Environmental Protection Agency (UBA). Climate Change 1/08. Dessau-Roßlau, January 2008. http://www.umweltdaten.de/publikationen/fpdf-l/3361.pdf

Öko-Institut, IFE-STE, DIW, Fraunhofer ISI, Ziesing: Politikszenarien für den Klimaschutz V- auf dem Weg zum Strukturwandel. Treibhausgas-Emissionsszenarien bis zum Jahr 2030 (2009). On behalf of the Environmental Protection Agency (UBA). Climate Change 16/2009. Dessau-Roßlau, Oktober 2009. http://www.umweltdaten.de/publikationen/fpdf-l/3764.pdf

SEC(2009)889 final MOVING FORWARD TOGETHER ON SAVING ENERGY, Synthesis of the complete assessment of all 27 National Energy Efficiency Action Plans as required by Directive 2006/32/EC on energy end-use efficiency and energy services COMMISSION STAFF WORKING DOCUMENT

SDC (2011) 'Fairness in a Car-dependent Society, Sustainable Development Commission, London.

Industry

DECC (2012). The Energy Efficiency Directive explained. Department of Energy and Climate Change, United Kingdom. Data retrieved on 6 February 2012 from:

http://www.decc.gov.uk/en/content/cms/consultations/eceed/eceed.aspx

eceee (2012). Energy efficiency obligations – the EU experience. Commissioned by eceee under a contract from the European Commission's DG Energy. European Council for an Energy Efficient Economy. March 2012.

European Commission 2006. Official Journal of the European Union: Directive 2006/32/EC on energy end-use efficiency and energy services. 27 April 2006.

European Commission 2011a. Energy Efficiency Plan 2011. COM(2011) 109 final. Brussels 8.3.2011.

European Commission 2011b. Proposal for a directive of the European Parliament and of the Council on energy efficiency and repealing Directives 2004/8/EC and 2006/32/EC, Brussels, 22.6.2011, COM(2011) 370 final, 2011/0172 (COD)

European Commission 2011c. National Energy Efficiency Action Plans (NEEAPs): update on implementation. Accompanying document to the Energy Efficiency Plan 2011.

European Commission 2009. Synthesis of the complete assessment of all 27 National Energy Efficiency Action Plans as required by Directive 2006/32/EC on energy end-use efficiency and energy services. Commission Staff Working Document. SEC(2009)889 final. Brussels, 23.6.2009.

Eurostat 2011. Taxation trends in the European Union - Data for the EU Member States, Iceland and Norway. 2011 edition. Publications of the European Union. ISBN 978-92-79-19644-7.

IEA/OECD 2011. Implementation of the 25 energy efficiency policy recommendations in IEA member countries: recent developments. Period from March 2009 to March 2011. 30 March 2011. http://www.iea.org/papers/2011/25recom_2011.pdf

JRC (2010). Voluntary Agreements in the Field of Energy Efficiency and Emission Reduction: Review and Analysis of the Experience in Member States of the European Union. Joint Research Centre. May 2010, Ispra.

Lapillone B. 2011. Energy savings obligation in the EU. Workshop presentation: “Savings obligations, public buildings targets and the promotion of CHP-Best practices in MS and cost of implementation, 17 October 2011, European Parliament. Enerdata.

MURE Database: http://www.isisrome.com/mure/index.htm

ODYSSEE Database: http://www.odyssee-indicators.org/

ODYSSEE-MURE Project 2012. Energy Efficiency Trends in the Industrial Sector in the EU. Lessons from the ODYSSEE-MURE project. Intelligent Energy Europe. 2012.

OECD/IEA 2011. 25 Energy Efficiency Policy Recommendations. 2011 Update.

WEC 2010. Energy Efficiency: A Recipe for Success. World Energy Council. United Kingdom. ISBN: 978 0 946121 00 7.

WEC 2008. Energy Efficiency Policies around the World: Review and Evaluation. World Energy Council. United Kingdom. ISBN: 0 946121 30 3.

i

ii