# ENERGY SAVINGS 2020

## How to triple the impact of energy saving policies in Europe

- FINAL VERSION -

A contributing study to Roadmap 2050: a practical guide to a prosperous, low-carbon Europe

# FOREWORD

The European Union committed itself in 2009 to the reduction of its Greenhouse gas (GHG) emissions by between 80 and 95% by 2050. The European Climate Foundation (ECF) has commissioned a series of reports from various sector experts to quantify that goal, assess how it can be achieved and what its impacts might be.

Energy Savings 2020 is the latest report in the series. The role of this report is to assess the impact of current EU energy and climate policies and to make recommendations on the design of an overarching energy saving policy framework to achieve Europe's 20% energy savings target by 2020 as a vital step to meet its 2050 GHG commitment.

The analysis was conducted by Ecofys and Fraunhofer ISI in the period of December 2009 to April 2010. The report was commissioned by the European Climate Foundation (ECF) and the Regulatory Assistance Project (RAP).

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# SUMMARY

Energy savings are widely recognised as a means to save money. At the same time they contribute to security of energy supply, greenhouse gas (GHG) emissions reductions, the fast and cheap achievement of a sustainable energy supply, and last but not least, significant job creation.

In its recent report *Roadmap 2050: a practical guide to a prosperous, low-carbon Europe*, the European Climate Foundation (ECF) recognises ambitious energy savings as one of the prerequisites for a low-carbon economy in Europe.

*Energy Savings 2020* is the latest report in the Roadmap 2050 series. The role of this report is to assess and make recommendations on the required energy saving policies to achieve the broader goal of the decarbonisation of the European economy. This broader goal sets out to achieve a mininum of 80% emissions reduction by 2050 (see Exhibit 1).

The European Union (EU) recognises the importance of energy savings and has set a policy target of achieving 20% energy savings by 2020, as compared to *business as usual* energy use. This target translates into an absolute reduction of primary energy use from 1800 Million tons oil equivalent (Mtoe) in 2005 to around 1600 Mtoe in 2020. The EU, however, remains ambivalent with respect to this target. For example, the Presidency conclusions of the European Council (25 and 26 March 2010) re-formulate the target as "moving towards a 20% increase in *energy efficiency*". Also, the interpretation of the energy savings target in EU law is much weaker than for the other two pillars of the EU climate package: greenhouse gases (GHG) and renewable energy. As a result, recent evidence suggests that the energy savings target will be missed by a wide margin.

In this context, the European Climate Foundation (ECF) and the Regulatory Assistance Project (RAP) commissioned the current study on EU energy savings from Ecofys and Fraunhofer ISI. The objectives of this study are threefold:

**Energy Savings are Essential for the Decarbonisation of the European Economy**

**Energy savings have the potential to cover half of the EU's 80% emission reduction target for 2050**
**Achieving the EU's 20% energy savings target by 2020 is capturing that potential**

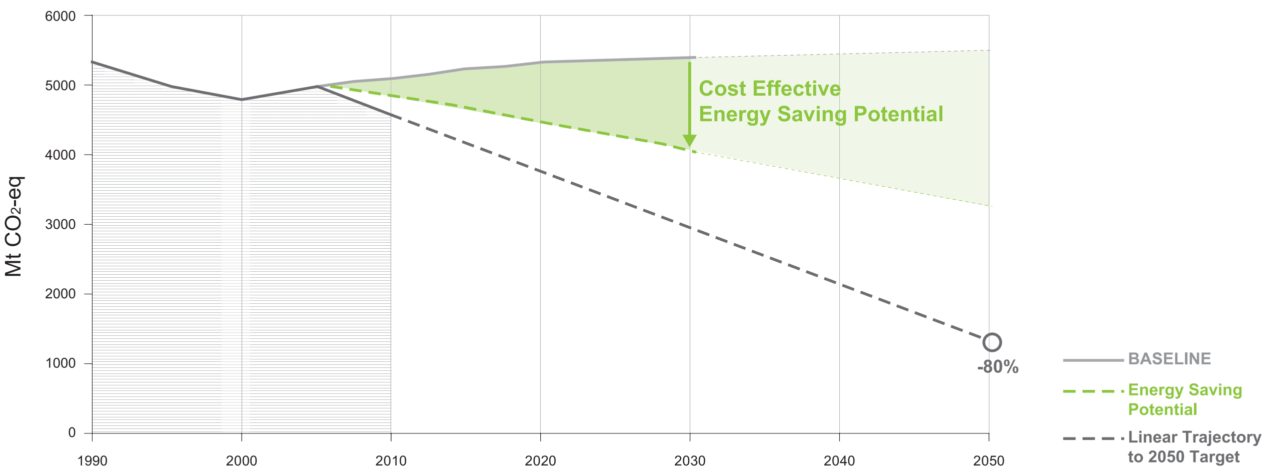



Exhibit 1 Greenhouse gas emissions in the EU 27: monitoring, baseline and linear trajectory towards the 2050 ambition of reducing emissions beyond -80% compared to 1990. The green wedge illustrates the impact of the cost-effective energy savings potential identified in this study.

1. Firstly, to restate the energy saving potentials in the EU 27 and its Member States by 2020 and 2030 based on the recent study of Fraunhofer et al. (2009): 'Study on the Energy Savings Potentials in EU Member States, Candidate Countries and EEA Countries'.

2. Secondly, to estimate the extent to which current energy savings policies capture this potential and the policy gap that remains against achieving the EU's indicative target of 20% energy savings by 2020.

3. Thirdly, to explore the feasibility of different design options of binding energy saving targets with a focus on their impact on the functioning of existing EU policies.

## FROM THIS STUDY, WE DRAW THE FOLLOWING KEY-CONCLUSIONS:

### FACTS AND FIGURES:

- In this study, we identified that the EU has sufficient cost-effective energy end-use savings potential to realise its overall 20% energy savings target by 2020 in conjunction with meeting its binding target for renewable energy sources (RES) (see Exhibit 2).

- We assessed the cost-effective potential of energy savings investments from a life cycle perspective using discount rates in line with government bond rates. The magnitude of potential identified in this analysis serves as a significant justification for enhanced energy savings policies aimed at removing the multiple implementation barriers that currently exist.

- Achieving the overall 20% energy savings target requires around 394 Mtoe of energy savings in 2020, compared to 'pre-recession' baseline expectations of the 2006 Energy Efficiency Action Plan (EEAP). Existing energy efficiency policies (95 Mtoe), renewable energy policies (20 Mtoe) as well as the economic recession (70 Mtoe) are expected to reduce energy use in the EU 27 in 2020 by 185 Mtoe compared to 2020 baseline projection.

- As a result, we expect that in 2020 a gap of around 208 Mtoe will remain towards the EU target.

- Our study concludes that closing this gap requires a threefold increase in policy impact compared to energy savings policies adopted since the 2006 EEAP (see Exhibit 3).

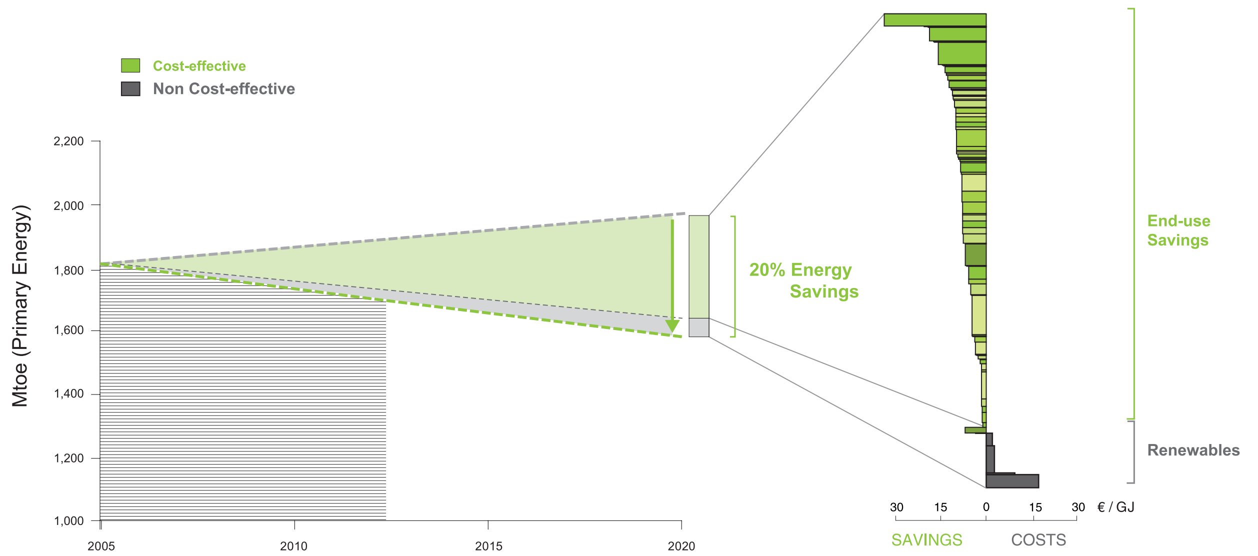
- The gap could be closed almost entirely, and most cost-efficiently, by realising the end-use savings potential we have identified.

