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Executive Summary

This report analyses best practice policy case studies for the industrial sector which may serve as examples for Member States of policies that could be implemented at a national to meet targets set out within the EU Effort Sharing Decision (ESD).

A variety of instruments exist at EU level to promote low-carbon technologies in the ESD industries:

- Update of the regulation on Combined Heat and Power (Cogeneration) (Directive 2004/8/EC). intended in the proposed Directive for Energy Efficiency from June 2011.
- Community framework for the taxation of energy products and electricity (Directive 2003/96/EC), which sets minimum taxation levels; companies have to provide in exchange more or less relevant efforts in the form of voluntary approaches to enhance energy efficiency and/or reduce emissions.
- Integrated Pollution Prevention and Control IPPC (Directive 2008/1/EC) (provisions for energy management).
- The Energy Performance Directive for Buildings (EPBD) (industrial buildings)
- The Eco-design Directive (industrial cross-cutting technologies)
- The proposed Energy Efficiency Directive (mandatory audits and energy management schemes).

The most important instrument for the reduction of GHG emissions from the industrial sector, the EU ETS, is not directly relevant for the non-ETS industries except for providing indirectly a carbon price signal to companies outside the EU ETS - as well through the price of energy carriers covered by the ETS, including electricity. However, the present low level of the carbon price signal has a limited indirect impact on company choices.

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

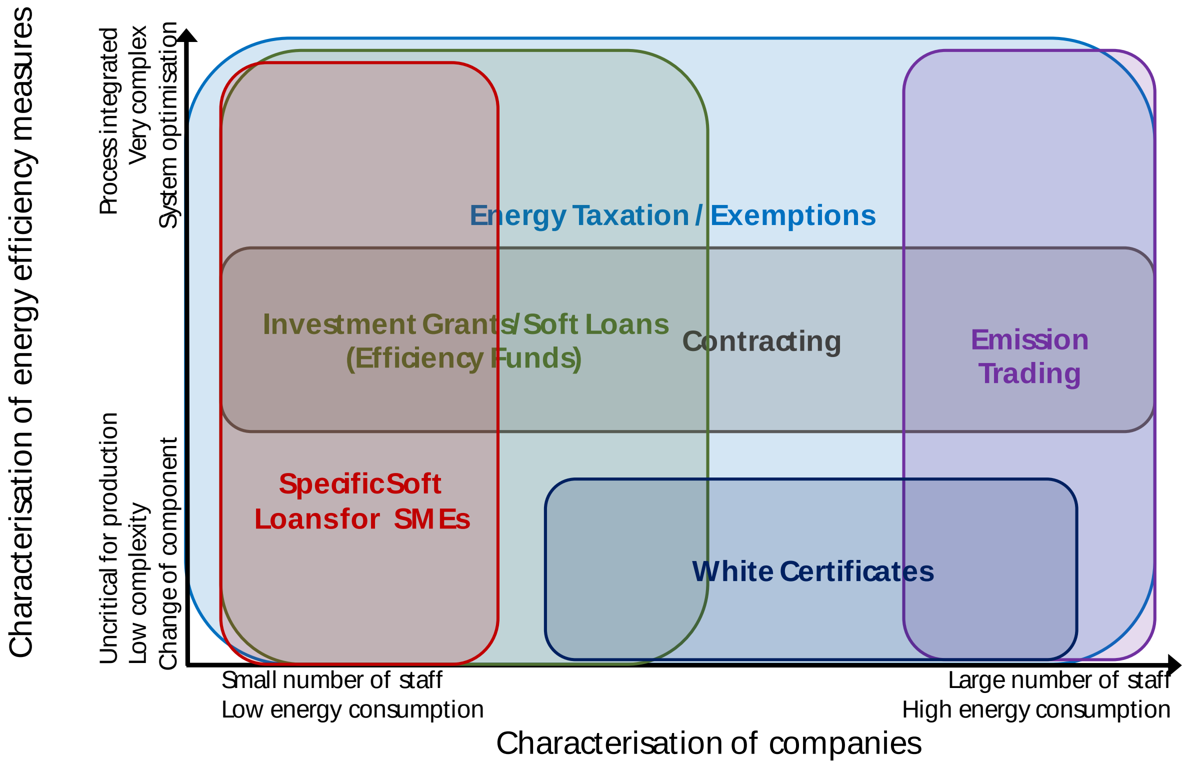
The ESD affects industrial companies not covered by the EU Emission Trading Scheme (EU ETS). For industry, this implies that the most energy-intensive installations such as blast furnaces, cement kilns, glass furnaces etc. are not covered by the ESD. The fact that the larger emitters are excluded from the ESD does not, however, imply that the ESD only covers small and medium-sized companies. The industry sector under the ESD is certainly made up of a large number of small and medium-sized enterprises (SMEs), which have particular characteristics, but also features larger companies with thousands of employees and which are less energy-intensive, such as companies in the engineering and transport equipment sectors. It is also important to underline that whilst a variety of policies and measures addressing the sector typically consider all emissions (including emissions from electricity consumption), only direct combustion emissions will (in most cases) be captured by the ESD. This also concerns emissions from heating industrial offices/production facilities, which account for 50% of the energy use in some sectors (such as the engineering sector).

Energy efficiency has been identified as a major option to reduce emissions from ESD industries, next to the option of introducing more low- or zero-carbon fuels into the sector. Theory and practice have identified a variety of barriers to these options in industrial companies which may justify the need for policy intervention. These barriers fall into two large groups: economic barriers (such as up-front investment barriers) and non-economic barriers (such as company culture and values), see the following diagrams.

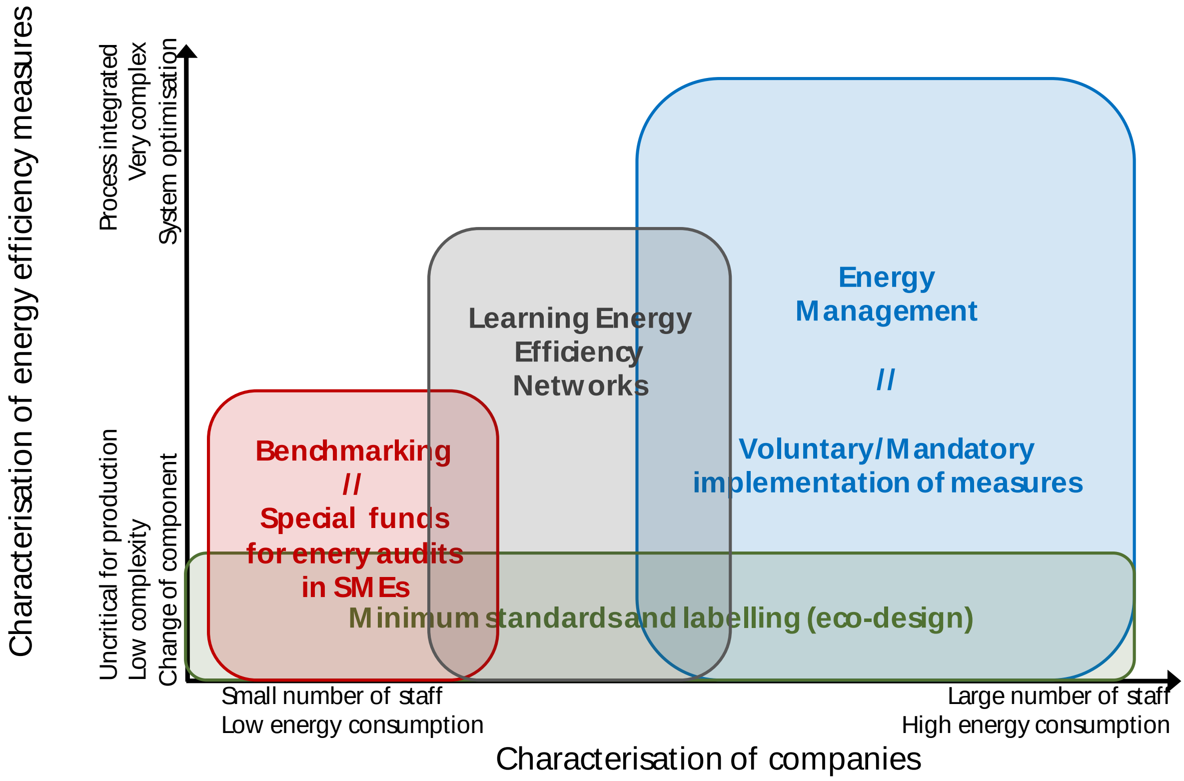
ESD industry is a heterogeneous group of companies and policy instruments therefore need to be tailored to address these different groups and their specific barriers along the product cycle, as well as the barriers for other actors to the diffusion of low-carbon technologies (technology suppliers, intermediaries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

- SMEs may need a special coaching process to enable them to adopt energy-efficient solutions as well as special tool boxes to help them reduce their transaction costs. In order to overcome the investment barriers, it is important to promote such activities more strongly, e.g. through energy efficiency funds.
- Larger companies under the ESD may suffer less from investment barriers, but may be subject to non-economic barriers such as split incentives or lack of information/motivation.

Policy instruments to overcome ECONOMIC barriers



Policy instruments to overcome NON-ECONOMIC barriers



When looking at the policy maps above with respect to non-economic and economic barriers**, we can identify four important areas for cooperation among Member States and for the expansion of activities under the ESD:**

- Financial support and incentive programmes for industrial energy efficiency exist in many Member States and constitute the most widespread type of instrument in the industry sector. They help to overcome the upfront investment barrier which is relevant for many companies despite the fact that many energy efficiency measures are economic over time. We analyse the implementation strengths and weaknesses of these programmes in **Case Study 1**. An important issue is to secure stable financing to compensate for erratic state budgets, especially in times of strict budgets.
- There is a substantial **gap with respect to smaller companies,** both with regard to **information about their energy consumption** as well as **support for implementing measures**. Specific financial instruments for SMEs do exist in some Member States (for example the SME Special Fund in Germany). This issue is discussed specifically in **Case Study 2**.
- **Voluntary/negotiated schemes** to improve energy efficiency and reduce GHG emissions in the industrial sector have been implemented in many Member States with varying success. **The success of such schemes hinges on linking the option to the intrinsic motivation of companies and complementing the measure with further policy options such as subsidy schemes, audit schemes and information**. **Case Study 3** analyses the strengths and weaknesses of these policies and highlights the role such agreements may play in the future policy mix. Such voluntary schemes may also provide policy options in case Member States decide to exclude installations between 20 and 35 MW from the application of the ETS, where MS have the freedom to choose.
- There is a substantial gap with respect to today's practice of energy efficiency **in medium-sized companies, which concerns the perception of transaction effort and the motivation of companies to save energy and implements low-carbon options**. This gap could be bridged by the newly developed instrument of Learning Energy Efficiency Networks. This instrument, currently being applied in Switzerland and Germany, **helps to lower transaction costs** for companies and is described in **Case Study 4** and analysed with respect to its potential for replication in other Member States and at EU level.

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Annex

1 Introduction

1.1 Background

This report was prepared by the Fraunhofer Institute for Systems and Innovation Research (ISI), in collaboration with AEA, as part of the study *Next phase of the European Climate Change Programme: Analysis of Member States' actions to implement the Effort Sharing Decision and options for further community-wide measures.* The project was funded by DG Climate Action of the European Commission (EC) with the aim of assisting the EC to identify policies and measures that enable the Member States to fulfil their national commitments under the Effort Sharing Decision (ESD).

In earlier phases of the project, an assessment was made of the projected emissions of greenhouse gases to 2020 in each of the main ESD sectors, the potential gap between the projected emissions and the ESD target, and the abatement measures that could be implemented to reduce this gap. In addition, a high level review was provided of the existing policies and measures at Member State level. Further information on the ESD, the Member States' targets under the ESD, and the analysis described above can be found in AEA/AlterraEcofys/Fraunhofer ISI (2012).

Building upon the earlier work, this report provides a more detailed examination of the policy options that could be implemented on a national or EU-wide level in order to deliver additional emissions reductions. The focus of the analysis is on additional policies that could be implemented to support and complement existing EU-wide policies.

This report focuses on policies within the **industry sector (as far as not covered by the EU Emission Trading Scheme).** A series of case studies illustrate examples of existing best practice policies that could be replicated to deliver additional emission abatement. In each case, an assessment is made of the relative strengths and weaknesses of the different policies, including synergies and co-benefits.

The case study policies selected are not intended to be exhaustive. Other policies have been, and could be, implemented to deliver similar objectives. This report therefore presents a sample of the policy available to decision makers looking to mitigate greenhouse gas emissions from the industry sector.

1.2 Characteristics of the industry sector

The ESD excludes greenhouse gas emissions covered by the (consolidated) Directive 2003/87/EC (establishing a scheme for greenhouse gas emission allowance trading within the Community) from its field of application[1]. For the industry sector this implies that the most energy-intensive installations such as blast furnaces, cement kilns, glass furnaces etc. are not covered by the ESD. The extent of emissions from the industry sector included in the ESD has been investigated in AEA/Alterra/Ecofys/Fraunhofer ISI (2012). However, even if larger emitters are excluded, this does not imply that the ESD only addresses small and medium-sized companies. The industry sector covered by the ESD is certainly made up of a large number of small and medium-sized enterprises (SMEs), which have particular characteristics, but also features larger companies which have thousands of employees but are less energy-intensive, such as those in the engineering and transport equipment sectors.

Finally, it is also important to underline that, whilst a variety of policies and measures addressing the sector typically consider all emissions (including emissions from electricity consumption), only direct combustion emissions will (in most cases) be captured by the ESD[2].

[1] According to recital (25) on changes in the inclusion of additional sectors into the EU ETS (e.g. from the non-ferrous metal and chemical sectors starting from 2013), this also implies changes in the definition of the emissions governed by the ESD: "Any adjustments in the coverage of Directive 2003/87/EC should be matched by a corresponding adjustment in the maximum quantity of greenhouse gas emissions covered by this Decision. "

[2] It is though important that savings from electricity consumption are also taken into account when considering policies. While the EU ETS is an important driver of emissions reductions associated with electricity consumption, the price signal from the EU ETS alone may not sufficient to

1.3 Emissions, policy gaps and abatement potential

1.3.1 Projected emissions

As discussed in AEA/Alterra/Ecofys/Fraunhofer ISI (2011), industrial emissions covered by the ESD cannot be estimated as easily as emissions from other sectors due to uncertainties about the split between industrial emissions falling within the scope of the ESD and those within the scope of the EU ETS. An estimated 46 % of industrial GHG emissions (out of this around 73 % are CO_2-related, and around 62 % due to energy-related CO_2) are captured by the ESD given the current definition of the EU ETS, but this will fall to 37 % after 2012 due to the increased scope of the EU ETS. The PRIMES/GAINS baselines, when disaggregated to a sub-sector level, suggest an even lower share of around 27 % after 2012.

According to the disaggregated PRIMES (EC, 2010) and GAINS baselines (IIASA, 2010), which constitute the main projections for CO_2 and non-CO_2 greenhouse gases in the EU, emissions from non-ETS industry could increase from 290 $MtCO_2$ eq. in 2005 to 336 $MtCO_2$ eq. in 2020 (+15.9%). The Member States' own projections, when disaggregated using the ETS/ESD split from PRIMES, suggest a higher level of emissions from the industrial sector in 2020 (416 $MtCO_2$ eq.). This difference is more marked for energy-related emissions than for process-related emissions (211 $MtCO_2$ eq. for the PRIMES/GAINS baseline projection and 286 $MtCO_2$ eq. for the Member State projections).

The analysis of the emissions shows that the industry sector under the ESD is smaller than the transport and buildings sectors, but has relatively rapidly increasing emissions for the time horizon of 2020.

1.3.2 Abatement potential

According to the analysis in AEA/Alterra/Ecofys/Fraunhofer ISI (2011), a cost-effective reduction potential of at least 60 $MtCO_2$eq. still remains in the non-ETS industry. Most of the potentials in the non-ETS industries are cost-effective and equally split across Member States.

The gap to the ESD target if applied uniformly across the sectors is comparatively high for the non-traded industries in most EU Member States including the new EU Member States. Energy efficiency options are the most important fields of action in those non-ETS industries. Actions to reduce emissions from non-traded industries include lowering the space heating demand (some non-ETS industries have 50 % space heat shares), more efficient industrial steam boilers (around 30% of industrial fuel use is for generating steam), improved furnaces and dryers and improved industrial processes.

There are large indirect reduction potentials in non-ETS industries due to electricity savings (164 $MtCO_2$ eq. by 2020). Although the issue of indirect emissions from electricity use spans every sector, it is particularly relevant for the non-ETS industries. These potentials include measures that are cost effective (where the savings arising outweigh the costs) but their take up may be hampered by non-economic barriers. The price signal from the EU ETS, which is realised through higher electricity prices to industrial end users, provides a further financial stimulus to companies. However, the existence of these non-economic barriers means that this stimulus alone is not sufficient to deliver the full potential and further policy interventions are required.

1.4 The need for policy intervention

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

deliver large reductions in consumption. Therefore, additional policies addressing specific barriers to electricity savings in industry can be justified, beyond the price signal from the EU ETS.

- According to Jaffe and Stavins (1994), the barriers to such options can be separated into non-market-failure barriers (private information costs, high discount rates, heterogeneity among potential adopters[3], hidden costs, access to capital) and market-failure barriers (such as imperfect information, principal-agent relationships, split incentives and adverse selection).
- Behavioural science points to barriers such as the form of information available, the credibility of information sources, inertia, and culture or values.
- Organisational theory identifies as barriers the power or status issues within an organisation associated with energy efficiency and its management.
- Further barriers are indicated by transaction cost economics and behavioural economics (Golove and Eto, 1996; Sorrell et al., 2004).

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

- lack of knowledge and market surveys of energy managers, particularly in SMEs, as well as of consulting engineers, architects, installers, bankers;
- high transaction cost of the energy manager (searching for solutions, tendering, decision preparation and decision-making). Due to their size and the low share of energy in their expenditure, the transaction costs of searching for funding for energy-saving measures are too high in SMEs;
- lack of own capital, fear of borrowing more capital for off-site investments (banks: risk of liquidation; companies: future possible change in production);
- technology producers or wholesalers often pursue their own interests which may contradict the possible innovative steps of efficient solutions; and
- 80% of companies based their decisions only on risk measures (payback period), but not profitability indicators (e.g. internal interest rate). Therefore, profitable options are rejected in the decision-making process (Table 1).

Table 1: Risk measures (payback period) versus profitability indicators (e.g. internal interest rate)

Payback time requirement (in years)	Internal rate of return in % per year[1)]							
	Useful life of plant (in years)							
	3	4	5	6	7	10	12	15
2	24%	35%	41%	45%	47%	49%	49,5%	50%
3	0%	13%	20%	25%	27%	31%	32%	33%
4		0%	8%	13%	17%	22%	23%	24%
5			0%	6%	10%	16%	17%	18.5%
6	unprofitable			0%	4%	10.5%	12.5%	14.5%
8						4.5%	7%	9%

1) Continuous energy saving is assumed over the whole useful life of the plant

[red] Profitable investment possibilities eliminated by a four-year payback time requirement

Source: Fraunhofer ISI

The ESD industry comprises a heterogeneous group of companies and policy instruments need to be tailored to address these different groups of companies and their specific barriers along the product cycle (Figure 1), as well as the barriers for other actors to the diffusion of low-carbon technologies (technology suppliers, intermediaries such as wholesalers etc.):

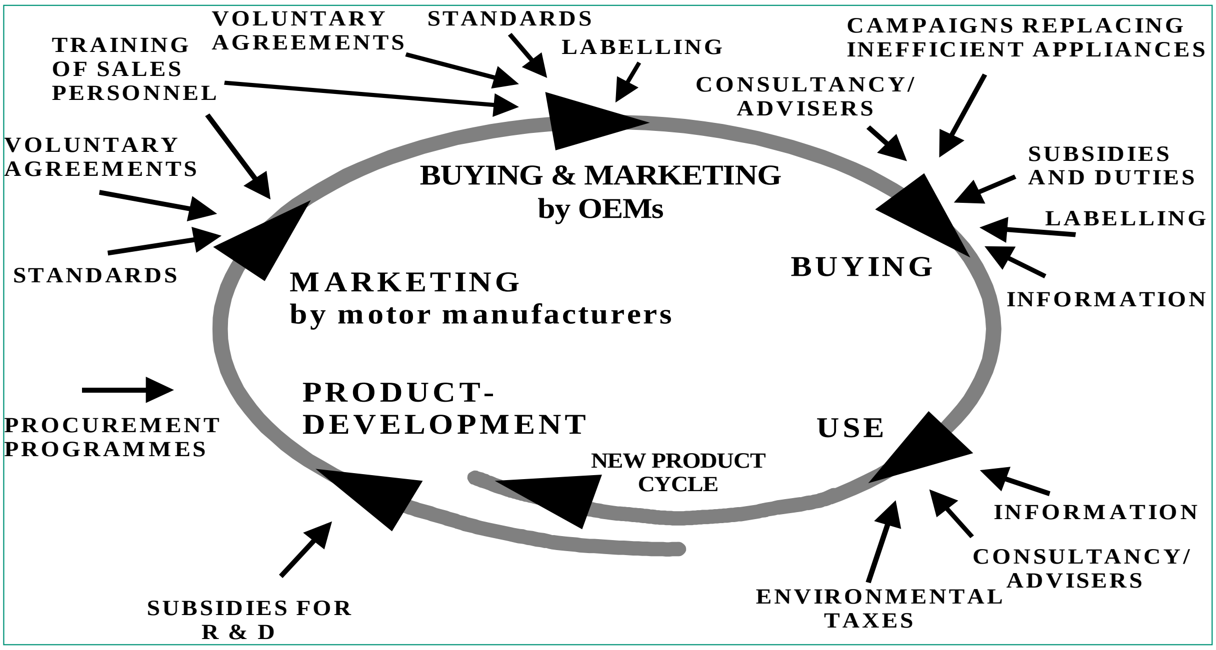
- SMEs may need a special coaching process to adopt energy-efficient solutions as well as special tool boxes to reduce their transaction costs. In order to overcome the investment

3 New products and practices take time to diffuse, a fact that is often attributed to some form of heterogeneity among potential adopters. People may realize different benefits and costs from the innovation, or have different beliefs about its benefits and costs, hear about it at different times, or delay in acting on their information.

barriers, it is important to promote such activities more strongly, e.g. via energy efficiency funds.

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

Figure 1: Possible policy instruments to reduce existing obstacles or support actors in the product cycle



1.5 Policy options

This report focuses on the industrial sector excluding those companies whose emissions are covered by the European Emission Trading Scheme (EU ETS). In the following sections we look at best practice examples and areas without sufficient policy coverage which are relevant for this sector.

Firstly, it is useful to map the overall policy landscape and the policy options that could be used to address the gaps in the landscape and to overcome barriers. In sections 2 and 3 we distinguish between economic and non-economic barriers to low carbon and energy-efficiency options in ESD industries. The beginning of each section features a **policy map** which describes the current policy landscape highlighting “black areas” and areas without sufficient coverage. This serves as a useful base to identify case studies for further investigation.

In order to map policies, we have to distinguish different levels:

- **fuels and electricity** (this separation is relevant later to distinguish the ETS/non-ETS parts of industry, although there are strong interactions, e.g. through fuel substitution).
- The **type of industrial energy use**:
  - Industrial cross-cutting technologies (such as electric motors and electric motor systems: pumps, ventilation, compressed air, industrial steam generators etc) which are used in many industrial branches;
  - cross-cutting technologies with specific branch characteristics (in particular industrial dryers and furnaces). These can be applied in different industrial branches but are not exactly identical and need to be adapted to the sector’s specifications;
  - process technologies (e.g. chemical or metallurgical reactors, etc.) which are specifically adapted for a particular industrial branch.
- The **size of companies** (from small to very large).
- The **complexity of energy use** (component versus system aspects).
- The **type of barriers to be overcome** by the policy instruments (in particular the distinction between economic barriers and non-economic barriers).
- The **exposure to international and national competition**.

In the diagrams at the start of sections 2 and 3, we try to map out the existing policy instruments for the industrial sector and how they are linked to the different dimensions discussed above. Given the fact that there are several dimensions, it is not possible to map them all in one graph. We have therefore chosen to map selected important aspects. In particular, we distinguish instruments to overcome non-economic and economic barriers. The large number of dimensions may help to explain why it is more difficult to tackle the industrial sector with a comparatively small number of instruments than is the case for other more homogeneous sectors such as the residential sector.

1.6 EU policy landscape

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

Other EU policies relevant for ESD industries comprise:

- Community framework for the taxation of energy products and electricity (Directive 2003/96/EC), which sets minimum taxation levels. However, at present, a larger number of companies benefit from tax exemptions but have to provide in exchange more or less relevant efforts in the form of voluntary approaches to enhance energy efficiency and/or reduce emissions. Such tax exemptions tend to be increasingly linked to energy efficiency measures, or at least to the introduction of energy management in companies.
- Regulation on Combined Heat Power (Cogeneration) (Directive 2004/8/EC). An update of this directive is intended in the proposed Directive for Energy Efficiency from June 2011.
- Integrated Pollution Prevention and Control IPPC (Directive 2008/1/EC), which has some, albeit weak, provisions for energy management.
- The Energy Performance Directive for Buildings (EPBD), which sets standards for buildings and is particularly relevant for ESD industries because in some sectors space heating represents 50 % of the energy consumption of the branch (e.g. in the engineering sector).
- The Eco-design Directive sets standards for a variety of products also in the industrial sector. These concern mainly electricity uses (e.g. minimum standards for electric motors) but some thermal cross-cutting applications in industry such as small to medium-size boilers not covered by the ETS and industrial ovens are also under preparation.
- The proposed Energy Efficiency Directive considers the introduction of mandatory audits and energy management schemes.

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

1.7 National policies

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

The following policies are applied to the industry sector:

- Financial/ fiscal incentives
- Regulations for industrial energy efficiency
- Legislative- although measures such as the setting of minimum energy performance standards for industrial cross-cutting technologies are now mostly the domain of the European Commission)
- Legislative-informative measures: mandatory energy managers/audits/reporting of energy consumption and energy saving measures
- Information provision/education/ training measures
- Voluntary/negotiated agreements (cooperative measures)
- New market-based instruments

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

1.7.1 Regulations

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

Minimum energy performance standards for industrial cross-cutting technologies are implemented under the EU Eco-design Directive (2005/32/EC) and the follow-up Directive 2009/125/EC of 21 October 2009 which establish a framework for ecodesign requirements for energy-related products (recast), the most important regulative measure for energy efficiency in the industrial sector. This framework obliges manufacturers of energy-using products to reduce at the design stage energy consumption and other negative environmental impacts occurring throughout the product life cycle. The Eco-design Directive introduces minimum efficiency standards for up to 40 products which cover – besides the industrial sector – the tertiary and the building sectors as well. The standards for electric motors and pumps and for ventilation fans are very influential in the industrial sector, but these are related to electricity consumption not covered by the ESD. Directly relevant for the ESD are regulations being prepared for boilers, industrial ovens, central heating products other than CHP (relevant for industrial space heating) and local room heating products,

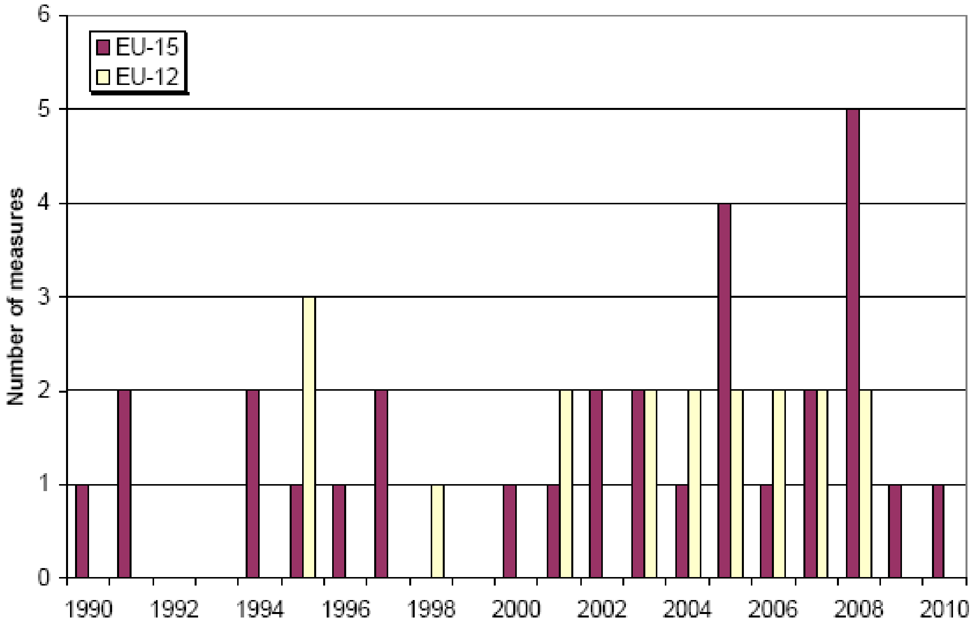
There have been some doubts about the efficiency of regulatory measures for the industry sector because the norms set are often well below the levels set by the Best Available Technology. This can also be observed for the Eco-design Directive to some degree. In many cases it has been found that the full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

So far, mandatory energy management is not a widespread measure and does not play a very prominent role in practice. One reason for this may be that large companies have energy managers while SMEs, where this is most relevant, have staffing problems with the activities. Also mandatory energy audits do not seem to be widespread. The disadvantages of mandatory audits include producers' perceptions of the mandatory nature of the instrument as an administrative burden rather than as a process helping them to reduce costs or become more competitive. Mandatory audits exist in particular in some eastern EU Member States (MS), such as Bulgaria, Latvia and Romania.