- Closing the gap in this way would lower EU energy bills by €78 billion annually in 2020[1] and save 560 Mt[(2)] of $CO_2$.

The key question for policy makers is how to provide policy incentives that achieve this threefold increase in savings impact. This report provides arguments for a binding energy savings target as part of the policy mix. Furthermore, introduction of a binding energy savings target is supported by the EU current approach on climate, renewable energy and air pollution policies. In all cases, the binding targets serve as a benchmark for implementation of a suite of targeted policy instruments.

1. Based on an oil price of €52 per barrel, excluding taxes.
2. Based on a economy-wide $CO_2$ emissions factor per unit of fossil primary energy of 2.7.

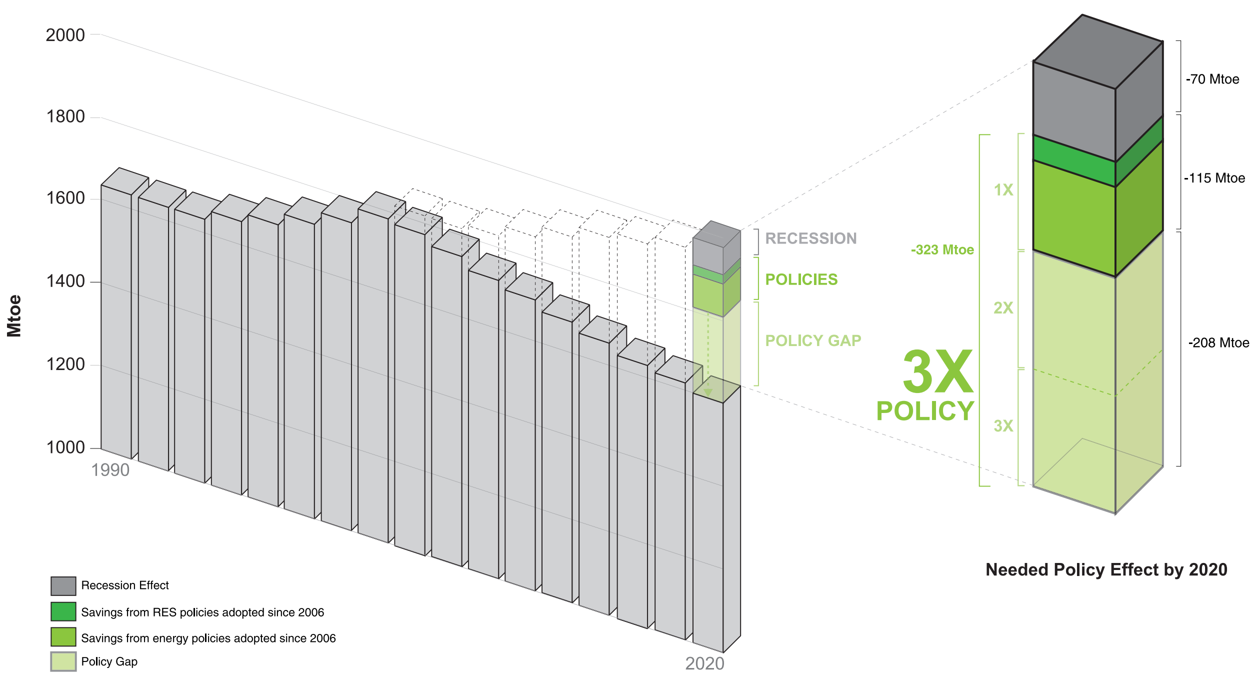
## The EU's 20% Energy Savings Target can be met largely through Cost-Effective Measures




Source: Ecofys and Fraunhofer ISI

Exhibit 2 EU energy demand in the baseline and the potential of cost-effective energy savings to meet the 20% energy savings target. The remaining energy savings gap is filled by fully implementing the 20% renewables target. This is because the calculation method of renewables (wind, hydro and solar) results in primary energy savings.

## A Tripling of Policy Impact is required to meet the EU's 20% Energy Savings Target




Source: Ecofys and Fraunhofer ISI

Exhibit 3 Even taking into account the economic recession and energy policies (since the adoption of the 2006 EEAP), meeting the 20% energy savings target by 2020 will require a three-fold increase in policy impact.

## Feasible design options

We have assessed four design features and four design options for a binding energy savings target, ranging from a single economy-wide EU target to Member State national targets for a subset of sectors. Though in theory all design options may be open, this analysis suggests that the most feasible design option is to introduce a binding energy savings target for 'end-users' at the Member State level. Key findings on this and related design issues are summarised below:

**Binding targets at Member State level are the most feasible**
A binding target at Member State level would ensure political accountability and commitment to deliver results while providing flexibility to choose and apply the most suitable tools to achieve the target. It could provide a framework to guide ambitious and coherent implementation of the existing EU energy efficiency policies, like the Energy Performance in Buildings Directive (EPBD), while also strengthening national policies. Such a policy package would reduce the risk of fragmented or weak national implementation activities. Furthermore, binding targets at Member State level will incentivise Member States to take a progressive position at the EU level when new standards (e.g. for appliances) are set.

**A Member State binding target for 'end-users' is a design option that covers the vast majority of energy savings potential**
An economy-wide binding target clearly provides Member States with the most flexibility and highest captured savings potential. However, it should also form the most effective and coherent interaction with EU-ETS and RES policies:

- EU-ETS participants may argue that a binding energy savings target that includes their facilities would reduce their EU-wide trade flexibility. Our calculations suggest that the additional fuel savings, compared to the baseline assumptions, expected from EU-ETS covered facilities is comparatively small.

- Our analysis of design options shows that applying the target to 'end-users' would work most effectively in combination with RES policies. This is because end-use energy savings are the most cost-effective way of increasing the percentage share of renewables in final energy consumption, as is already recognised in the RES Directive.

Overall, our analysis shows that a target focusing on energy use outside the scope of EU-ETS would still capture 94% of the savings potential required to reach the 20% energy savings target by 2020, when implemented in conjunction with the EU's binding RES target. More specifically, we estimate that the RES target will achieve 15% of that potential by increasing the efficiency of energy supply through an increased share of (100% efficient) renewables in the generation mix.  A binding energy savings target that focuses on electricity and fuel end-use in the built environment, the transport sector, small and medium size enterprises and the industrial energy use not covered by EU-ETS will achieve another 79% of energy savings potential in the EU economy by 2020.

**A savings target is best expressed in absolute energy use terms**
A savings target should be transparent and easy to monitor and measure. By far the most straightforward way to comply with these criteria is to define the target as an absolute energy use in a target year and monitor the absolute development of energy use over time. This means that the energy use which remains is measured, rather than estimating the savings. Under this approach, the volume of energy savings, as compared to a baseline, is only estimated once and upfront when setting the target. Subsequently,

existing energy statistics, already implemented in all EU Member States through statistical offices, provide a straightforward way to monitor progress towards the target. Such an approach would also best safeguard the significant energy savings that are required to achieve the EU's ambition of deep GHG reductions towards 2050.

**For targets applied to 'end-users', expressing the savings as 'adjusted final energy' will be the most transparent and measureable approach**

Our study suggests that a target for 'end-users' may preferably be expressed as 'adjusted final energy use'. Here, the electricity and district heat components of final energy use data, readily available from energy statistics, are weighted with a factor of 2.5 and 1.2 respectively. This is to ensure that electricity and district heat savings are weighted in a similar way as fuel savings. We recommend weighing factors that are constant over time and across Member States. This method resembles the primary energy use definition but will increase coherence across Members States. A constant factor over time would provide the most transparent view on end-use energy savings achieved. A constant conversion factor would ensure that fuel, district heat and electricity savings are weighted the same across Member States, which would provide EU-wide comparability for end-use energy savings.

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# CHAPTER 1
# WHY THIS ENERGY SAVINGS 2020 STUDY?

## BACKGROUND

Energy savings are widely recognised as a means of saving money. At the same time they contribute to security of energy supply, greenhouse gas (GHG) emissions reductions, the fast and cheap achievement of a sustainable energy supply, and last but not least, significant job creation.

Currently, Europe has a set of three combined climate and energy targets for 2020: 20% GHG reduction, 20% renewable energy sources (RES) and 20% energy savings. Whereas the GHG and RES targets are binding, the energy savings target is not (see Figure 1 - 1). Recent insights indicate that the energy savings potential is not being realised fast enough and falls short of what is needed to meet the 2020 target (e.g. COM(2008) 772 final). This would mean that more comprehensive and costly measures would have to be taken to meet the GHG and RES targets by 2020, and that employment opportunities will be lost. It would also mean that achievement of deeper GHG reduction targets beyond 2020, in line with scientific recommendations and political commitments, will become increasingly difficult.

The European Climate Foundation (ECF) and the Regulatory Assistance Project (RAP) have asked

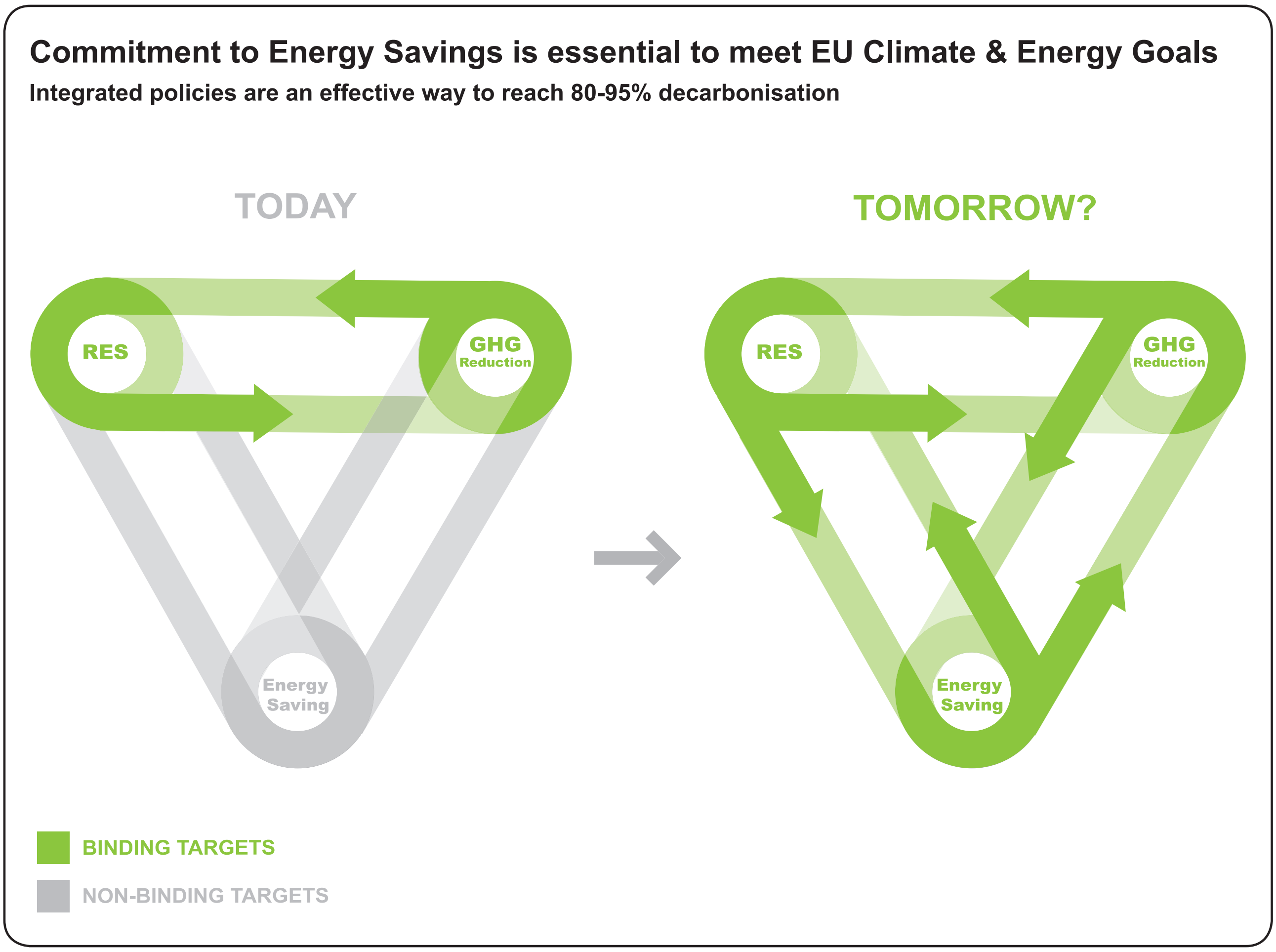


Figure 1 - 1 The aim of this study: investigating the feasibility and impacts of introducing binding targets for energy savings in the EU.

Ecofys and Fraunhofer ISI to investigate the feasibility and impacts of introducing a legally binding primary energy savings target in the European Union. ECF and RAP consider a binding target as an indispensable ingredient of a policy mix that should speed up the implementation of energy savings policies in the EU.

When designing binding energy savings targets, the starting point is not a 'green field' situation, but a policy landscape in which a variety of directives and regulations pull and push in order to achieve GHG reductions, increase renewable energy and improve energy efficiency. A major design question is therefore what binding energy savings target would fit best in the existing political landscape.

## AIM OF THE STUDY

The central objectives of this study are threefold:

1. Firstly, to estimate the extent to which current energy savings policies capture this potential and the policy gap that remains to achieving of the EU's target of 20% energy savings by 2020.
2. Secondly, to restate the energy saving potentials in the EU 27 and its Member States in 2020 and 2030 based on the recent study of Fraunhofer et al. (2009): 'Study on the Energy Savings Potentials in EU Member States, Candidate Countries and EEA Countries'.
3. Thirdly, to explore the feasibility of different design options of binding energy savings targets with a focus on their impact on the functioning of existing EU policies like the ones for renewable energy and GHG reduction (including EU-ETS).

## READING GUIDE

The first two objectives are dealt with in chapters 2 to 5 of this report:

- Chapter 2 summarises the multiple justifications for additional energy savings efforts.
- Chapter 3 describes current energy and climate policies and their impacts on energy use and greenhouse gases.
- Chapter 4 discusses the energy savings potential in the EU.
- Chapter 5 discusses the role of a binding energy savings target in the policy mix.

Chapters 2-5 serve as a starting point for the exploration of design options for binding energy savings targets.

- Chapter 6 discusses how best to express a binding target and the interaction of such a new policy element with existing legal EU energy and climate policies.
- Finally, chapter 7 explores four main design options for a binding target.

CHAPTER 2

# ENERGY SAVINGS ARE ESSENTIAL FOR THE DECARBONISATION OF THE EUROPEAN ECONOMY

This chapter highlights multiple arguments for more ambitious energy savings from the perspective of greenhouse gas reductions, economic benefits, energy security and renewable energy.

**Roadmap 2050: a practice guide to a prosperous, low-carbon Europe**

The European Union committed itself in 2009 to the reduction of its $CO_2$ emissions by between 80 and 95% by 2050. The European Climate Foundation has commissioned a series of reports from various sector experts to quantify that goal, assess how it can be achieved and what its impacts might be.