1.7.2 Information, education, training

Informational measures are considered relevant complements to other measures despite the fact that their direct impacts are considered to be low. Despite this, these measures tend to be implemented by most EU MS for the industrial sector. In recent years, more information programmes have been directed at the industrial sector (Figure 2) – these programmes are generally part of more general information campaigns across all sectors.

Figure 2: Frequency of information measures over time



Source: Adapted from MURE[4]

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

1.7.3 Market-based instruments

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

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

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

Because the focus here is on policy instruments that are relevant for the Effort Sharing Decision, the EU ETS will not be handled in more detail. However, JI/CDM are also flexibilities under the ESD.

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

[4] MURE, as a part of the ODYSSEE-MURE project, is a joint project under the Intelligent Energy for Europe Programme of the European Commission/DG Energy which provides an information platform on energy efficiency policies in Europe.

1.8 Selection of case study policies

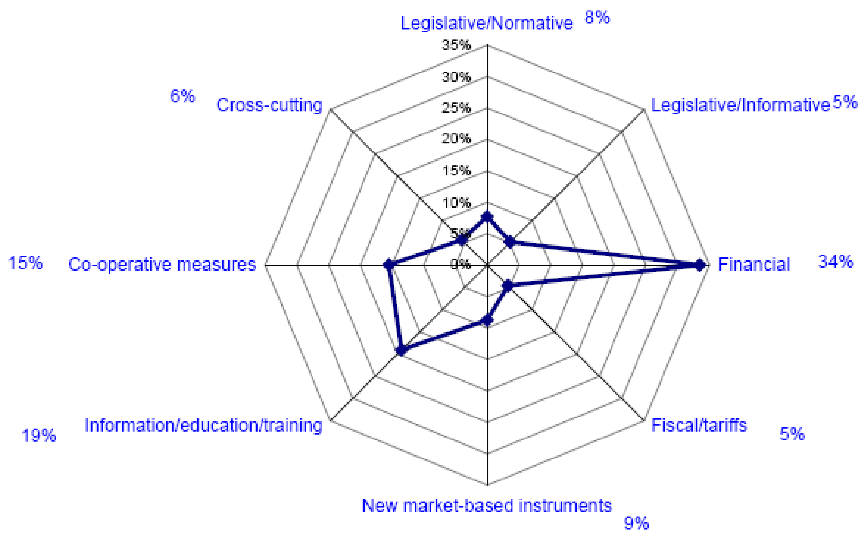
In this section we will identify which policy areas are still insufficiently covered and where examples from Member States provide information on how to cover these gaps more broadly across the other Member States or through harmonised action at EU level. This choice will further be substantiated in sections 2 and 3 based on the policy map developed in those sections.

When looking at the policy maps presented in sections 2 and 3 with respect to non-economic and economic barriers**, we identify four important areas for cooperation among Member States and expansion of activities under the ESD:**

- Financial support and incentive programmes for industrial energy efficiency are present in many Member States and constitute the most widespread type of instrument in the industrial sector. They help to overcome the upfront investment barrier which is relevant for many companies, despite the fact that many energy-efficiency measures are economic and pay back over time. We will analyse the implementation strengths and weaknesses of these programmes in **Case Study 1**. An important issue is to secure stable financing to compensate for erratic state budgets, especially in times of budget rigour.
- There is a **particular gap with respect to smaller companies,** both about **information on their energy consumption** as well as with regard to **support for realising measures**. Specific financial instruments for SMEs are being developed in some Member States (such as, for example, the SME Special Fund in Germany). This issue will be discussed specifically in **Case Study 2**.
- **Voluntary/negotiated schemes** to improve energy efficiency and reduce GHG emissions in the industrial sector have been implemented in many Member States with varying degrees of success. **Key to the success of these instruments was to link the option to the intrinsic motivation of companies and to complement the measure with further policy options, such as subsidy schemes, audit schemes and information**. **Case Study 3** will analyse the strengths and weaknesses of these policies and point to the future role which such agreements may have in the future policy mix.
- An important gap appears with respect to today's practice of energy efficiency **in medium-sized companies: that is, the perception of transaction effort and of motivation of companies to save energy and to implement low-carbon options**. This gap may be suitably covered by the newly developed instrument of Learning Energy Efficiency Networks. This instrument **helps to lower transaction costs** for the companies, is at present developed in Switzerland and Germany and will be described in **Case Study 4** and analysed with regard to its potential for replication in other Member States and at EU level.

Figure 3 shows that financial/fiscal measures and cooperative measures (in particular voluntary/negotiated agreements) are among the most widely adopted types of measures.

Figure 3: Number of measures by type in industry in the EU (ongoing measures since 1990)



Note: Co-operative measures correspond to voluntary and negotiated agreements

Source: Adapted from MURE (www.mure2.com)

In order to shed further light on gaps in policy intervention, we also briefly discuss the new provisions under the forthcoming Energy Efficiency Directive. These provisions are not yet final, but give an idea of what is being discussed. Important policies which are presently being debated for the new Energy Efficiency Directive are energy audits and White Certificate Schemes. We will briefly present here the provisions as they currently stand in the draft of the Directive.

With respect to energy audits, the draft EU Energy Directive has the following provisions:

- It requires regular mandatory energy audits for large companies in paragraph 2 of Article 7 ("Member States shall ensure that enterprises not included in the second subparagraph of paragraph 1 are subject to an energy audit carried out in an independent and cost-effective manner by qualified or accredited experts at the latest by 30 June 2014 and every three years from the date of the previous energy audit."). However, voluntary actions are admitted as a substitute for mandatory audits in paragraph 3: "Energy audits carried out in an independent manner resulting from energy management systems or implemented under voluntary agreements concluded between organisations of stakeholders and an appointed body and supervised by the Member State concerned or by the Commission, shall be considered as fulfilling the requirements of paragraph 2." The Directive also lays down a series of requirements of energy companies regarding metering and billing. Article 7 specifies that Member States shall develop programmes to encourage small and medium-sized enterprises to undergo energy audits.

With respect to White Certificates/Energy Saving obligations, the draft EU Energy Directive has the following provisions:

- The proposal requires Member States to establish national energy-efficiency obligation schemes (Article 6). The scheme shall ensure that either all energy distributors or all retail energy sales companies operating on the Member State's territory achieve annual energy savings equal to 1.5% of their energy sales, by volume, in the previous year in that Member State, excluding energy used in transport. This amount of energy savings shall be achieved by the obligated parties among final customers. However, the draft directive allows in paragraph 9 of Article 6 to opt out of this requirement: "As an alternative ... Member States may opt to take other measures to achieve energy savings among final customers".

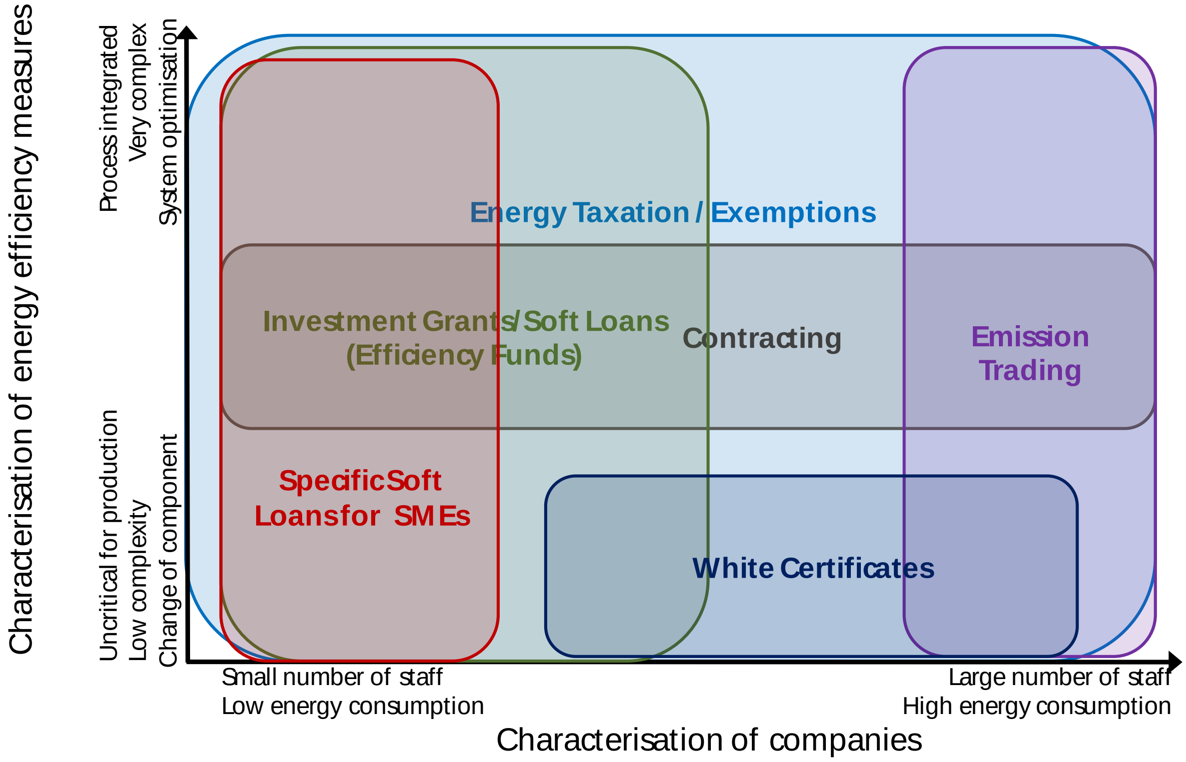
2 Policies to overcome economic barriers for industries under the ESD

2.1 Background

Figure 4 shows the most relevant instruments to overcome economic barriers. Such barriers may be, for example, the upfront investment barrier, low payback as compared to usual company requirements etc.

The graph shows that it is also necessary in this case to adapt the instruments to the size of the company (amount of energy consumption) and to the complexity of the energy-consuming system.

Figure 4: Policy instruments to overcome economic barriers



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

- **Larger companies** (if carbon-intensive) are subject to the emission trading scheme which provides (in principle) an economic signal to the actors, if the cap is low enough and the carbon price sufficiently high.
- **Medium-sized companies** may be supported through the introduction of White Certificate schemes and the organisation of energy services markets, e.g. based on energy performance contracting. They may also be supported in realising measures through energy efficiency funds.
- **Smaller companies** may benefit from special soft loans and grants to carry out energy-efficiency measures which do not contradict state aid provisions.

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

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

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

- First, for the public bodies providing the subsidies it is much easier to define the cases which are relevant for the subsidies in a standardised way. Process-specific improvements are generally only possible in combination with detailed energy audits, frequently to be provided by external auditors.
- Second, a number of companies refrain from initiating detailed external audits on process technologies because they consider them to be at the heart of their business and are reluctant to accept external energy audits. This barrier could be overcome by mandatory audits, as mentioned in the present draft of the Energy Efficiency Directive, or by audits based on voluntary agreements, as advocated in the EU Directive on Energy Efficiency and Energy Service. This could be an important field of the energy services to be developed under this Directive.

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

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

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

In addition, there are also *De minimis* rules which allow providing state aid at a low level.

Table 2 shows some relevant cases where state aid is admitted and the conditions for state aid as set by the GBER (EC, 2008).

Table 2: Some categories of measures, aid amounts and aid intensities applicable under the General Block Exemption Regulation GBER and with relevance for ESD industries

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

Source: EC (2008)

As an example the aid concerning energy saving specifies for

- Investment aid: Eligible costs: Strictly limited to the extra costs directly related to energy saving and a level of energy saving higher than Community standards are both identified. Furthermore, the operating benefits and operating costs arising during the first three years of the life of the investment (for SMEs), first four years (for large undertakings outside of the EU CO2 ETS (Emissions Trading Scheme)) or first five years (for large undertakings which are part of the EU CO2 ETS) are deducted and added respectively. Eligible investments can be made in land, buildings, plant equipment and technology transfer.
- Operating aid: The aid is limited to compensating for net extra production costs taking into account the benefits resulting from the energy saving. Investment aid granted is deducted from the production costs. It is limited to five years.

For more information see EC (2008).

2.2 Barriers to uptake

The economic barriers to uptake of low-carbon options in ESD industries were discussed in section 1.4. The most significant of these barriers are summarised in Table 3 differentiating SMEs and larger industries under the ESD.

Table 3: Economic barriers to uptake of low-carbon options in ESD industries

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

Therefore, the case studies in this section will look at policies which address these main barriers.

2.3 Policy options to overcome economic barriers

The specific policy instruments selected for more detailed examination as part of a case study are:

- **Case study 1:** A broader view of **financial support and incentive programmes** which aim to address the first major barrier to uptake of upfront costs, and are a popular measure in many European countries.
- **Case study 2:** A specific view is provided of the **German KfW SME Fund for Energy Efficiency** which aims to alleviate the more specific barriers of small and medium-sized companies mentioned in Table 3

2.4 Case Study 1: Financial support and incentive programmes

2.4.1 Objective of the measure

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

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

2.4.2 Application of the measure in the EU Member States

An overview of recent implementations of financial support and incentive programmes is given in Annex 1. There it can be seen that a considerable number of such programmes were introduced after the year 2000 across most Member States. The majority of these measures give direct financial support to companies that invest in some way in energy saving or low-/zero-emission fuels. Incentives through subsidised interest loans or tax deductions are less common.

2.4.3 Main features of the measure

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

1. Grants / subsidies;
2. Soft loans for energy efficiency, renewables and CHP;
3. Tax exemption / reduction / accelerated depreciation;
4. White certificates/energy efficiency obligations

The list of policies is not exhaustive, and other potential policies have been implemented in the EU and elsewhere to deliver similar objectives. Further details on alternative policies can be found in the MURE measures database[5] and IEA policies and measures database[6] respectively.

[5] http://www.isisrome.com/mure/
[6] http://www.iea.org/

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

2.4.4 Evaluation of the measure: Financial support and incentive programmes

This section evaluates the impacts of the policy in terms of economic, environmental and social factors, indicating if the impacts are positive, neutral or negative and if the impact is high or low.

(++) High positive impact
(+) Low positive impact
(n) Neutral
(-) Low negative impact
(- -) High negative impact

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

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

	Economic impacts	
What was the cost to deliver the outcome, was it value for money?	(++)	Given the fact that mainly economic options for energy efficiency and low-carbon technologies are implemented, the competitiveness of companies is largely enhanced.
	(+)	Marginal cost to administer is relatively low for tax-based schemes, as the arrangements are already in place. Higher costs to administer subsidy schemes, soft loans or obligations.
	(n)	Costs can be limited by setting limits for: the number of eligible options; the time period for the scheme; the total subsidy funding available; the maximum subsidy per subsidised option; target-setting in the case of obligations.
	(-)	Greater than expected response can be costly if suitable limits are not put in place in the case of direct subsidies or taxation.
	(-)	Subsidies may crowd out private investments, i.e. the investment would have been made anyway, even without the subsidy (free-rider effects).
What wider economic impacts does the policy have?	(++)	Stimulates the early market for highly energy-efficient process and cross-cutting technologies in industry (e.g. high-efficiency industrial steam boilers).
	(++)	Potential savings for consumers are significant. Savings are mainly on upfront costs or over the lifetime of the energy-efficiency option, but may also occur over the lifetime (e.g. enhanced depreciation).

	(n)	Increased uptake of low-carbon options can stop once the incentive is taken away. It can be expected that monetary incentives will be phased out in the medium or long term. Ideally, manufacturers would have been able to achieve cost reductions so that the reduction in incentives will not affect market uptake.
	(-)	Loss of revenue from taxes (company tax) can extend over the lifetime of the energy-efficiency option.
	(--)	Subsidising low-carbon options may lead to the crowding out of more innovative technologies from other fields with larger potential for economic growth.
	(--)	Indiscriminate payment of incentives may subsidise non-European manufacturers, leading to loss of European jobs.

Environmental impacts

Did the policy deliver the desired outcome?	(++)	Industry (excluding EU ETS industries) represents a non-negligible fraction of overall energy consumption and GHG emissions.
	(+)	Financial schemes tend to have a strong contribution to the environment targets with the limitations set by available budgets.
What other impacts has the policy had?	(++)	Improvements in local air quality. This is particularly important for pollution from industrial activities in urban areas.
Are there impacts on emissions from other sectors?	(++)	The enhanced development of energy management systems in conjunction with financial subsidies will also benefit electricity savings, hence leading to a reduction of indirect emissions from the power sector.

Social impacts

Was the policy well received, were there issues in gaining acceptance, what did they relate to?	(++)	Improving energy efficiency in industries helps to maintain competitiveness and hence employment.
	(-)	Subsidies contribute to increase state deficits and are hard to maintain in times of economic crises. Hence the need to link them more strongly with sources independent of budgetary cyclicity (e.g. financing through the EU ETS or through supplier obligations)
What are the distributional impacts?	(-)	Subsidising the improvement of energy efficiency in industries may lead to lower budgets available for other innovations that could make potentially larger contributions to economic growth. However, promoting green technology increasingly appears as the key in economic growth.

	Cross-cutting	
Are there interactions with policies in other sectors?	(++)	Environmental policy and industrial policy strongly interact, as low-carbon and energy-efficiency technologies increasingly contribute to the overall competitiveness of a country, directly through the development of new technology fields, and indirectly through improved supply security
Timeframe – is there anything to note about the timing of policy implementation and expected impacts?	(++)	Energy-efficiency options in the industrial sector can be mobilised in a fairly short time frame especially concerning cross-cutting technologies

2.4.5 Maximising desired impacts/reducing unwanted impacts

This section looks at how the positive impacts could be maximised to ensure the policy delivers its full potential. We have compiled the lessons learned from schemes that have already been introduced, as well as using evidence from the literature to suggest how implementation could be improved. Strategies to mitigate the negative impacts are also suggested.

Maximising the benefits

Upfront incentives e.g. grants may be more effective

Evidence suggests that the form of the incentive is just as important as the total subsidy amount. This is also relevant for the industrial sector. Studies in the transport sector indicate that consumers are highly sensitive to upfront costs, and less influenced by total cost of ownership, which may explain why schemes which deliver upfront incentives tend to be more effective than those which offer savings post-purchase.

Stabilise the financing sources

Linking subsidy schemes to erratic state budgets will lead to a stop-and-go policy in promoting energy efficiency and low-carbon options in ESD industries. It is therefore important to open stable financing sources. Examples are the forthcoming energy efficiency fund in Germany financed by the EU ETS income, as well as financing from energy efficiency obligations and White Certificate schemes. Another example for environmental tax recycling is the National Fund of Environmental Protection and Water Management of Poland which among others addresses the efficient use of energy and highly efficient co-generation facilities. According to the National Fund of Environmental Protection and Water Management (http://www.nfosigw.gov.pl/en/), "it is supplied, mainly, with the income from the fees and fines for the use of the environment, service and concession fees, fees following from the Energy Law, the act on recycling of end-of-life vehicles, income from the sales of Assigned Amount Units for greenhouse gas emissions and many other sources".

Establish instruments in parallel to overcome non-economic barriers Frequently, the upfront investment barrier is accompanied by non-economic barriers such as lack of information. Energy management schemes (EMS) are important elements to recognise such non-economic barriers. The introduction of such EMS should be generalised in Europe by enforcing their introduction systematically as a counterpart for tax reductions to companies and in combination with subsidy schemes.

Integrate technology providers and intermediaries into the package Companies are the end-users of technologies. However, there may be intermediaries such as original equipment manufacturers (OEMs) or wholesalers, as well as technology suppliers. As they are not concerned about the economic barriers, they may face non-economic barriers which should be resolved in packages with economic measures.

Mitigating measures

Minimise distortion of competition Each intervention in the industrial sector is linked to a distortion of competition. For this reason, strict state aid rules have been set up. On the other hand, without large-scale programmes, investments in low-carbon and energy-efficiency technology will not be undertaken. State aid rules need therefore to carefully check how aid can be maximised while avoiding distortion in competition. Member States should check whether options specified by EC (2008) are used and known to the largest possible amount at national level. On the other hand they should systematically set up financial programmes (for example to replace inefficient old steam and hot water generators in industry not covered by the ETS which represent a larger fraction of fuel uses) and cross-check with the European Commission for simplified approaches to comply with state aid rules.

Minimise economic burden on companies As far as possible, measures should not introduce additional burdens but be recognised as a benefit by the companies. For example, administration for subsidy schemes should be standardised and the load on the companies reduced. On the other hand, if data collection is necessary it should be used to provide further information to companies, e.g. on their position as compared to others, through benchmarking approaches.

2.5 Case study 2: Special fund for energy efficiency in SMEs

Case study 2 - Special fund for energy efficiency in SMEs in Germany - is strongly linked with case study 1, as it is also a financial scheme to promote energy efficiency in industry. However, it provides a better insight into the policies to overcome barriers for small and medium-sized enterprises (SMEs).

2.5.1 Objective of the measure

This fund was launched by the Federal Ministry for Economics and Technology (BMWi) and the KfW Förderbank in November 2007 and became effective in 2008. It promotes energy-efficiency investments in small and medium-sized companies (Fraunhofer ISI 2008). The fund consists of two parts: first, it supports the advice about potential energy savings in SMEs, providing a grant of up to 50 % for an independent energy consulting. Second, financial support is given for the resulting investments to exploit the saving potentials by means of low-interest loans.

2.5.2 Application of the measure in the EU Member States

All European countries have gaps in promoting energy efficiency in SMEs due to the relatively strong presence of barriers. It is therefore important to develop and finance more standardised instruments to support audits in SMEs and enhance implementation of the proposed measures by developing adequate financing schemes.

The cost-effectiveness of the German programme for firms and the low share of public expenditure underline its value in the German energy-efficiency policy mix and suggest its expansion in Germany as well as in other countries

2.5.3 Main features of the measure

The energy audit programme was launched by the German Ministry of Economic Affairs in 2008 and was designed on the basis of a market study completed in 2006. The target group comprises all SMEs[7] in all sectors as well as self-employed. The programme comprises two kinds of audits which can be combined or used separately. These are:

- An “initial” or screening audit taking one or two days which covers a short check of the energy-using equipment and records the energy consumption, existing deficits as well as recommendations for improvement; for this type of audit 80 % of the total cost are granted.

- A “comprehensive” or detailed audit of up to 10 days with a detailed inspection of one or more energy consumption areas and suggestions for related EEMs; subsidies cover up to 60 % of the audit cost.

For both types of audits, a standardised template for the audit report is provided that assures that all important aspects of firms’ energy consumption are analysed. Besides the templates, the programme does not provide any standardised tools for the assessment. The (supported) cooperation between the auditor and the firm ends with the delivery of the audit report. Further follow-ups are not foreseen in the programme, but they sometimes take place. The auditors themselves do not require a particular training nor do they need to fulfil an assessment to be approved as auditor under this programme.

The programme is managed by the KfW, the German Promotional Bank owned by the federal republic and the federal states. It is responsible for approving applications and paying out grants. The communication with the companies is delegated to “regional partners”, mainly chambers of trade and commerce, but also business development institutions or energy agencies. They check and process the applications to the KfW. A searchable database of qualified and independent consultants is provided by the KfW on the internet, which should enable interested companies to find a suitable consultant in their region. The KfW checks consultants’ qualifications before listing them in the online database.

The KfW also provides soft loans to implement EEMs. However, the audit is not a precondition to receiving a loan. The programme does not comprise additional elements like voluntary targets or obligations on energy management schemes.

During the evaluated period from March 2008 to June 2010, in total 10,400 audit grants were approved by the KfW. Of these, 80% were initial audits and 20% comprehensive audits. The monthly approvals remained around 400-500, after an initial increase at the start of the programme in 2008.

According to the KfW statistics, the mean participating firm has around 38 employees, while 50 % of the firms have less than 20 employees. The share of larger firms is particularly low and only 10% of firms have more than 100 employees. On the other hand, the 10% of the largest firms account for more than 30% of energy demand, whereas the firms below 25 employees only account for 20% of energy demand, although they represent about half of the firms in the sample.

Most implemented EEMs can be characterised as cross-cutting technologies (see Table 4). They are relatively easy to identify for the external auditors, because the energy end-uses they address are

[7] Defined as firms with less than 250 employees

similar (e.g. space heating, lighting) and the EEMs often show a large degree of standardisation. Furthermore, most of the recommended EEMs only show a limited degree of innovation. Several of the measures are standardised and have been applied for many years.

Table 4: Characteristics of Energy Efficiency Measures (EEM) by type of end-use

Type of measure	Relative energy savings [%]					Payback period [a]					Investment [k€]				
	Mean	25%	50%	75%	Sample	Mean	25%	50%	75%	Sample	Mean	25%	50%	75%	Sample
Heating and hot water	**7.6**	1.5	3.7	9.3	80	**6.3**	3	5	9	79	**27.7**	1.0	3.5	25.0	99
Compressed air	**0.9**	0.2	0.3	1.6	20	**2.4**	1	2	3	25	**7.0**	0.3	2.5	6.0	41
Electric motors and drives	**1.2**	0.3	0.7	1.6	8	**4.4**	3	4	5	11	**33.5**	1.2	2.5	8.0	17
Ventilation and AC	**4.9**	1.5	3.3	8.2	15	**7.9**	2	9	12	14	**38.2**	0.3	1.2	45.0	21
Lighting	**3.3**	0.6	1.9	4.5	56	**4.2**	2	3	5	53	**5.1**	0.5	2.0	5.0	87
Building insulation	**10.1**	1.9	6.4	11.7	67	**10.6**	5	9	12	55	**28.7**	4.5	10.0	26.8	84
Heat recovery	**7.1**	1.8	4.3	9.6	47	**5.2**	3	5	7	33	**38.6**	5.0	15.0	30.0	31
Process technology	**3.8**	0.7	1.8	5.9	24	**7.2**	3	8	10	16	**49.1**	0.0	15.0	50.0	23
ICT	**3.4**	0.2	0.4	4.5	9	**3.4**	2	5	5	5	**13.5**	0.4	5.0	15.0	13
Cooling (for processes)	**4.9**	0.9	3.8	7.4	29	**6.2**	4	5	10	13	**23.2**	0.3	1.5	20.0	19
Energy management	**1.1**	0.0	0.2	3.1	3	**3.2**	0	3	5	10	**3.5**	0.1	0.6	6.0	14
Behavior	**2.8**	1.3	2.2	4.7	5	**1.7**	0	1	2	7	**0.4**	0.0	0.0	0.5	27
Other measures	**3.3**	0.2	1.9	2.9	18	**6.4**	2	6	11	17	**25.5**	0.0	0.3	3.0	22
Total	**5.9**	1.0	2.6	7.3	382	**6.1**	2.0	5	8	342	**22.7**	0.5	3.0	15.0	502

Note: The table shows the mean value for the relative savings, the payback period and the investment in the energy saving measures as well as the position of the first 25/50/75% of the companies, respectively. The latter measures whether the distribution of the companies across the three parameters is homogeneous.

Source: Fraunhofer ISI (2011)

2.5.1 Evaluation of the measure: KfW Special Fund for Energy Efficiency in SMEs

The general impact evaluation carried out for financial schemes for ESD industries in section 2.4.4 is also relevant for the specific case study on small industries and is not repeated here. However, we refer instead to the results of a recent evaluation by IREES/Fraunhofer ISI (2010) (an English version of this evaluation is submitted for publication).

The evaluation of the audit component shows that the German energy audit programme for small and medium-sized companies provides a way to improve energy efficiency in firms cost-effectively and reduces the initially discussed energy-efficiency gap. However, particularly financial barriers still prevail despite the programme. The programme is very cost-effective and shows a net present value of 4 to 23 € per MWh saved, which implies net earnings for firms. Each euro of public expenditure for audit grants induced 17-33 euros of private investment. On average, the firms adopted 1.7 to 2.9 measures, which they would not have done without the programme, and saved 3 to 5% of their energy consumption. The implemented measures show an average payback period of 6 years. Particularly building-related measures account for the large share of implemented measures. Building insulation has the highest average payback period of 10.6 years, while for example EEMs to improve compressed air systems only have 2.4 years on average. In total, during the evaluated time period from March 2008 to June 2010, the programme induced final energy savings of 950 to 1,630 GWh/a (310 to 530 kt CO_2/a). Assuming that the audit programme continues at the present activity level, it would accelerate the (average long-term) energy-efficiency progress in industry and service sector by about 3.3 to 5.6% (Source: Fraunhofer ISI, forthcoming report).

The energy savings resulting from such a fund in Germany are assessed at around 10 Petajoules in the year 2016 in the 2nd National Energy Efficiency Action Plan Germany, 2011.

2.5.2 Maximising desired impacts/reducing unwanted impacts

This section looks at how the positive impacts could be maximised to ensure that the policy delivers its full potential. We have compiled the lessons learned from schemes that were already introduced, as well as using evidence from the broader literature to suggest how implementation could be improved.

Strategies to mitigate the negative impacts (discussed in the assessment of social, economic and environmental impacts of financial support schemes) are also suggested.

Maximising the benefits

SMEs need more specifically designed subsidy schemes	SMEs require a more specific focus in the design of subsidy schemes. They need more simplified and standardised procedures to learn about energy efficiency opportunities and they may require stronger support to carry out measures, especially also in industrial buildings which is an important share of energy consumption in SMEs.
Stimulate awareness of the right investment appraisal	Companies and in particular SMEs frequently apply payback periods as a measure to evaluate the economics of a measure. From the experience in the Learning Networks for Energy Efficiency and Climate Protection (Case Study 4), it appears that this approach may be improved by looking into the ways such companies set up their investment criteria and whether this can be changed by suitable information or voluntary schemes.
SMEs may require higher amounts of financing to compensate for upfront investment	For SMEs, the upfront investment barrier is higher than for larger companies. It is therefore necessary to compensate larger parts of the cost differential with less energy-efficient options

Mitigation measures

Minimise economic burden on companies	As far as possible, measures should not introduce additional burdens, but be recognised as a benefit by the companies. For example, administration for subsidy schemes should be standardised and reduce the load for the companies. On the other hand, if data collection is necessary, it should be used to provide further information to companies, e.g. on their position as compared to others, through benchmarking approaches.