In their first report on the decarbonisation of the European economy - "Roadmap 2050: a practice guide to a prosperous, low-carbon Europe" – the findings show clearly that the more than 80% $CO_2$ emissions reduction target is a practical and technically and economically feasible goal, in line with Europe's energy security, economic and climate goals.

The Roadmap 2050 study, which was undertaken by many of the leading experts in the field and consulted widely with industry and policy makers, finds that, due to the necessity to shift many sectors away from fossil fuels towards electricity, the decarbonisation of the power sector is a keystone to the overall move to a low-carbon economy in Europe.

On energy efficiency, the key finding of the Roadmap 2050 exercise is that the decarbonisation of the European power sector, and by turn the economy, will not be feasible by 2050 without significant energy savings. What this analysis shows is that effective energy efficiency measures can make a significant contribution to reducing the European energy bill by 2020, alongside reductions in fossil fuel imports that would accompany greater renewables capacity in the system. This results not only in lower bills, but also a reduction in foreign expenditure of fossil fuels, keeping much needed revenue within the borders of the EU, with positive effects on both GDP and employment.

With proper support, energy efficiency resources would allow Europe's utilities to cost-effectively retire or avoid building more than 440 medium-size coal plants (500 MW each) by 2050. The Roadmap 2050 analysis shows that, by avoiding more expensive generation and transmission needs, energy efficiency measures can also reduce the cost of the transition to a decarbonised power sector by up to 30%.

## 2.1 DEEP GHG REDUCTIONS REQUIRE STEEP ENERGY SAVINGS

Energy savings are essential to achieve an 80% or more reduction in greenhouse gases in the EU by 2050. This is illustrated in Figure 2 - 2. The graph shows the impact on greenhouse gases of realising cost-effective energy savings in the built environment, transport and industry sectors of the EU. Chapter 4 of this report explains in depth how we estimated this energy savings potential. When compared to a linear trajectory towards the EU's 2050 ambition, this graph clearly indicates the importance of realising the EU's energy savings potential.

In a separate study (SERPEC: Ecofys et al., 2009a), we showed that the first half of the linear GHG-trajectory to 2050 (2005-2030) actually resembles the maximum pace at which the EU can reduce its GHG emissions. This maximum pace was estimated by assuming that low-carbon technologies are applied in each cycle of renewal or renovation of industrial plants, power production plants, buildings, cars, trucks and electric appliances. Renewal rates – at the end of an installation's technical lifetime – range from 10–15 years, for e.g. refrigerators and cars, up to 50 years for industrial plants. At the same time, the rate of improvement of existing installations (retrofitting industrial plants or renovating houses) is assumed to more than double from 1–1,5% to 2–3% per year. Some limitations were also assumed; for example, there is a practical maximum to the market growth rates of new technologies because the supply chain for new technologies needs time to grow and reach substantial market shares. In turn, the SERPEC figures on maximum feasible GHG reduction rates and potentials by 2030 are largely supported by several other (model) studies (Ecofys et al., 2009a).

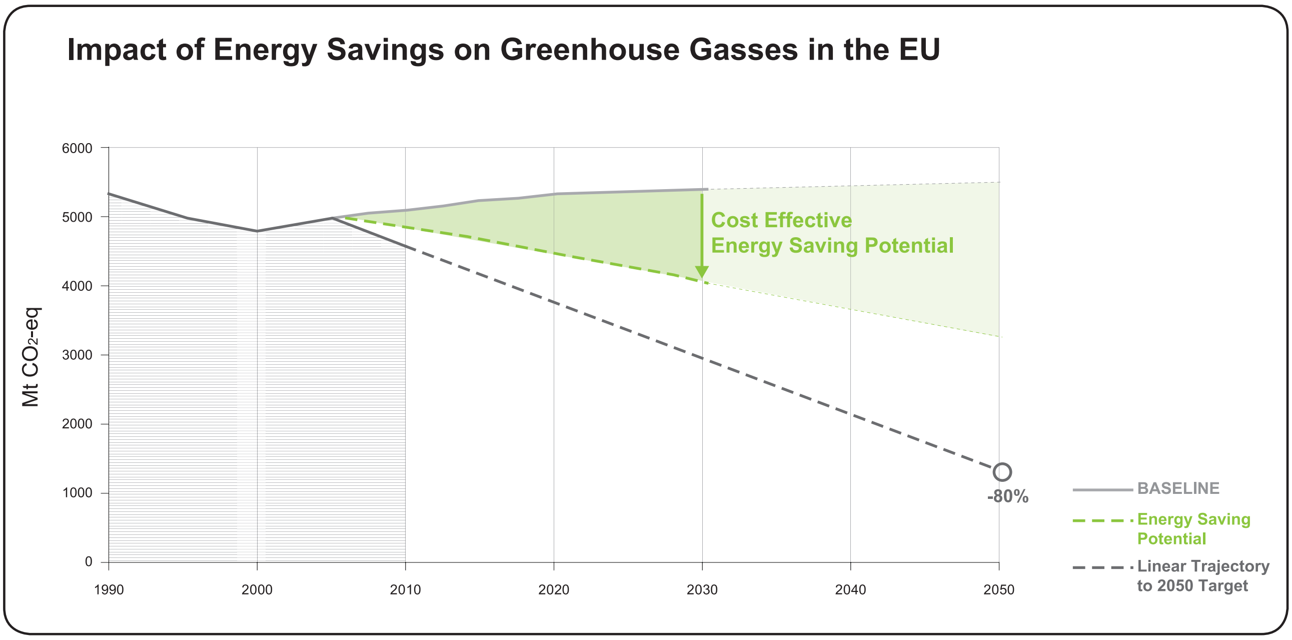


Figure 2 - 2 Greenhouse gas emissions in the EU 27: monitoring, baseline and linear trajectory towards the 2050 ambition of reducing emissions beyond -80% compared to 1990. The green wedge illustrates the impact of the cost-effective energy savings potential identified in this study (see chapter 4).

The assumptions on energy savings in SERPEC are similar to the savings potential identified in this study (chapter 4) and illustrated in Figure 2 - 2. These studies underline the requirement for immediate action to get on the linear track to deep GHG reductions by 2050.


## 2.2 Energy savings: saving money, creating jobs, improving competitiveness

Energy savings save money, create jobs and improve the competitive position of Europe in the long term. In addition to these direct benefits, energy savings also have some inherent co-benefits:

- Improvement of energy security
- Support in reducing GHG emissions
- Support in meeting RES targets

### 2.2.1 Saving energy is saving money

It is important to define precisely what is understood by "saving energy is saving money" because savings can be defined in different ways:

1. **'Money not spent on energy':** These are the economic savings which occur when a certain amount of energy is saved. This does not take account of the investments which are necessary to realise the savings; they are therefore gross savings.

2. **'Net savings for the 'end-user':** These are net savings for the 'end-user' which take into account the required investment as well as the financial revenues from saved energy. Here, taxes need to be considered where relevant for the 'end-user' as it is assumed they are factored into the investment decision. Applied discount rates can either reflect current rates at which 'end-users' have access to capital or a more ideal situation (e.g. reflecting long-term societal and political priorities). The latter was applied in this study in the HPI Scenario[3] in which financing is available at low interest rates and non-economic barriers have been removed.

3. **'Net savings to the economy':** This category represents net savings for the economy as a whole. Generally, these savings tend to be lower than net savings for the 'end-user', but much depends on how the monetary savings are circulated back to the economy and how investments in energy efficient technologies give impulse to the local economy.

In the following section we will briefly discuss the amounts saved under these definitions.

### 1. Money not spent on energy

The 'Money not spent on energy' is quite straightforward to calculate. The European Commission estimates in its Impact Assessment of the Action Plan for Energy Efficiency (SEC(2006)1174) that achievement of the 20% energy savings target would result in money not spent on energy (excluding taxes) in 2020 in the range of €100 - 150 billion annually, depending on the price developments of oil[4]. The policy gap of 208 Mtoe identified in this study (section 3.6) means that Europe will need to spend €78 billion[5] more annually on energy in 2020.