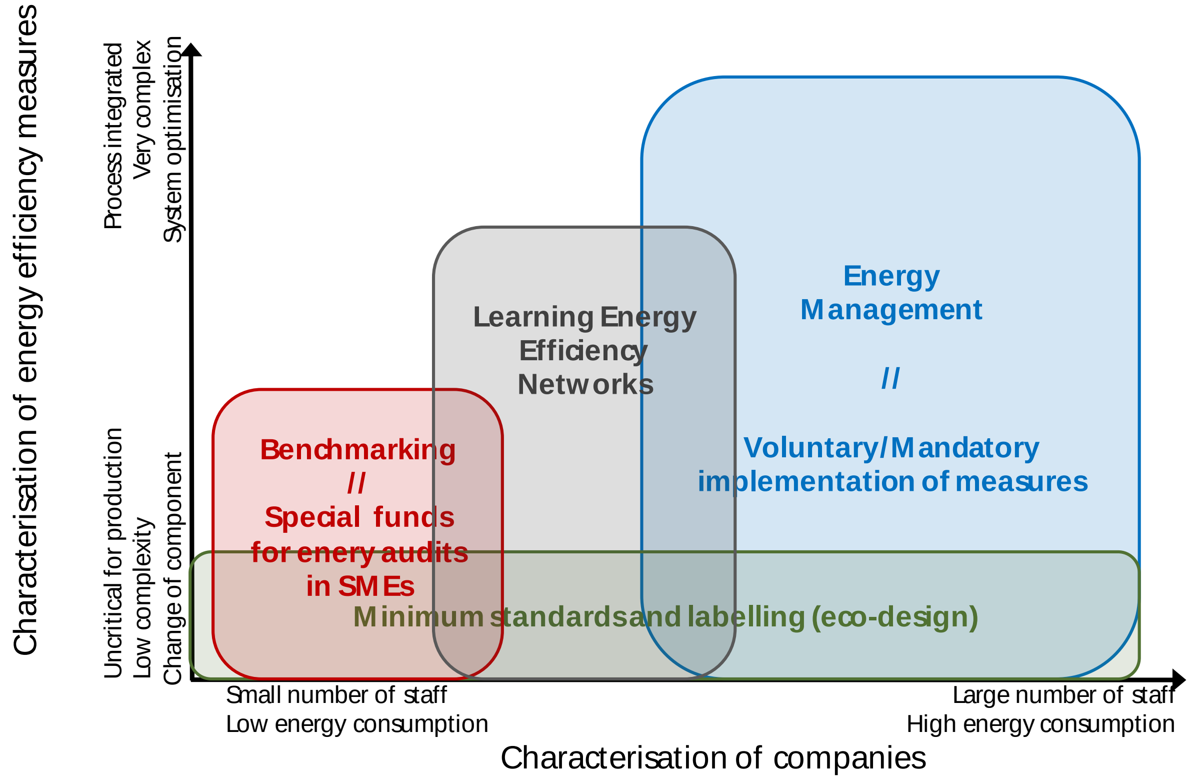
3 Policies to overcome non-economic barriers for industries under the ESD

3.1 Background

Figure 5 shows the most relevant instruments to overcome non-economic barriers. Such barriers may be, for example, information deficits, split incentives (e.g. in the case of intermediate constructors of machinery), the use of inadequate investment calculations (risk instead of profitability) etc.

The graph shows that it is necessary to adapt the instruments to the size of the company (amount of energy consumption) and to the complexity of the energy-consuming system.

Figure 5: Policy instruments to overcome non-economic barriers



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

- **Larger companies** can afford to have systematic energy management schemes, such as DIN EN 16001. They may also be required on a voluntary or mandatory basis to implement certain measures. This may also comprise companies which are part of the EU ETS and **shows that in the case of non-economic barriers they may be subject to additional measures, even if they are part of the EU ETS**. The economic signal from the EU ETS may not be sufficient to provide enough incentives to overcome the barriers. This is particularly the case of electricity-saving measures in the industrial sector.
- **Medium-sized companies** may be organised in so-called “Learning Energy Efficiency Networks” where a certain number of companies (15-20) from different sectors work together in networks which set themselves voluntary targets and have a structured approach to realising the energy-efficiency measures. This is specifically adapted to medium-sized companies with a certain amount of energy consumption. They do not have the experience in energy management of the more energy-intensive companies, but use enough energy to have

a structured approach, so that transaction costs can be kept at reasonable levels. This is a new instrument which is not yet widely introduced in Europe.

- The **smaller companies** use too little energy to carry out full energy audits. However, they may benefit from the knowledge provided by benchmarking systems (both at the level of process energy and cross-cutting technology). They may also be supported via special funds in carrying out (simplified) energy audits because usually the amount of energy consumption is too small to justify in-depth audits.

In terms of **complexity of the process**, this generally increases with the size of the company, but not exclusively. Especially industrial cross-cutting technologies have system aspects also in smaller companies and required system optimisation rather than only efficient components. Hence it is important to develop, for example, benchmarking instruments which are able to reflect the system optimisation aspects, e.g. in the case of steam generation and distribution, compressed air generation and distribution etc.

Across the different sizes of the companies there are the **minimum standards set by the eco-design directive and labelling schemes**. This applies mostly to components (individual boilers for steam raising) rather than complex systems (e.g. steam piping).

3.2 Barriers to uptake

The non-economic barriers to uptake low-carbon options in ESD industries were discussed in section 3.1. The most significant of these barriers are summarised in Table 5 by differentiating SMEs and larger industries under the ESD.

Table 5: Non-economic barriers to uptake of low-carbon options in ESD industries

Company type / Barriers	SMEs	Larger companies
Split incentives (e.g. in the case of intermediary constructors of machinery),	Medium to high	Medium
Behavioural barriers, such as the form of information available, the credibility of information sources, inertia, and culture or values	High	High
Organisational barriers: the power or status issue within an organi-sation associated with energy efficiency and its management.	High	High
Transaction cost barriers	High	Medium
Use of inadequate investment calculations	High	High

Therefore, the case studies in this section will look at policies which address these main barriers.

3.3 Policy options to overcome non-economic barriers

The specific policy instruments selected for more detailed examination as part of case studies are:

- **Case study 3:** A broader view of **voluntary or negotiated agreements** which aim to address non-economic barriers to the uptake of low-carbon and energy-efficiency options in many European countries.
- **Case study 4:** A specific view of the **German Learning Networks for Energy Efficiency and Climate Protection** which aim to reduce the transaction cost barrier and a variety of non-economic barriers for medium-sized companies.

There are a variety of further good examples to overcome non-economic barriers. Just as one further particular example we mention here the Carbon Reduction Commitment (CRC) Energy Efficiency

Scheme[8] which is a mandatory scheme aiming ot overcome non-economic barriers. The sectors targeted by the Carbon Reduction Commitment scheme generate over 10% of UK Carbon Dioxide (CO2) emissions, around 55 MtCO2. The Carbon Reduction Commitment scheme aims to reduce carbon emissions from these organisations by at least 4 million tonnes of carbon dioxide per year, by 2020. It features the following main elements:

- ***Emissions reporting requirement:*** Participants in the CRC will need to measure and report their carbon emissions annually, following a specific set of measurement rules. The first annual report of emissions is due in July 2011.
- ***A new carbon price:*** Starting in 2012, participants will buy allowances from Government each year to cover their emissions in the previous year. This means that organisations that decrease their emissions can lower their costs under the CRC. There are two important changes about buying allowances that the Government announced in October 2010:
  (1) The money raised from the sale of allowances will be retained by the Government rather than recycled back to CRC participants.
  (2) The first sale of allowances to cover emissions in fiscal year 2011/12 will be in 2012 rather than 2011.
  The price of allowances was set at £12 per tonne of carbon dioxide in the 2011 Budget.
- ***Ranking of participants in a performance league table:*** A publicly available CRC performance league table will show how each participant is performing compared to others in the scheme. If an organisation is a good carbon performer, the league table will help give a significant boost to the organisation's reputation, demonstrating its success in cutting emissions. However, because of the changes announced in October 2010, there is likely to be no direct financial benefit under the CRC from an improved position in the league table. An organisation's league table position each year will be determined by performance in three metrics:
  * Early action metric: 50% of the company score is based on what percentage of the organisation's electricity and gas supplies is covered by voluntary automatic meter readings (AMR) in the year to 31 March 2011. The other half is based on the proportion of the CRC emissions certified under the Carbon Trust Standard or an equivalent scheme.
  * Absolute metric: The percentage change in the organisation's emissions, compared to the average of the previous five years (or number of years available until 2014/15).
  * Growth metric: the percentage change in emissions per unit turnover, compared to the average of the previous five years (or number of years available until 2014/15).
  The weighting of these three metrics will change over time. In the first year, early action will count for 100% of the organisation's league table score. Over the first few years of the scheme, the early action metric will gradually fade in importance until the absolute and growth metrics receive 75% and 25% weightings respectively in 2014/15 and thereafter.

3.4 Case Study 3: Voluntary or negotiated agreements

3.4.1 Objective of the measure

Voluntary or negotiated agreements are mainly aimed at companies to encourage them to voluntarily engage in energy-saving and energy-efficiency measures. In order to make participation in such measures more attractive to firms, incentives, such as tax reductions/ exemptions, may be provided in return to agreeing to take part in the measures.

Voluntary agreements have the advantage that firms can *choose* to participate in them, for example, according to their cost-benefit ratio arising from the programme. If the costs of engaging in energy saving or increasing energy efficiency are lower than the benefits from the incentive (e.g. a tax reduction), then the company will benefit from participating in the programme. Therefore, particularly firms with relatively low costs of reducing their energy consumption are attracted by such measures.

Frequently, voluntary or negotiated agreements are considered as a trade-off for other types of measures, in particular taxation measures. An example for this is the Norwegian programme for energy efficiency in industry, where companies of the energy-intensive pulp and paper industry may apply to participate in a programme for energy savings and therefore will be given a full exemption

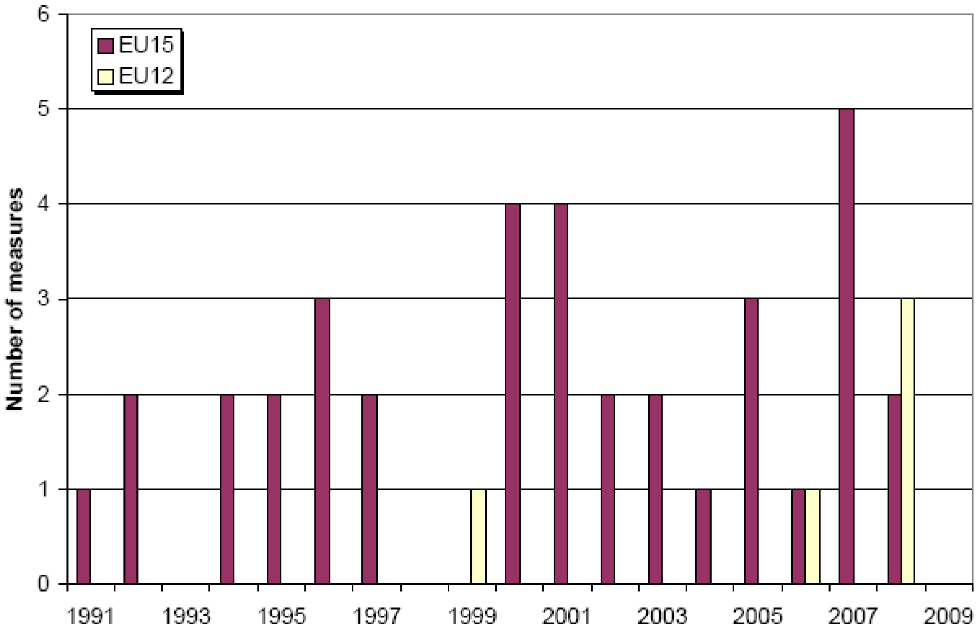
[8] For more information see http://www.decc.gov.uk/en/content/cms/emissions/crc_efficiency/crc_efficiency.aspx and http://www.carbontrust.co.uk/policy-legislation/business-public-sector/pages/carbon-reduction-commitment.aspx#how-CRC-works

from the electricity tax. Such voluntary schemes may also provide policy options in case Member States decide to exclude installations between 20 and 35 MW from the application of the ETS, where MS have the freedom to choose.

3.4.2 Application of the measure in the EU Member States

One important question is whether voluntary or negotiated agreements may slowly disappear, given the large role the EU Emission Trading Scheme (ETS) is playing in Europe. An analysis of the frequency of these measures in the MS over the last years (Figure 6) shows that this does not seem to be the case, as even over the past few years quite a number of new voluntary or negotiated agreements have been introduced.

Figure 6: Frequency of voluntary or negotiated agreements over time (EU-15[9] and EU-12[10])



Source: Adapted from MURE

More countries from the EU-15 have applied this measure than from the EU-12, while some of the latter are also developing this instrument. Within the EU-15, however, three countries have made particular use of this type of measure: Finland, Sweden and Spain, the first two of them have long traditions using this instrument. Some new EU MS, such as Hungary, are also mentioning it in their National Energy Efficiency Action Plan (NEEAP) to complement existing financial incentives.

Annex 2 gives an overview of the implementation of this policy within the Member States since the year 2000. This overview shows that some voluntary or negotiated agreements address energy efficiency more generally, while others target specific technologies or appliances. Thereby electric motors in industry appear as a relevant objective to improve energy efficiency, but also CHP, lighting and buildings. There are far fewer voluntary or negotiated agreements than financial incentive measures implemented in the Member States.

3.4.3 Main features of the measure

There are three types of voluntary and negotiated agreements. First, agreements can be can be stand-alone (but backed up by a well-managed structured process from the public side), further there are those with a threat of future regulation and finally, ones that are implemented in conjunction with existing taxes or regulations, with subsidy schemes and/or audit schemes.

[9] EU-15: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom
[10] EU-12: Bulgaria, Cyprus, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Malta, Poland, Romania, Slovakia, Slovenia

Completely voluntary agreements are relatively low-cost incentive programmes, whereas the second type uses further incentives for participation, such as relief from additional regulation. The last type relies on a voluntary programme, on the one hand, and in some cases a penalty of non-compliance, and the use of a GHG tax or such instruments like the EU ETS, on the other hand (Price 2005).

In the following table, specific national voluntary and negotiated programmes are presented to illustrate these cases.