3. The HPI (high policy impact) scenario is explained in chapter 4.

## 2. Net savings for the 'end-user'

These are the monetary savings for the 'end-user' and can be derived from the cost-curve for energy efficiency options (see Figure 2 - 3). In chapter 4 we describe in depth how we assessed this potential and the associated costs or savings. The net savings for the 'end-user' include the money not spent on energy and the investment cost of energy savings options. The cost savings that arise from the 'negative' part of the cost-curve account for €107 billion of annual savings in the year 2020. In chapter 3 we will show that about two-third of these savings (208 Mtoe) are not captured by current policies, which amounts to €71 billion[6] per year of savings that 'end-users' lose because of insufficient policies.

## 3. Net savings to the economy

The net savings for the 'end-user' of around €107 billion in 2020 do not present the net benefits to the society. In fact, determining those impacts through the economy is a rather complex issue. To our knowledge, there is no European-wide study available investigating the macro-economic benefits of European-wide energy efficiency measures in detail. As an illustration we refer to the economy-wide evaluation of the German Energy & Climate Package, which contains large programmes to save energy (Jochem et al., 2008; see textbox).

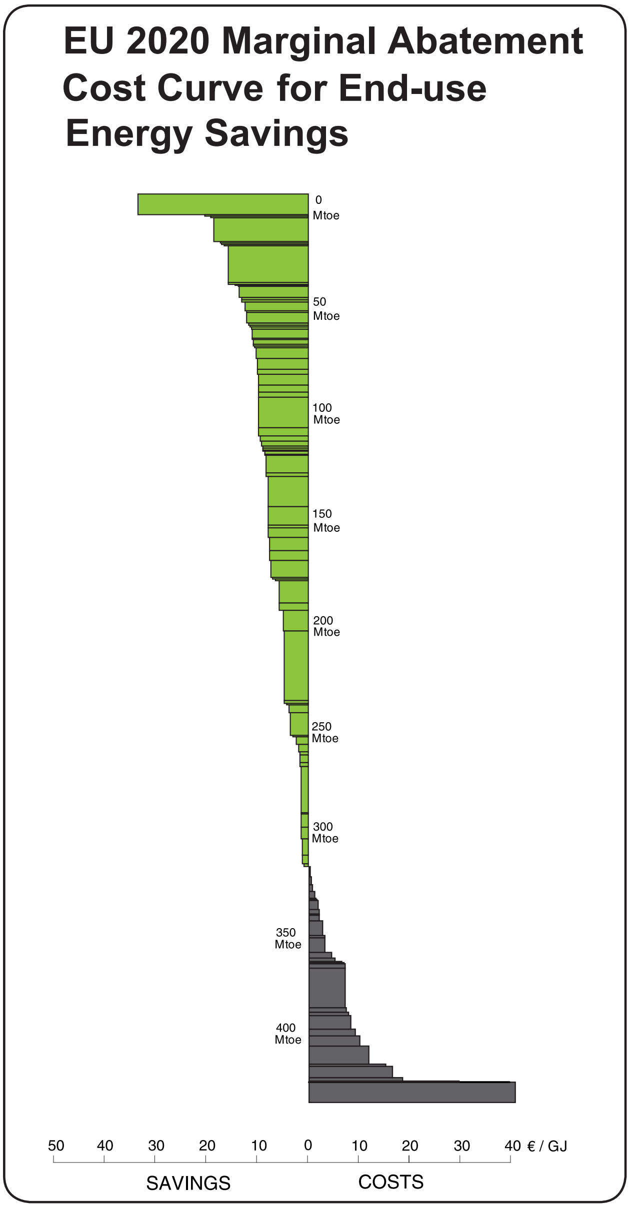


Figure 2 - 3 Overall MACC for energy savings options of end-use sectors in the EU 27 in 2020. Energy savings are expressed in primary energy units. Energy savings (Y-axis) are relative to the baseline (source: Fraunhofer et al., 2009).

4. 20% energy savings by 2020 equals saving 390 Mtoe according to the Impact Assessment (SEC(2006)1174). Assumed oil prices are $48 (lower value) and $70 per barrel (higher value) net of taxes. In COM(2008) 772 final ("Energy efficiency: delivering the 20% target"), €220 billion is mentioned using an oil price of $96 per barrel.
5. 208 Mtoe x 52 €/barrel x 7.2 barrel/toe/1000 = €78 billion excluding taxes (oil price: 61 $/barrel; source PRIMES 2007).
6. This figures includes taxes and can therefore not be compared directly with the €78 billion not spent on energy.

**Ambitious energy savings can make the German economy grow**

Jochem et al. (2008) evaluated the macro-economic impacts of achieving 40% reduction in GHG emissions in Germany by 2020 (the 'Meseberg programme'). In addition to ambitious energy saving measures, this package also contains more expensive measures for renewable energy sources. The package provides three main types of direct and indirect impetus for the economy as a whole:

1. Additional investments in climate protection, which reduce or eliminate the need for certain other types of investments;

2. Changes in energy costs and energy expenditures (this allows the consumer to spend money saved on energy on investments in energy efficiency but also on other investments and consumption expenses);

3. Changes in energy imports, especially imports of fossil fuels.

Jochem et al. (2008) find that the programme requires investments amounting to €35 billion per year in 2020. This is an increase of about one-third compared with existing net investments in the German economy. These investments would also have indirect positive effects for Germany as they are more likely to favour domestic and employment-intensive sectors (such as industrial goods).

The authors conclude that between 2020 and 2030, the cumulative impetus resulting from additional investments, energy cost savings and the induced structural changes, will lead to significant economic growth. They calculate that German GDP would increase by around €70 billion in 2020 and €110 billion in 2030 (0.2% GDP increase per year). This would create more than 500,000 new jobs in 2020 and 900,000 new jobs by 2030.

### 2.2.2 Saving energy creates jobs

Compared to, for example, (renewable) energy supply sectors that governments may decide to support or invest in, schemes that are able to effectively redistribute funds to energy savings generally generate greater added value and substantial direct employment gains. A study for the UK for example has estimated that 10 to 30 person years of direct employment is created for every million pounds spent on energy efficiency measures, which could even increase to 60 person years provided that training programs are sufficiently implemented (ACE research, 2000). Another recent study in Hungary concluded that between 43,000 and 130,000 net new jobs could be created in the country by 2020 from a large-scale buildings efficiency retrofit programme based on several scenarios, ranging from energy efficiency improvements of 40% for 150,000 dwellings to 75-90% for 250,000 dwellings per year (Ürge-Vorsatz, Diana et al., 2010).

The green paper on Energy Efficiency (COM(2005) 265 final) estimated that energy savings measures could create 1 million new jobs in the EU by 2020. Due to the labour-intensive and localised nature of the work, the bulk of these jobs will be created in local installation and manufacturing, but will also benefit the European transport, energy, and service sectors. With the highest unemployment rates in Europe in the manufacturing and installation industries, efficiency and savings measures will create jobs in those areas where they are most needed. Direct employment will be created in the manufacturing of equipment and materials. Insulation, glazing, industrial process improvements, the fitting of heaters, furnaces and heating systems, management and monitoring as well as the administration of investment programs and policy schemes, but also auditing, monitoring of energy use, efficiency rating, marketing and consultancy all offer job opportunities.

The above mentioned figures have to be interpreted carefully. Some of the jobs that are created to enable energy efficiency improvement and energy savings will inevitably displace existing jobs in other sectors.

Determining the exact level of displacement in sectors where product and service demand is reduced, or in other words, the net jobs that are gained in an emerging sector, is a highly complex issue.

Energy savings in the residential building sector could also have a multiplier effect on the local level as consumers are likely to divert savings on energy bills into general consumption (into the generally labour-intensive consumption sectors). Such indirect employment effects depend on the cost-effectiveness of the investments and the payment methods used.

Reducing energy poverty[7] though the renovation of social housing is another important socio-economic effect of energy savings measures (see textbox*)*.

**Energy savings to reduce energy poverty in the UK**

Energy efficiency policies in the domestic sector has been acknowledged by the UK government as a key measure to help the UK meet its GHG and energy savings targets. The six large gas and electricity suppliers have the obligation to deliver a certain quantity of energy savings (2002-2008) or Carbon emissions reductions (2008-2011). At least 40% of their obligation should be targeted to poor or elderly customers in order to reduce 'energy poverty'. Suppliers meet their targets by setting up schemes to deliver reductions in carbon emissions e.g. delivering loft insulation to low income households or subsidising the cost of cavity wall insulation. Suppliers have promoted measures using a variety of partners including Local Authorities, Social Housing Providers, charities, retailers, manufacturers, newspapers and linking with other programmes such as the Warm Front Scheme (OFGEM, 2008).

Going forward, the Department of Energy and Climate Change has recently outlined a new model for energy efficiency delivery, whereby suppliers would partner with local authorities and other organisations to meet aggressive savings targets, in conjunction with the introduction of "local" carbon reduction targets that would be the responsibility of local authorities (DECC, 2010)

### 2.2.3 Saving energy ensures long term European competitiveness

The absolute decoupling of economic growth from energy use could contribute to increasing the competitiveness and attractiveness of EU businesses. Europe is a global leader in exporting regulatory and technical standards. This may provide EU businesses with a first-mover advantage and in addition reduce import and resource vulnerabilities.

The recent EU 2020 strategy proposes a "resource efficient Europe" that should decouple economic growth from energy use, as a 'flagship initiative' (COM(2020) 2010). This report shows that to achieve this, substantial additional energy saving efforts are required.

More generally, the successful realisation of an energy savings target will lead to a skilled and highly specialised workforce in several sectors of the EU economy. This could have a positive, more indirect effect on commerce competitiveness in the

7. Households are said to live in 'energy poverty' if they need to spend more than 10% of their disposable income to heat their homes to an adequate level.

manufacturing and services sectors as well as in R&D. The construction and refurbishment sectors (as well as energy suppliers) however hardly face any non-EU competition. Therefore the impact on overall EU competitiveness of these sectors is likely to be rather small.

Higher efficiency power plants would ideally lead to lower electricity prices for 'end-users' and thereby increase EU competitiveness, provided that such (new or refurbished) plants are cost-effective (this depends among other factors on the price of fossil fuels).

Reducing energy use in any industry has two main benefits: it cuts operational expenses, often contributing to increased output, and secondly forms the main pillar of a company's environmental strategy. Utility and energy costs are generally the main components of the total operational costs of companies. Monitoring energy use and implementing measures to reduce energy use therefore become increasingly important when competing in a global market against countries whose energy (and labour) costs are relatively low compared to those in the EU.

Additionally, consumers are increasingly aware of the environmental impact of their behaviours. Companies that, as part of their business strategy, can deliver low-carbon and low-energy intensity products build competitive advantage and create added value.

## 2.3 SAVING ENERGY IMPROVES ENERGY SECURITY

The report 'European Energy and Transport Trends to 2030' of January 2003 put energy security on the political agenda. The report, based on the PRIMES-2003 scenario, foresaw an increase in the EU's energy import dependency from just below 50% in 2000 to 68% in 2030. Table 2 - 1 illustrates the latest data based on the PRIMES-2009 projections for 2020.

For reasons of simplification, we here define energy security in terms of import dependency[8]. Under this definition, energy savings contribute to improved energy security when the saved energy reduces the absolute amount of energy imported into the EU (instead of reducing intra-EU energy distribution). Assuming that the total volume of savings associated with the 20% target is saved on fossil energy imports (oil, gas and coal) would reduce the import dependency in 2020 to 55% (see Figure 2 - 4).

| EU ENERGY IMPORT DEPENDENCY | OIL | NATURAL GAS | COAL | TOTAL |
|---|---|---|---|---|
| SHARE IN TOTAL ENERGY USE 2005 | 37% | 24% | 18% | |
| SHARE IN TOTAL ENERGY USE 2020 (PRIMES-2009) | 34% | 25% | 16% | |
| INCREASE OF NET IMPORTS 2005-2020 (PRIMES-2009) | +9% | +36% | +14% | |
| IMPORT DEPENDENCY 1990 | | | | 45% |
| IMPORT DEPENDENCY 2005 | | | | 54% |
| IMPORT DEPENDENCY 2020 (PRIMES-2009) | | | | 62% |
| IMPORT DEPENDENCY 2030 (PRIMES-2009) | | | | 60% (1) |
| IMPORT DEPENDENCY 2030 (PRIMES-2003) | | | | 68% |

(1) The lower import dependency compared to 2020 is explained by the increased share of renewable energy

Table 2 - 1 EU Import dependency in 2020 and 2030.

## 2.4 ENERGY SAVINGS HELP ACHIEVE THE RENEWABLE ENERGY TARGET

**Energy savings are fundamental to increasing the share of renewable energy supply at affordable prices**

A binding energy savings target would make a major contribution to the achievement of the 2020 RES target. As overall demand growth slows or decreases, the more achievable the 20% supply and higher RES targets become.

### Impact of Energy Savings on EU Energy Imports

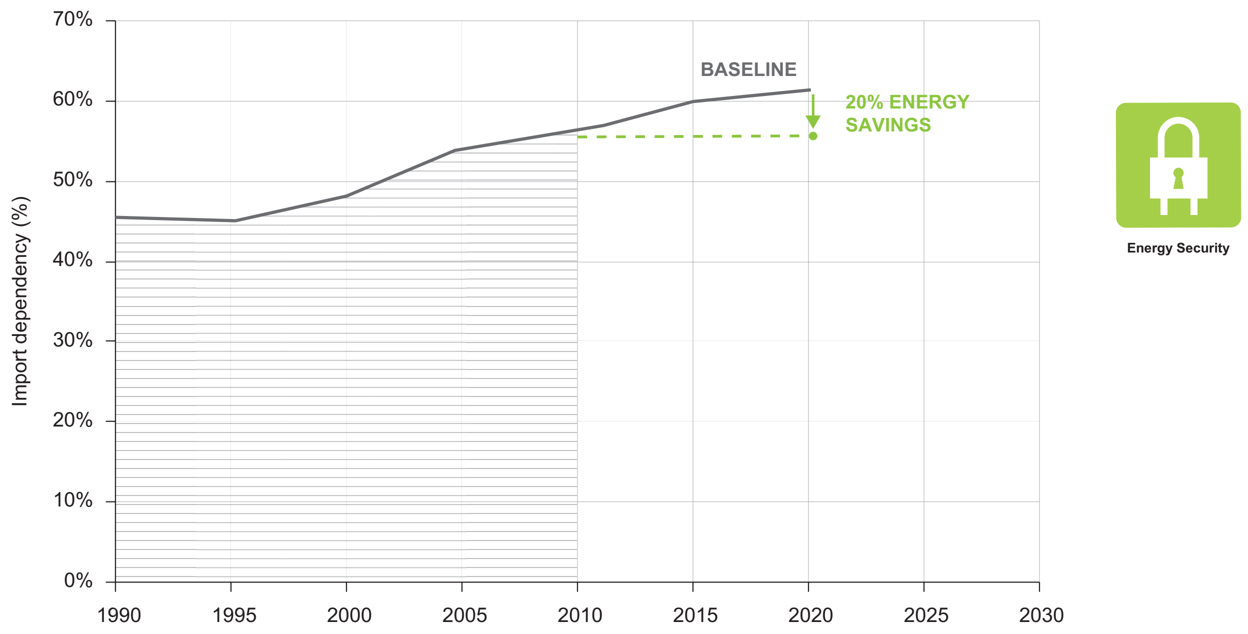


Figure 2 - 4 EU's energy import dependency under the PRIMES-2009 baseline conditions and after realisation of the EU's 20% energy savings target.

8. See Ecofys (2009c) Analysis of impacts of climate change policies on energy security, for an in-depth analysis on energy security indicators.

CHAPTER 3

# MEETING THE 20% TARGET REQUIRES A TRIPLING OF CURRENT POLICY IMPACT

To what extent will the EU target to save 20% energy by 2020 be realised by existing EU policies? This chapter starts by presenting a short overview of the energy savings strategies of the Commission, Council Decisions and the European Treaties. Existing, implemented policies on energy savings, climate and renewable energy, are described in sections 3.3 to 3.5. Finally, section 3.6 provides an overview of expected impacts of EU policies on future energy use and GHG emissions in the EU.