	Overview	Examples
Stand-alone VAs with a strictly structured process from the public side	Stand-alone voluntary agreements have proved successful in cases where the government set up a well-structured process. In other cases when the government agreed on low-level targets, little success was achieved beyond business as usual.	**Netherlands: Long-term Agreements with the Industry, third phase** The third generation of these long-term agreements (LTA 3) is an expansion of the second one, which aimed at energy savings in the whole product chain. The first phase, in contrast, focused on improving process efficiency. The LTA are targeted at small and medium-sized enterprises – larger firms that are energy-intensive and subject to the EU ETS do not take part in them, but instead in the so-called Covenant Benchmarking Energy Efficiency. The LTA 3 likewise helps smaller companies to work towards reaching ambitious energy-efficiency targets (SenterNovem 2009). The explicit goal of LTA 3 is a 2 % average efficiency improvement per year until 2020, i.e. for the period between 2005 and 2020 an overall improvement in energy efficiency of 30 %. 20 % thereof are to be achieved within plant limits, and the remaining 10 % outside, e.g. by less material use or by recycling. In order to achieve these goals, participating firms are supposed to develop energy-efficiency plans, to implement them and to report about the results. In return for signing an LTA, a company is more likely to be granted the environmental permit that it needs to operate (Energy Research Centre of the Netherlands 2010). At the end of 2008, 31 sectors participated in the LTA, of which 18 industrial sectors representing 58 % of the energy consumption of all LTA sectors and 15 % of all industrial energy consumption. In the period between 2001 and 2008, in the industrial sectors 11 million tonnes of CO_2 reductions were achieved through energy efficiency improvements. In the years between 2005 and 2008, the ambitions were largely exceeded by the results (SenterNovem 2009). Overall, the instrument has been judged as very successful, making an essential contribution to the high level of energy efficiency in the Netherlands. Beyond its energy-efficiency impact, it has positive side effects for participants: it raises the awareness of structural energy savings and contributes to better working-relations between government and industry (SenterNovem 2005).

	Overview	Examples
VAs to replace threat of future regulation	Frequently, VAs are proposed as an alternative to regulation or other measures supposed to be less flexible or burdened with higher cost. Experience has also shown that VAs may be used to “play on time” if the public counterpart does not have a clear vision of results to be achieved or agrees on low-level targets.	**Germany: Voluntary Agreement on CHP** The voluntary agreement for the promotion of CHP, made by the federal government and German business in 2001, is an addition to the voluntary agreement on climate protection. Its goal is to decrease industrial CO2 emissions with the help of diverse measures by 45 million tonnes per year until 2010, of which 23 million by CHP. The agreement was a substitute for an originally planned quota scheme and is supported by a law on CHP, which entered into force some months after the start of the agreement (Fraunhofer ISI 2006). The impact of the voluntary agreement on CHP is evaluated to be relatively low for two reasons: a considerable amount of CO2 reductions by CHP will already be achieved by the market – the autonomous extension of CHP capacities for economic reasons is very probable in German industry – and there are other measures that increase the profitability of industrial CHP.(Fraunhofer ISI 2006).
VAs in combination with other instruments	These voluntary framework agreements between industry associations, companies and communities, on the one hand, and government on the other hand are to reduce specific energy consumption and introduce operational methods that help making energy efficiency an integral part of companies’ and communities’ operations	**Finland: Voluntary Energy Conservation Agreement in Industry (1997-2007).** The two principal measures of the agreement are energy auditing and analyses, and conservation measures. Industry associations engage in promoting energy-saving and participation in the agreement among their members, firms and communities make use of energy audits and analyses, set up their own energy conservation plans and implement cost-effective conservation measures. The government subsidises investments in energy-saving and energy auditing/ analyses (MOTIVA 2006). In its first implementation, the Voluntary Energy Conservation Agreement ran from 1997 to 2007. Subsequently, it was extended from 2008 to 2016 under the name Energy Efficiency Agreement. Energy savings made under this agreement by the end of 2006 altogether lowered heat and fuel consumption by 4.3 % and electricity consumption by 2.6 %. The Finnish Voluntary Energy Conservation Agreement was extended for another eight years until 2016 (MOTIVA 2006).

3.4.4 Evaluation of the measure: Voluntary or negotiated agreements

This section evaluates the impacts of the policy in terms of economic, environmental and social factors, indicating if the impacts are positive, neutral or negative and if the impact is high or low.

(++) High positive impact
(+) Low positive impact
(n) Neutral
(-) Low negative impact
(- -) High negative impact

The experience with voluntary agreements has been mixed, according to independent assessments. Some of the earlier programmes seem to have failed to achieve their targets, whereas more recent voluntary agreement programmes are better designed and therefore more successful. Features of such improved programmes are, for instance, an implicit threat of future taxes or regulations, or the conjunction with an energy or carbon tax. Such measures are cost-effective and can provide energy savings beyond business-as-usual (IPCC 2007). Additionally, they have important longer-term impacts including:

- changing attitudes towards and awareness of energy efficiency
- reducing barriers to innovation and technology adoption
- creating market transformations to establish greater potential for sustainable energy-efficiency investments (IPCC 2007).

The most effective agreements are those that set realistic targets, include sufficient government support as well as a real threat of increased government regulation, or energy or GHG taxes if targets are not achieved (Price 2005), (IPCC 2007).

The specific Member States cases mentioned above reflect this mixed success of voluntary agreements. While the Finnish and Dutch agreements were so successful partly because they provided important benefits for participating firms, the German agreement's low impact arises mainly from the fact that it was crowded out by the market and by other measures that were aimed in the same direction.

The Finnish voluntary agreement was combined with other measures, which explains its effectiveness and high impact. Empirical evidence shows that many voluntary or negotiated agreements nowadays are coupled with other types of measures. Such a combination of measure types in one programme seems to be more effective in terms of its energy and GHG-saving impacts.

	Economic impacts	
What was the cost to deliver the outcome, was it value for money?	(++)	Given the fact that mainly economic options for energy efficiency and low-carbon technologies are implemented, the competitiveness of companies is largely enhanced.
	(+)	Costs to administer voluntary schemes are comparatively low, but not negligible if the agreements are taken seriously.
	(-)	Smaller companies may have more difficulties finding their way into voluntary schemes as they lack staff.
What wider economic impacts does the policy have?	(++)	Stimulates the early market for highly energy-efficient process and cross-cutting technologies in industry (e.g. high-efficiency industrial steam boilers).
	(++)	Potential savings for companies are significant. Investments are paid through energy savings which occur due to the removal of non-economic barriers.
	(n)	Increased uptake of low-carbon options may stop if the participation in voluntary schemes is finished. Hence the importance of implementing a new culture for energy efficiency in companies through an efficient implementation of energy management schemes.

	Environmental impacts	
Did the policy deliver the desired outcome?	(++)	Industry (excluding EU ETS industries) represents a non-negligible fraction of overall energy consumption and GHG emissions.
	(n/+)	The environment success of voluntary agreements depends largely on three factors: the integration with the general culture of companies, the willingness of public bodies to set ambitious targets, and the combination of the agreements with other measures such as financial measures, audits and strong regulation.
What other impacts has the policy had?	(++)	Improvements in local air quality. This is particularly important for pollution from industrial activities in urban areas.
Are there impacts on emissions from other sectors?	(++)	The enhanced development of energy management systems in conjunction with voluntary schemes under the ESD will also benefit electricity savings, hence indirectly emissions from the power sector.

	Social impacts	
Was the policy well received, were there issues in gaining acceptability, what did they relate to?	(++)	Improving energy efficiency in industries helps to maintain competitiveness and hence employment.
	(++)	Where voluntary procedures lead to a change in industrial culture such as in the case of Learning Networks, they induce a new look at the contribution of energy efficiency to the success of a company.
What are the distributional impacts?	(n)	none

	Cross-cutting	
Are there interactions with policies in other sectors?	(++)	Environmental policy and industrial policy strongly interact as low-carbon and energy-efficiency technologies are increasingly contributing to the overall competitiveness of a country, directly through the development of new technology fields, indirectly through improved supply security.
Timeframe – is there anything to note about the timing of policy implementation and expected impacts?	(++)	Energy-efficiency options in the industrial sector can be mobilised in a fairly short time frame especially concerning cross-cutting technologies.

3.4.5 Maximising desired impacts/reducing unwanted impacts

This section considers how the positive impacts could be maximised to ensure the policy delivers its full potential. We compiled the lessons learned from schemes that have already been introduced, as well as using evidence from the broader literature to suggest how implementation could be improved. Strategies to mitigate the negative impacts are also suggested.

Maximising the benefits

Overcome hurdles between energy-using companies and technology producers	Energy-efficient plants and machinery require significant investment and therefore higher capital cost than their less efficient options, but they also generate savings in energy costs. This substitution of energy cost by more capital-intensive efficiency investments is often not adequately considered and explained by technology manufacturers to their customers.
Enable a favourable institutional setting	When launching voluntary approaches, a favourable institutional setting is an important factor. The initiating institution should have the trust of local organisations such as the chamber of commerce, the local municipality or utility, or a regional industrial platform, energy agency or trade association. The chances for successfully initiating agreement are extremely low if the companies have a lack of confidence in the initiating institution or person.
Establish instru-ments in parallel to overcoming non-economic barriers	Frequently, there are several non-economic barriers in parallel or along the life cycle of energy-efficient options. Removing one barrier alone may not be enough.

Mitigating measures

Voluntary approaches should be constructed bottom-up rather than top-down	When voluntary approaches are constructed from the top down (i.e. through head associations), frequently they adapt to the slowest ship in the fleet. It is important to identify forerunners and to construct the agreements with them. This helps to avoid building up voluntary approaches “just for show”.
Reward outstanding engagement in a visible way	Provide rewards to active participation in the forms of financial rewards and visibility for the company (e.g., see the energy efficiency award of the German energy efficiency agency (“dena”) or the reward for innovation and climate (“iku”) provided by the Confederation of German Industries BDI in cooperation with the German Ministry of the Environment).

3.5 Case study 4: Learning Networks for Energy Efficiency and Climate Protection

Case study 4 - Learning Networks for Energy Efficiency and Climate Protection in Germany - is strongly linked with case study 3, as it is also based on voluntary approaches to promote energy efficiency in industry. However, it provides a better insight into the policies to overcome specific non-economic barriers in medium-sized companies.

3.5.1 Objective of the measure

In energy efficiency networks (EENs), 10 to 15 regionally based companies from different sectors share their experiences in energy-efficiency activities in moderated meetings. After an initial consultation and identification of profitable energy-efficiency potentials in each company, all participants decide upon a joint energy-efficiency and a CO_2 reduction target over three to four years. Information on new energy-efficient solutions is provided by experts during these meetings and the performance of each company is monitored on an annual basis. A typical network period contains up to 16 meetings, after which the companies decide whether or not the EEN should be continued.

The main goals of an EEN are to reduce transaction costs, to overcome existing obstacles, to raise the priority of energy-efficiency aspects within the company, particularly in cross-cutting technologies and, hence, to reduce their energy costs. Results from 70 networks in Switzerland and more than 20 networks in Germany show that the participating companies can double their energy efficiency improvements. Almost every company has a profitable efficiency potential (internal rate of return > 12 %), at between five and 20 % of its present energy demand.

To foster the idea, a “30 Pilot Networks” project was initiated by Fraunhofer ISI in 2008 and funded by the German government. Besides implementing 30 EENs, the main goal of the project was to improve an existing network management system (MS) to operate EENs to a high quality standard. The MS consists of an EEN manual with helpful documents (e.g. contract templates, checklists, technical manuals, presentation of energy-efficient solutions) and about 25 software-based techno-economic calculation tools which are being developed under a joint user interface. The MS, labelled as LEEN (Learning Energy Efficiency Network) is intended to offer several elements needed for the European Norm 16001 (energy management systems). EENs are financed and operated mainly by industry itself. They represent an innovative approach for medium-sized companies, being applicable in any industry with minor adaptations.

3.5.2 Application of the measure in the EU Member States

All European countries have gaps in promoting energy efficiency in medium-sized companies, due to the relatively strong presence of barriers, in particular also the information and motivation barriers. It is therefore important to develop suitable instruments to help overcome transaction costs in the companies.

The first successful locally organised energy efficiency networks – called EnergyModel – was observed in Switzerland in the late 1990s (Bürki 1999, Graf 1996, Kristof et al. 1999, Konersmann 2002). The creation of the Swiss Energy Agency in 2002 within the context of the CO_2 law for industry provided an additional incentive for further network generation. One major role of this agency is to act as an intermediary in the CO_2 reduction target negotiation between companies and the federal government. Companies that reduce energy-related CO_2 emissions within the framework of a negotiated target, and accept an annual evaluation, can be exempted from a surcharge on fossil fuels, currently set at 36 CHF (or 25 €) per tonne CO_2.[11] Around 70 energy efficiency networks are now working in Switzerland. About 2,000 companies are involved in this scheme, representing 3.9 million tonnes of CO_2 which is more than one third of the total CO_2 emissions of the Swiss industry and service sector. The target agreements are mostly based on energy-efficiency improvements over a given period of time, e. g. four years, or on fossil fuels substitution by options such as industrial organic waste, renewables, or electricity[12]. The target agreements achieved until 2010 amount to more than one million tonnes of CO_2 or 29 % of a fixed efficiency development since the year 2000 (EnAW

[11] This was approved by the Swiss parliament in line with the Swiss CO_2 law in 2008.
[12] (Electricity is almost CO_2-free in Switzerland, arising from 60 % hydro power and 35 % nuclear power generation).

2011). The energy-efficiency networks are financed by the participating companies with individual contributions of some 2,400 to 15,000 € per year, depending on the size or the annual energy costs of each company. The average annual energy cost savings after four to five years of operation are 165,000 CHF (or 120,000 €) per company.

The idea was transferred to Germany in 2002. Currently, 50 EENs are operational in Germany. The idea of learning networks was also taken up by the State Grid Corporation of China (SGCC) in order to fulfil requirements to save 0,5% of their distributed electricity annually.

The cost-effectiveness of the German programme for firms and the low share of public expenditures underline its value in the German energy efficiency policy mix and suggest its expansion in Germany as well as in other countries

3.5.3 Main features of the measure

Consultant engineers usually return from on-site visits at companies with substantial energy-efficiency potentials that are easy to realise and usually have high rates of internal return (Romm 1999). The limited realisation of profitable efficiency potentials has been the subject of discussions about obstacles and market imperfections for more than a decade (e. g. IPCC 2001 and 2007), and the heterogeneity of these obstacles and potentials has been tackled by sets of several policy measures and instruments (Levine et al. 1995, DeCanio 1998).

Profitable energy-efficiency potentials are often not exploited in industry, since management does not focus on energy issues. Energy efficiency is not considered to be a strategic investment (Cooremans 2010). Furthermore, there are various obstacles to energy efficiency (DeGroot 2001): (1) In medium-sized companies, there is often no adequately informed energy manager. He may also lack time to gain the necessary knowledge, as energy issues are only one of several tasks. (2) Efficiency investments often have relatively high transaction costs compared to the capital investment. This aspect may be decisive for small efficiency investments (Ostertag 2003). (3) Energy costs are often treated as overheads and not allocated to individual production lines or departments of the site. This reduces the incentive to invest in energy-efficient technologies as the profit centre will not earn the full benefit of such an investment.