## 3.1 EU ENERGY SAVINGS POLICY AMBITIONS

How is the topic of energy savings embedded in EU strategies, Action Plans and European Council decisions? These policy ambitions have been translated into concrete EU policies including Directives, Decisions and Regulations.

### Strategic overview (in chronological order)

- **2005: The Lisbon Strategy ('a new start').** The strategy refers to the promotion of (energy-efficient) eco innovations. The strategy does not specify targets (COM(2005) 24 final).

- **2005: Thematic Strategy on the sustainable use of natural resources.** This strategy is one out of seven thematic strategies announced in the sixth environmental Action Plan. The strategy does not include specific energy savings ambitions (COM(2005) 670 final).

- **2005: Green Paper on Energy Efficiency ('doing more with less').** The Green Paper states that: 'according the numerous studies, the EU could save at least 20% of its present energy consumption in a cost-effective manner' and 'This Green Paper on energy efficiency envisages launching the debate on how the EU could achieve a reduction of the energy consumption of the EU by 20% compared to the projections for 2020 on a cost-effective basis' (COM(2005) 265 final).

- **2006: Energy Efficiency Action Plan.** The action plan, endorsed at the Spring Council of 2007 is the first official EU policy action that includes a 20% energy savings target for 2020 (COM(2006) 545 final).

- **2006: EU Sustainable Development strategy (renewed).** The strategy, endorsed at the European Council of 15 and 16 June 2006, refers to existing Energy Efficiency targets (Energy Efficiency Action Plan and the Energy Service Directive). No additional ambitions are set.

- **2008: Second Strategic Energy Review**: An EU Energy Security and Solidarity Action Plan (COM(2008) 781 final). The commitment to the 20% energy savings target is repeated: 'Energy efficiency measures have a critical role to play in ensuring that the climate and energy objectives are being achieved at least costs, with a particular focus on buildings and transport', and 'The package will reduce energy consumption in the EU in 2020 by as much as 15%'.

- **2008: Climate and Energy Package**. The package confirms the 20% energy savings by 2020 as one of the pillars of achieving the overall 20% GHG target by 2020. Legal adoption of the 20% energy savings target is not explicit.

- **2009: European Council Conclusions.** Preceding the Copenhagen COP15 meeting, the Presidency Conclusions of the Brussels European Council of 29 and 30 October 2009 set political ambitions for deep GHG reductions towards 2050: ….'It supports an EU objective, in the context of necessary reductions according to the IPCC by developed countries as a group, to reduce emissions by 80-95% by 2050 compared to 1990 levels' and 'It is committed to take a decision to move to a 30% reduction by 2020 compared to 1990 levels, as its conditional offer with a view to a global and comprehensive agreement for the period beyond 2012, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities.'

- **2010: Europe 2020.** In early 2010 the new Commission proposed the EU 2020 strategy (COM(2010) 2020), which was agreed at the Brussels European Council of 25 March 2010[9]. One of the three priorities in the strategy is sustainable growth: promoting a more resource efficient, greener and more competitive economy. 'Moving towards a 20% increase in energy efficiency' is regarded as one of the headline targets that is critical for success of the strategy by 2020.

**In summary, we conclude that:**

- The 20% energy savings target by 2020 originates from the 2005 Green Paper on Energy efficiency and was confirmed in Action Plans and Council Decisions that followed. In June 2010, the target was adopted by the European Heads of State and Government (the European Council) as part of the new 'Europe 2020' strategy.

- Though the 20% energy savings target has politically been agreed upon, it is not explicit in any legally binding EU decision. Thus, in a sense it is still to be regarded as a policy 'ambition' that has not been fully translated into concrete policies (see chapter 3.3).

**Lisbon Treaty provides a new option to develop energy savings policies[10]**

The Lisbon Treaty consists of a number of amendments to the existing Treaties including the change of the name of the Treaty establishing the European Community (EC Treaty) into the Treaty on the Functioning of the European Union (TFEU). It entered into force on 1 December 2009. It introduces a new energy chapter that establishes the power of the EU to develop an energy policy, making energy an area in which the Union shares competence with the Member States. Until recently, the European Treaties did not explicitly recognize such EU competence on energy issues. Therefore, the EU energy measures were adopted under other provisions of the EC Treaty such as the environmental provisions of Article 192 TFEU (ex-Article 175 EC Treaty) and the internal market provisions of Article 114 TFEU ( ex-Article 95 EC Treaty). Examples are EU legislation such as the Energy Services Directive (environmental provisions), the Eco-design Directive (internal market provisions) and the Renewable Energy Directive (both environmental and internal market provisions).

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9. See Conclusions of the Brussels European Council of 25 and March 2010. The European Council agreed on the main elements of the strategy (including a headline target of 20% energy efficiency) . The strategy was formally adopted in June 2010.
10. Text based on ClientEarth (2009).

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Under the new TFEU the Union retains its competence to adopt energy savings policies under the environmental and internal market provisions. In addition, the new energy chapter gives the EU the competence to develop a more strategic and harmonised energy policy to be implemented in all Member States. Article 194 TFEU describes four objectives guiding the development of EU energy policies. It states that: “In the context of the establishment and functioning of the internal market and with regard for the need to preserve ad improve the environment, Union policy on energy shall aim, in a spirit of solidarity between Member States, to:

- ensure the functioning of the energy market;
- ensure security of energy supply in the Union;
- promote energy efficiency and energy saving and the development of new and renewable forms of energy; and
- promote the interconnection of energy networks.”

The competence of the EU to adopt energy policy measures under the new energy chapter only applies when these measures do not affect:

- Member State’s right to determine the conditions for exploiting its energy sources
- Member State’s choice between different energy sources and
- The structure of Member State’s energy supply.

This study focuses on possible and feasible EU policy design options for binding energy savings targets. Before going into further details it is worth considering the question of whether the new energy chapter allows the EU to establish energy efficiency binding targets. To answer this question it is necessary to assess legally binding energy savings targets against the above-mentioned criteria of Article 194 TFEU. Such assessment is beyond the scope of this study. However, it can be argued that the introduction of binding energy savings targets would not be in contradiction with these criteria: 1. typically energy savings should not affect a Member State’s right to exploit energy resources, 2. binding energy saving targets would still allow a Member State to choose from its portfolio of energy sources even if changes in energy demand/consumption would affect decisions regarding energy mix, and 3. such targets do not directly affect the structure of energy supply.

It seems therefore, that adopting binding energy saving targets would not be in contradiction with Art. 194 TFEU and could be adopted on the basis of this Article. This would provide the EU with a new option in the development of energy savings policies.

Environmental policy Treaty articles can of course also be used as the legal basis for energy efficiency measures. The appropriate legal framework would have to be determined according to the objectives established in the Directive and the arguments presented by the European Commission in the impact assessment. The European Court of Justice would have the final word if the basis was challenged.

## 3.2 BALANCING BETWEEN NATIONAL VERSUS EU COMPETENCIES

In the next sections 3.3 to 3.5 we look at the EU's energy and environment legislation from the perspective of energy savings. The national implementation of EU law provides different degrees of flexibility for Member States, as illustrated in the textbox below.

In general, EU Directives, and in particular Framework Directives, allow Member States to flexibly implement ('shape') the required legislation in their national policy contexts. The strength of flexible EU approaches, which leave the formulation of actual policies to Member States, is also its weakness, especially when clear and measurable targets are not indicated, as it may result in inconsistent implementation, with different levels of ambition between Member States (see textbox on Energy Services Directive in section 3.3.2).
On the other hand, targeted EU-wide rules run some risk of being watered down in the policy development process to a lowest common denominator ambition level, because of the many stakeholders involved (see e.g. textbox on Eco-design Directive in section 3.3.4).