Another obstacle emerges if the buying department is focused exclusively on reducing the investment instead of minimising the life cycle cost. This leads to wrong decisions, as the capital cost of energy-related investments often has a share in life cycle cost of five to 20 %, while the energy cost is between 50 and 90 %. Furthermore, decisions on energy-efficient investments are taken by 85% of industrial companies solely on payback period calculations often limited to two or three years (ISI 2009). Given normal life times of these investments of between 10 and 20 years, this decision process systematically discriminates against the long-term energy-efficiency investments. Furthermore, the co-benefits of energy-efficient new technologies are rarely identified or included in the profitability calculations by energy or process engineers. This is due to the lack of a systemic view of the whole production site and possible changes related to the efficiency investments (Madlener & Jochem 2004). Social relations such as competitive behaviour, mutual regard and acceptance not only play a role between enterprises, but also internally within a company. Efforts to improve energy efficiency are influenced by the intrinsic motivation of companies' actors and decision-makers, the interaction between those responsible for energy and the management, and the internal stimuli of key actors and their prestige and persuasive power (InterSEE 1998, Schmid 2004).

The question arises, as to how these obstacles and market imperfections could be alleviated and social processes used more beneficially by designing an appropriate instrument. One answer for medium-sized companies seems to be local learning networks of energy managers. The major components of the underlying framework of learning networks can be summarised as follows:

- To compensate for a lack of knowledge and market awareness, each participating company is given an initial consultation and all participating energy managers are informed of new and reliable efficiency technologies by a senior engineer. Advantages and limitations of the new energy-efficient solutions and changes to the production and product quality at the production site are then discussed among the participating energy managers, identifying risks and co-benefits.

- Based on the concept of innovation research, and in an atmosphere of trust, the exchange of experiences about energy-efficient solutions leads to lower transaction costs of the followers and late applicants compared to the costs of the first movers. The different attributes associated with the company size of participating network members – the large ones with their potential to hire specialists and the small ones with close contact between the energy manager and the management - leads to new ideas of how to handle energy-efficiency investments and organisational measures within the companies.
- Finally, the framework also integrates social and individual psychology concepts: (1) a knowledgeable energy manager receives social acceptance from his colleagues during the regular meetings; (2) once a common efficiency and CO_2 reduction target of the network has been agreed upon, social cohesion and responsibility motivates the energy managers, who can also argue within their company that it has to contribute to the joint targets; (3) there is low competitive behaviour within the network as an allied group; (4) individual motivation through professional career enhancement is supported by fast learning opportunities and obvious successes in reducing the energy cost validated by the yearly monitoring by the consultant engineer; (5) the motivation of management to achieve high public reputation as a company striving for a sustainable production status. (Schmid 2004, Flury-Kleubler et al. 2001).

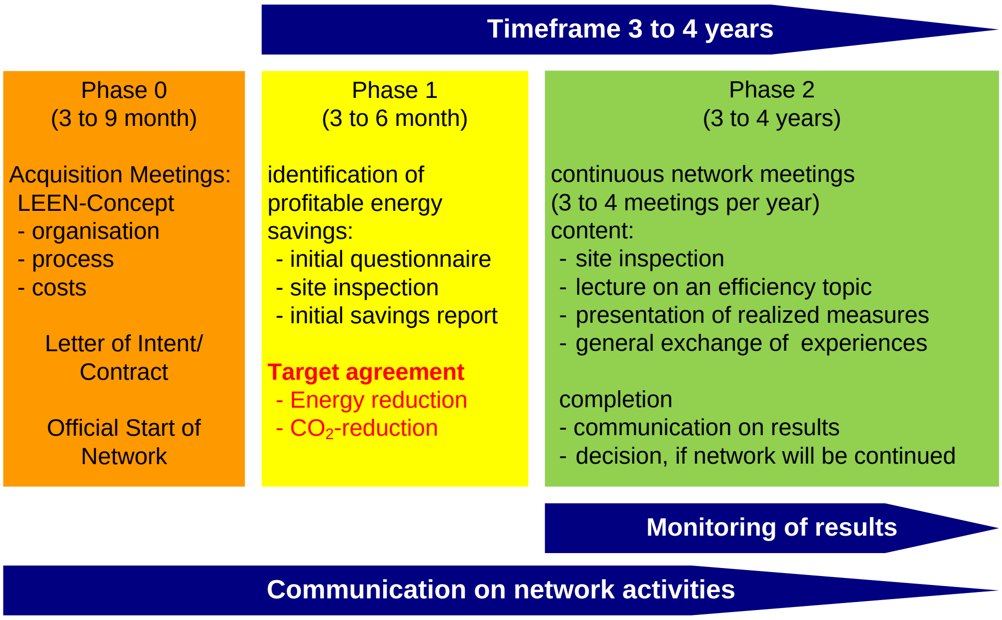
Starting from the positive Swiss experiences, an initial learning energy-efficiency network (LEEN) was launched in mid 2002 in Germany, in the Hohenlohe region by the government of Baden-Württemberg. This network was accompanied by a scientific evaluation (Jochem & Gruber 2004). As the results of this pilot network were very positive regarding the reduction of energy cost and CO_2-emissions by overcoming the various obstacles (Jochem & Gruber 2007), additional efficiency networks have been launched since 2005 by various institutions, reaching a total of 40 networks by the end of 2010.

The main activities of the energy-efficiency networks are (1) an initial consultation for each company by an experienced engineer, (2) an agreement on a common target for energy-efficiency improvement and for CO_2 emission reduction of the network with a time horizon of three to four years on the basis of the results of the initial consultation, (3) regular meetings (four times per year) with presentations on technical and organisational issues by invited senior experts and exchange of experiences among the energy managers, and (4) an annual monitoring of energy-efficiency progress and the reduction of energy-related greenhouse gas emissions for each company and the network.

These major elements are embedded in a sequential process (Figure 7):

- The **network establishment phase (Phase 0)** is a pre-phase to the network. Normally, it takes three to nine months to acquire the dozen companies required for a network. Existing energy or environmental working groups of a chamber of commerce or a regional industrial platform may minimise the efforts of this phase.
- The energy-efficiency network starts operating with **Phase 1 (so called initial consultation phase)**: the consultant engineer conducts an initial consultation for each company of the network. The consultation normally takes about eight to ten days per company, depending on its size. It starts with a questionnaire which is completed by the company that may also add energy-related material such as power demand profiles or planned energy-efficiency investments. This information provides the engineer with an overview of the company's energy use and management before carrying out an on-site inspection (one to two days). Together with the energy manager, the consultant engineer indentifies energy-efficiency and eventually energy substitution options. The engineer then writes a report evaluating the possible measures, describing the technical characteristics of the solutions suggested and their economic risks and profitability (net present value, internal rate of return). Based on the aggregated results of these (confidential) reports, the engineer suggests a common energy and CO_2 reduction target with a three or four years time horizon. The energy mangers of the network discuss the suggested targets and decide upon them.

Figure 7: Setting up and operating an energy-efficiency network for the first three to four years



- After the target setting, the network enters **Phase 2 (networking phase)**. Energy managers of the companies meet on a regular basis (typically three to four times per year). These meetings incorporate a one hour site visit of the company hosting the meeting in order to give each colleague an overview of the production and energy related plant and machinery. During the meeting, which is moderated by a LEEN-trained moderator, a senior expert reports on an energy efficient technology or organisational measure that had been previously agreed by the energy managers. The expert is usually chosen by the moderator and is not committed to the network. The presentation may be co-refereed by one or two energy managers from the participating companies and the topics cover cross-cutting technologies, such as heat generation and distribution, electrical motors, compressed air, ventilation, air conditioning, process cooling, illumination, heat recovery, green IT, energy management systems, green electricity and gas supply, modern forms of wood use and use of organic wastes, etc. Organisational measures and competences are also the topic of a meeting (e.g. profitability calculations, co-worker motivation, cooperation between the energy manager and the procurement department of the company). Implemented measures and investments will be reported and discussed in an environment of mutual exchange and personal trust. This point is vital to the network, giving the other participants first hand information on practical observations, failures and benefits. Furthermore, a telephone hotline for spontaneous questions and technical advice is set up for the whole network period by the consultant engineer and the moderator.
- During Phase 2, the consultant engineer and the moderator jointly conduct an annual monitoring of implemented measures and investments (bottom-up analysis) and the total performance of the site (top-down analysis). They track the energy-efficiency progress and the CO_2-emission reduction of each company (confidential reporting) and the progress of the total network in its aggregated form. In order to maintain the independence of the consultant engineer, the implementation of the measures remains the responsibility of the company which is able, but not required, to realise measures with the help of the engineer.
- The internal and public communication on the network's activities and achievements is the final module of the network, which may include press releases or press conferences (e.g. when the target is set or reached) or mutual exchange of experiences in seminars and conferences with members of other energy-efficiency networks.

The LEEN management system supports all these tasks and activities by providing the engineer, the moderator and the energy managers with appropriate documentation, suggested text elements of contracts, reports and press releases as well as calculation tools for investments and the annual monitoring. These useful elements and tools have been and still will be developed by Fraunhofer ISI and partners in two publicly funded projects between 2006 and 2008 (Bauer et al. 2009) and 2008 to 2013 (ISI 2010). The LEEN management system aims to guarantee a minimum professional standard for the initial consultation, the annual monitoring, and the moderation of the meetings as well as to minimise the cost for all related tasks.

The confidence that develops between the participants fosters the general (and increasingly free and trustful) exchange of experiences and ideas during the network meetings and associated bi-lateral communication. When a network reaches the end of Phase 2, the companies may decide to terminate the network, to continue it, or to change the moderator or the consultant engineer. Experience with various networks illustrate that participants normally decide to continue the network for several years. The oldest network in Germany has been operational since 2002, and the oldest in Switzerland since the late 1980s.

The cost of the network's operation (initial consultation, moderation of the meetings, annual monitoring of the companies and the network, and the project management) is around 60,000 to 80,000 € per year assuming 10 participating companies and a three to four year operation of the network. 6,000 to 8,000 € are generally paid by each company each year. Sometimes sponsors such as local utilities or chambers of commerce take over the role of the network manager and of the moderator and, in some cases, the cost of operating the networks is sponsored by federal states of Germany or by the federal government (see below the project of 30 Pilot Networks; www.30pilot-netzwerke.de).

The initiator of an energy-efficiency network may be a chamber of commerce, the environmental department of a city administration, a moderator or consulting office, a regional utility or a regional industrial platform. The initiator may or may not take on the role of the network manager depending on the interest of the institutions participating in the acquisition phase. In contrast to Switzerland, where no utility manages energy-efficiency networks, more than one third of the current 45 networks in Germany are operated by utilities (i.e. one large utility (EnBW) and a few municipalities). The consultant engineer is either selected before the acquisition phase starts or is chosen by the companies of the new network in a limited tendering process.

3.5.4 Evaluation of the measure: Learning Networks for Energy Efficiency and Climate Protection

The general impact evaluation carried out for financial schemes for ESD industries in section 3.4.4 is also relevant for the specific case study on Learning Networks for Energy Efficiency and Climate Protection and is not repeated here.

The achievements described in this section are mainly based on the following projects:

- EEN Hohenlohe (2002 – 2006): implementing the initial German energy-efficiency network in Hohenlohe.
- Environmental communication and energy efficiency in SME (2006 – 2009): development of an energy-efficiency network management system and establishing and evaluating five EENs (Bauer et al, 2009).
- 30 pilot networks (2008 – 2013): establishing 30 networks nationwide and enhancing the initial management system for EENs (ISI 2010).

After the initial network was established in the region of Hohenlohe, a second demonstration project was launched in Germany with funding from the German Federal Foundation on the Environment, two federal states and three private companies. The project's main objectives were: (1) to evaluate different network managers from an institutional point of view (including a large German utility company) and (2) to develop a network management system that guarantees a minimum performance standard for the activities of network managers, moderators and engineers in Germany.

After this demonstration project was completed with positive results (see below), the German government decided to fund a nationwide network project, the so-called 30 pilot networks. The objective of this project is to disseminate knowledge on how to generate and operate efficiency networks for medium-sized companies over all 16 federal states (see first results below). Another objective is to enhance and extend the management system for EENs and further develop investment calculation tools operating under a joint user surface.

Table 6: Efficiency gains and reduced specific CO_2-emissions (in %) of four energy efficiency networks in Southern Germany

Name of network	Period observed	Energy efficiency gain in %	Reduction of spec. CO_2-emissions in %	Monitoring method
EnergyModel Hohenlohe	2004 - 2008	8.0	7.5	top-down
Energy network Ulm same network without the participating utility	2004 - 2007 2004 - 2007	6.0 4.5	24.0 [1)] 4.0	top-down top-down
Central Germany [2)]	2005 - 2008	8.0	6.5	bottom-up
East-Wuerttemberg	2006 - 2008	4.0	4.0	top-down
[1)] CHP: Substitution of natural gas by wood chips [2)] 8 companies out of 13 participating				

Source: Bauer et al, 2009

The achievements observed in five energy efficiency networks over a period of two to four years (between 2004 and 2008) look promising and first conclusions could be drawn reflecting similar results as found for Swiss industry (Kristof et al. 1999, Konersmann 2002):

- On average, the companies participating in the efficiency networks agreed upon an efficiency target of around 2 % per year which is double what the average industry achieved during the last five years. This joint target was met by all five networks. However, the authors observed substantial deviations for individual companies for very different reasons (e.g. substantial or no new investments, high growth or decline in production, low or strong support from the board; Bauer et al. 2009).
- The results of the reduction of specific CO_2 emissions were a little less than 2 %, as electricity demand with its higher specific CO_2 emissions increased its share in all networks. However, in one network (Ulm), the CO2 emissions dropped by 24 % between 2004 and 2007 due to a substantial substitution of a gas-fired cogeneration plant to wood chips.
- After three to four years, the energy cost savings of a company ranged in the order of 120,000 € per year and 500 tonnes CO_2 reduction per company (average).
- Six companies out of the 48 companies participating in four networks received an award for high efficiency performance or environmental protection within three years.
- Since 2005, the third largest German electricity utility initiated 16 energy-efficiency networks with 200 companies until March 2011 which is one third of all presently operating energy-efficiency networks.
- An interesting observation was (and still is) that several participating companies started checking their products for higher efficiencies (e.g. high efficient ventilators, gear boxes) or developing new products and systems (e.g. energy management systems); other companies approached their technology suppliers asking for improved and high efficiency solutions (e.g. lower weights of transport lines, better insulation and control techniques of kilns).
- While 100 measures were planned and implemented, 60 new ideas – mostly more complex and sophisticated – were born and developed for further improvement of the companies' energy performance.

The authors concluded in 2008 that the learning EENs represent a new effective instrument for energy and climate change policy, which is in the core of the interest of industry, given the high profitability of many efficiency solutions. In addition, the EENs could be considered as an instrument of innovation and industrial policy, given the increasing demand for high energy-efficient solutions and related cost reductions if thousands of companies would ask for them. It would strengthen the investment goods industries and their potential for exporting those solutions to the world market.

Status and preliminary results of the 30 Pilot Networks project in Germany

The project 30 Pilot Networks has two main goals: to implement 30 energy-efficiency networks in Germany, and to further develop a network management system to set up and professionally operate energy-efficiency networks which may number 600 to 700 by 2020. The latter contains several elements:

- A network establishment manual that describes how potential medium-sized companies can be acquired for a network. This supplies the initiator of an efficiency network with (1) valuable references about how existing work groups attracted companies, (2) assistance on how to set up an informative meeting (e.g. timetable, agenda) and (3) gives instructions how to describe the network to potential participants in a meeting.
- A manual for the initial consultation phase that describes the typical course of such a consultation. However, the main support is given by a design report incorporating the results of the consultation and a variety of technical tools that help the engineer to calculate energy savings (currently existing, high efficiency motors, boilers, compressed air, CHP). About 15 other tools are in various stages of development, all of which will run under a single-user interface which is also under development. As the calculation method and used equations are documented in detail, the whole process is transparent to the engineer and company. The identified measures are summarised in one table. This table gives the company an overview of each measure, informing them of its energy- and CO_2 reduction and its profitability. All measures are aggregated to provide the company with an overview of the overall investment cost and cost savings when all profitable measures are implemented.
- A manual for the network meetings helps the moderator to prepare these meetings. It contains samples of agendas, e. g. an agenda for the first meeting where the order of technical topics of the following meetings is defined, and an agenda for the meeting where the reduction targets are set. Furthermore, the moderator is given a list of technology experts for presentations during the meetings, with contacts if required.
- A fourth part of the manual describes the communication process within the network. On the one hand, it focuses on the flow of information in the network by giving advice on how to present the results of the initial consultation to the Board, how to motivate the staff and co-workers, or how to communicate the activities and success. On the other hand, it supports the public relations process of a network, e. g. with suggestions for press conferences, press releases, flyers, and other possible publications.

These four manuals are the core of the handbook for energy-efficiency networks. The handbook is enhanced by samples of contracts, presentations, check lists, guidelines and other information documents to implement and carry out a network.
The last few networks of the planned 30 pilot networks are still being acquired. Due to the economic crisis in 2008/2009, it was difficult to convince companies to participate in long-term projects like the EEN. As of April 2011, 26 of the 30 networks are operating. Eight of these networks have finished the consultation phase. The first analysis of two networks resulted in nearly 420 measures where 330 were found to be particularly profitable with an internal return rate of higher than 12 %, based on 10 to 20 years lifetime (Table 7). These measures require an additional investment (compared to a standard investment) of about 5.3 million € which lead to energy cost savings of about 2.1 million € per year. Hence the average rate of return is nearly 40% and the net present value of the energy savings[13] over 20 years (i=10%) outnumbers the investment by a factor of 2.5. The annual CO_2 reduction of the profitable measures is equivalent to nearly 10,000 tonnes per year which is about 7.6 % of the total emissions of the company. All in all, the consultation of 23 companies indicated a highly profitable energy-efficiency potential (Figure 6).

[13] i.e. the monetary energy savings discounted to the year of the investment

Table 7: Energy-efficiency measures of 50 initial consultancy reports and their profitability

	No of measures	partial investment*	CO_2-reduction	yearly cost reduction	NPV (i=10%, 20 yrs)	internal rate of return (20 yrs)	static amortisation	dyn. amortisation (i=10%)	energy reduction [% MWh]	CO_2-reduction
		[1,000 €]	[CO_2 t/a]	[1,000 €/a]	[1,000 €]	[%]	[a]	[a]	[%]	[%]
profitable measures	332	5,260	9,750	2,070	12,360	39.3%	2.5	3.0	7.8%	7.6%
all measures	417	16,000	10,600	2,260	3,720	12.9%	7.1	12.9	13.2%	10.3%

* additional investment that leads to the energy reduction

Source: own calculations

The first results of the analysis of the 30 Pilot Networks project on the potential energy savings and profitability of different technologies are based on the examination of nearly 50 initial consultancy reports (Table 8). Lighting and compressed air have the best economic evaluations. Nearly 90 % by number are profitable and the low difference of the profitability between profitable and all measures indicate that only a few are less profitable. Space heating reveals a different picture. Many, especially larger, investments are not profitable, at least when applying company criteria. Only 64 % of the investments indicate profitable measures. These results are preliminary, as they are based on the initial consultancies. Nevertheless, there is strong evidence that a high number of identified measures are profitable and profitability of different technologies varies. For the non-profitable measures applying company rules or for measures that might become economic under increased energy prices it is important to consider how such type of measures can be supported financially to make them viable for companies.

Table 8: Energy-efficiency measures of 50 initial consultancy reports and their profitability by technologies

	No of measures	partial investment*	CO_2-reduction	yearly cost reduction	NPV (i=10%, 20 yrs)	internal rate of return (20 yrs)	static amortisation	dyn. amortisation (i=10%)
lighting		[1,000 €]	[CO_2 t/a]	[1,000 €/a]	[1,000 €]	[%]	[a]	[a]
profitable measures	61	1,224	1,697	343	1,886	27.9%	3.6	4.6
all measures	71	1,356	1,774	356	1,876	26.2%	3.8	5.0
compressed air								
profitable measures	64	860	1,890	371	2,640	43.1%	2.3	2.8
all measures	73	1,052	1,955	391	2,633	37.1%	2.7	3.3
electric devices								
profitable measures	99	710	1,034	262	1,764	37.0%	2.7	3.3
all measures	144	5,126	1,074	421	-1,158	7.2%	12.2	-1.0
process heat								
profitable measures	53	209	635	126	932	60.1%	1.7	1.9
all measures	63	590	1,405	154	807	26.0%	3.8	5.1
space heat								
profitable measures	132	2,917	4,319	924	5,466	31.6%	3.2	4.0
all measures	205	19,438	5,637	1,191	-7,786	5.4%	16.3	-1.0

Source: own calculations

3.5.5 Maximising desired impacts/reducing unwanted impacts

This section regards how the positive impacts could be maximised to ensure the policy delivers its full potential. We compiled the lessons learned from schemes that have already been introduced, as well as using evidence from the broader literature to suggest how implementation could be improved. Strategies to mitigate the negative impacts (as discussed above in the assessment of social, economic and environmental impacts of voluntary or negotiated agreements) are also suggested.

Maximising the benefits

Optimising participation	The creation of Learning Energy Efficiency Networks can be optimised by creating momentum through the involvement of important stakeholders that can organise and moderate larger number of networks such as electricity distributors or generators, industrial associations for trade and commerce etc.
Combine with suitable subsidy packages	The functioning of the networks may benefit from the combination with financial subsidy schemes in particular for energy audits. Further, the results from the networks must be publicised to promote the reputation of good performers. An instructive example are the performance league table as established under the CRC Energy Efficiency Scheme in the UK

Mitigation measures

Harmonising procedures	Non-standardised procedures, which create additional barriers for companies, present a risk to the effective functioning of the networks. For this reason it is important to set up standardised network procedures as for example the LEEN Standard in Germany set up for the Learning Energy Efficiency Networks (http://www.leen-system.de/leen-de/inhalte/ueber-uns.php)

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Annex 1: Implementation of financial incentive measures in the EU Member States (for more information on each measure we refer to the MURE database on energy efficiency measures, www.mure2.com)

Member State	Title of the measure	Starting Year	Ending Year	Semiquantitative Impact
Belgium	Promotion of Cogeneration	2005		Low
Belgium	Energy audits	2002		Medium
Belgium	Financial incentives for investments in energy efficiency	2002		Low
Bulgaria	Energy Efficiency Act (EEA) – Mandatory Industrial Audits for Energy Efficiency	2006		High
Bulgaria	Grants for energy audits in SME	2006		Medium
Bulgaria	Energy Efficiency and Renewable Energy Credit Line (BEERECL)	2004		Medium
Croatia	FZOEU energy efficiency programme	2004		Medium
Croatia	FZOEU and MINGORP energy audits programme	2004		Low
Croatia	FZOEU renewables promotion programme	2004		Medium
Cyprus	Governmental grants/subsidies scheme for the promotion and encouragement of RES, energy saving and the creation of a special fund for financing or subsidising these investments	2003		High
Czech Republic	Investment subsidies in the framework of the annual government Programme A	2006	2006	Low
Czech Republic	Operational Programme Industry and Enterprise for the period 2004-2006	2004	2006	Medium
Czech Republic	FINESA Programme	2004		Unknown
Czech Republic	Operational Programme Enterprise and Innovation for the period 2007-2013	2007	2013	Unknown
France	FIDEME: fund for investment in environment and rational use of energy	2000		High
France	FOGIME: Guarantee fund for energy conservation	2000		Low
Germany	Heat-Power Cogeneration Act (Kraft-Wärme-Kopplungsgesetz)	2002	2010	Medium
Germany	Special fund for energy efficiency in SME´s (Sonderfonds Energieeffizienz in KMU)	2008		High
Greece	Incentives for obligatory implementation of Energy Management Systems	2008	2016	High
Hungary	EU Structural Funds for Environment and Infrastructure Operative Programme	2004	2006	Medium
Hungary	Environment and Energy Operative Programme	2007		Unknown

Hungary	Third party financing within the frame of Environment and Energy Operative Programme	2007	2013	Unknown
Ireland	Combined Heat and Power (CHP) Grants Programme	2006		Medium
Ireland	Tax Relief for Energy Saving Equipment	2008		Medium
Italy	Financial Package for the Establishment in Municipal Gas Utilities of Low Grade Heat Production Equipment	2001	2002	Low
Italy	Financing for energy efficiency and diffusion of renewables	2005		Low
Italy	Efficient lighting system	2007		Low
Italy	Efficient electric motors and inverters	2007		Medium
Italy	Promotion of cogeneration	2007		Medium
Latvia	Energy Efficiency Investments	2009	2013	Low
Latvia	Investments in Clean Fuels	2009	2013	Medium
Latvia	Investments in CHP	2009	2013	Medium
Luxembourg	Realising electricity savings potential of industrial cross-cutting technologies	2010		High
Malta	Support schemes for industry and SME's	2006	2013	Unknown
Malta	Modernisation of Agricultural holdings	2009	2013	Medium
Netherlands	Environmental Quality Electricity Production (Dutch: MEP) for CHP (Dutch: WKK) and MEP for sustainable energy	2003	2006	High
Norway	Energy management – companies in networks (Energistyring – bedrifter i nettverk)	2003	2007	High
Norway	Energy Consumption - Industry (Energibruk - industri)	2003		High
Norway	Grants to local heating plants (Program for lokale energisentraler)	2008		Medium
Poland	“Polish Energy Efficient Motor Program - PEMP”	2004	2009	Low
Poland	2007 to 2013 Infrastructure and Environment Operations Programme and Regional Operations Programme (1)	2008	2013	Unknown
Poland	2007 to 2013 Infrastructure and Environment Operations Programme and Regional Operations Programme (2)	2008	2013	Unknown
Portugal	MAPE/PRIME - Measure for Supporting the Use of Energy Potential and Rational Use of Energy	2001	2006	Medium
Romania	The Law on Efficient Energy Use	2001	2008	Medium
Romania	Management of energy demand and development of the energy balance sheets	2001	2010	High

Romania	Financial support for investment projects to reduce energy consumption	2001	2008	High
Romania	Implementation of investment projects co-financed by community funds	2008	2010	High
Romania	Promoting energy efficiency and RES utilization at energy final consumers	2008		Medium
Romania	Grant-supported credit line for Romania that has been established by the European Commission and the European Bank for Reconstruction and Development.	2008	2010	Medium
Romania	The promotion of ESCO's	2007	2010	Medium
Romania	The promotion of CHP's	2007		Medium
Slovakia	Operational Programme "Competitiveness and Economic Growth" priority line Energy	2008		Unknown
Slovenia	Energy audits and feasibility studies subsidies	2003		Medium
Slovenia	Financial incentives for efficient electricity use measures	2008	2016	High
Spain	ICO-IDAE Financing Line for Renewable Energies and Energy Efficiency Projects	2000	2008	High
Spain	Plan for the Promotion of Renewable Energies 2000-2010 (Plan de Fomento de las Energías Renovables 2000-2010)	2000	2005	High
Spain	Energy Saving & Efficiency Strategy in Spain (E4) 2004-2012: Technologies in New Processes	2004	2012	High
Spain	Action Plan 2008-2012: Public Support Programme (Plan de Acción 2008-2012: Programa de Apoyo Público)	2008	2012	High
United Kingdom	The Enhanced Capital Allowance Scheme	2001		Medium
United Kingdom	The Carbon Trust - (Various initiatives)	2001		High

Annex 2: Implementation of voluntary and negotiated agreements in the Member States (for more information on each measure we refer to the MURE database on energy efficiency measures, www.mure2.com)

Member State	Title of the measure	Starting Year	Ending Year	Semiquantitative Impact
Belgium	Voluntary agreements on energy efficiency or CO_2	2003		High
Bulgaria	Voluntary long term agreements in industry	2006		Medium
European Union	Voluntary labeling of electric motors (CEMEP/EU Agreement)	2000	2003	Low
European Union	European Green Light Programme	2007		Low
European Union	European Green Building Programme	2005		Unknown
Finland	Recommendations for the procurement of high efficiency electric motors	2004		Low
Finland	Energy Efficiency Agreement of Industry 2008-2016	2007	2016	High
Finland	Energy Efficiency Agreement of Energy Production 2008-2016	2007	2016	High
Finland	Energy Efficiency Agreement of Energy Services 2008-2016	2007	2016	Medium
Finland	Voluntary agreement (AERES)	2002		High
France	Motor Challenge Programme	2002		Low
France	Negotiated agreements between ADEME and professional federations	2003		Low
Germany	Voluntary agreement with German industry II (Erklärung der deutschen Wirtschaft zur Klimavorsorge II)	2000		Medium
Germany	Voluntary Agreement on CHP (Selbstverpflichtung der Wirtschaft zur Förderung der KWK)	2001	2010	Low
Germany	Contracting in relation to heating, ventilation and air conditioning	2007		High
Ireland	Least Cost Planning for Ireland	2000		Medium
Ireland	Energy Agreements	2006		High
Malta	Promotion of Modal Shift	2009		Low
Netherlands	Long Term Agreements with the Industry, second phase (MJA2)	2001	2012	High
Netherlands	Benchmarking Covenant	2000	2012	High
Netherlands	Long Term Agreements with the industry, third phase (MJA3)	2001	2020	Medium
Romania	Long Term Agreements with Industry	2008	2010	High

Romania	Promoting energy efficiency and RES utilization at energy final consumers	2008		Medium
Slovakia	Operational Programme "Competitiveness and Economic Growth" priority line Energy	2008		Unknown
Spain	Action Plan 2008-2012: Voluntary Agreements (Plan de Acción 2008-2012: Acuerdos Voluntarios)	2008	2012	Medium
Sweden	The Programme for Energy Efficiency in Industry	2005		High
Sweden	Energy efficiency in small and medium sized enterprises	2008		Unknown
United Kingdom	Climate Change Agreements	2001		High

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