**The wide range of EU regulatory approaches**
EU legal provisions provide a wide range of approaches, ranging from very flexible Directives to Regulations that are entirely and directly applied in national legislation in all Member States. Examples of EU law in the area of energy are, in order of a decreasing degree of flexibility for Member States:

1. Directives that prescribe to Member States a process of target setting, planning, implementation and monitoring of national policies and measures. The Energy Performance of Buildings Directive falls into this category (Directive 2010/31/EU).

2. Directives that impose a non-binding target on Member States and prescribe a process of planning, implementation and monitoring of national policies and measures. The Energy Services Directive (Directive 2006/32/EC, as amended) is an example, as well as the 2001 Renewable Electricity Directive (Directive 2001/77/EC, as amended; now recast into the Renewable Energy Directive (Directive 2009/28/EC)).

3. Directives that impose a binding target on Member States and prescribe a process of planning, implementation and monitoring of national policies and measures. Here, the current Renewable Energy Directive serves as an example, as well as the Effort Sharing Decision (Decision No 406/2009/EC).

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4. Directives, other than Framework Directives that provide common EU wide rules, which have to be followed by Member States to prevent disperate national legislation. One example is the recently reviewed EU-ETS, with a central EU-wide cap, and harmonised allocation rules (Directive 2009/29/EC).

5. Regulations that are entirely and directly applicable in all Member States. Typically, 'product' Regulations define standards for specific technologies, such as $CO_2$ emissions limits for passenger cars (Regulation (EC) No 443/2009) or for electric motors (Commission Regulation (EC) No 640/2009). Only when Regulations are adopted under the environmental provisions of the Treaty, rather than the internal market provisions, are Member States in principle allowed to enforce more stringent standards. This is the case for the $CO_2$-regulation on passenger cars.

## 3.3 Energy Savings Policies

### 3.3.1 Energy efficiency action plan

The policy target to save 20% of primary energy in the EU by 2020 originates from the 2005 Green Paper on Energy Efficiency. The target was repeated in the Action Plan for Energy Efficiency in 2006, politically endorsed at the Spring Council of 2007, reconfirmed as part of the EU's Climate and Energy package in 2008/2009 and was finally adopted by the European Heads of State and Government (the European Council) on 17 June 2010 as part of the new 'Europe 2020' strategy.

Figure 3 - 5 illustrates that the target was defined relative to baseline energy use development in 2020. The target is non-binding and is based on economy-wide primary energy use.

**EU's 20% Energy Savings Target Compared to the Baseline**

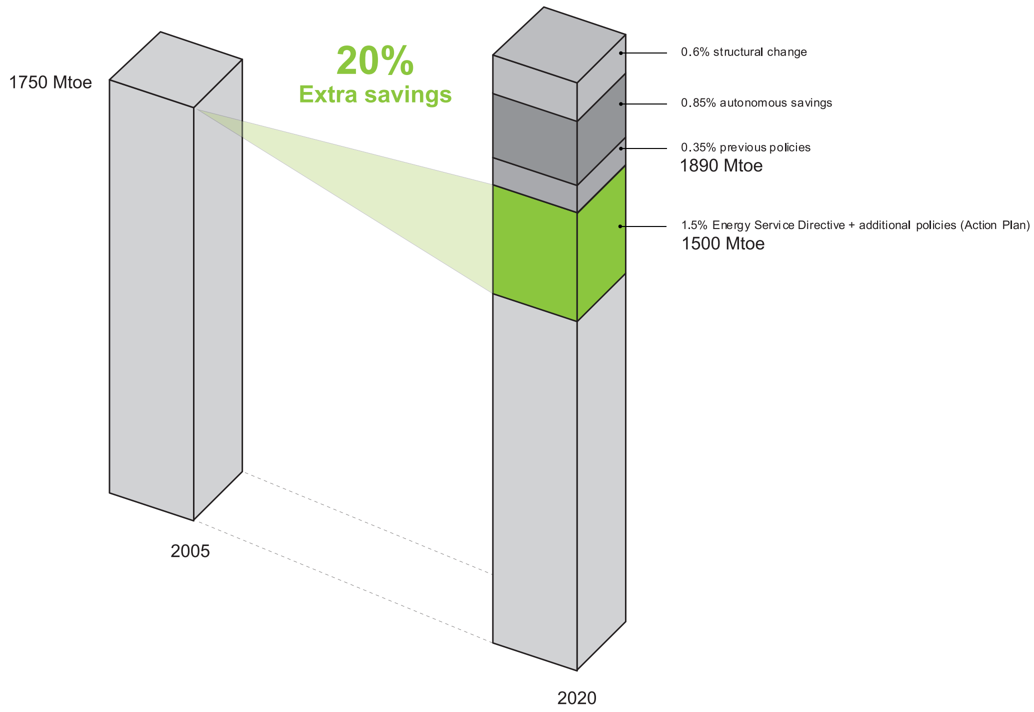


Figure 3 - 5 Indicative 20% energy savings target (source: Energy Efficiency Action Plan 2006 (COM(2006) 545 final). Data is expressed in primary energy units.

**The 20% target resembles a primary energy use of around 1600 Mtoe in 2020**

The definition of the energy savings target can easily give rise to discussion on what the target actually means. Is it an efficiency improvement target that is 'relative' and does not give guidance on absolute levels of energy use? Is it a target relative to a baseline, which could change when the baseline changes? Or is it a target for absolute primary energy use in the EU in 2020?

The Energy Efficiency Action Plan (COM(2006) 545 final) clearly defines the 20% savings target relative to a baseline. The target, estimated against the PRIMES-2007 baseline, represents absolute primary energy use of 1574 Mtoe in 2020. This value equates to the 1500 Mtoe reported in the Action Plan (see Figure 3 - 5) corrected for Romania and Bulgaria, the countries which most recently acceded to the Union.[11]

11. The indicative 20% target on energy savings refers to projections for 2020, as estimated by the Commission in its Green Paper on Energy Efficiency, which used the PRIMES-2003 baseline. This baseline covers EU 25 with separate model runs for Bulgaria and Romania. PRIMES-2007 covers EU 27 and gives similar values for primary energy consumption in 2020 for the 27 Member States (1970 Mtoe in PRIMES-2003 and 1968 Mtoe in PRIMES-2007).

In this study, we assume that the energy use target of 1574 Mtoe is not dependent on *changes* in the baseline scenario (either downwards after an economic recession or upwards when economic growth is higher than expected). In our view, this is consistent with the Commission's[12] interpretation.

### 3.3.2 The Energy Services Directive

The Directive on energy end-use and energy services (Directive 2006/32/EC, hereafter Energy Services Directive) applies to energy providers and final energy consumers, excluding final energy consumers that participate in the EU-ETS (industry). Thus, the Directive covers the fuel, district heat and electricity consumption in sectors such as the built environment, transport and smaller industrial installations.

The Directive aims to promote the efficient end-use of energy by providing energy savings targets on the *final* energy use for the period 2008-2016 of those sectors in each EU Member State that are not regulated by the Emissions Trading Scheme. More precisely, the savings target is defined as a volume of energy savings equal to 9% of the final energy use of a reference period 2000 - 2005. A share of early action savings (achieved before 2008 and initiated not earlier than in 1991 or 1995[13]) may be included in the target achievement on condition that they have a lasting effect. The Directive also aims to promote the development of a market for energy services that delivers energy efficiency improvements to final consumers (see textbox).

**White Certificates Schemes**

'White Certificates' are an instrument used in conjunction with policies that obligate energy suppliers to initiate energy savings projects with their customers. Such schemes have been introduced in Italy, France, UK and Flanders. The schemes set an obligatory target for a volume of energy savings that the energy service companies have to realise in order to acquire White Certificates. These are generated on a project basis in which the savings of (a package of) measures is calculated against a reference 'baseline' or reference situation. These certificates can be traded among energy service companies. The service companies compensate for the cost of generating certificates by a generic increase in the gas or electricity price.

To monitor progress on the development of policy instruments for reaching the 2016 targets, Member States have to submit National Energy Efficiency Action Plans (NEEAPs) in 2007, 2011 and 2014. A recent evaluation of the first round of NEEAPs pointed to (Energy Efficiency Watch, 2009):

- The absence of a harmonised set of calculation, monitoring and evaluation methods, and a common reporting template.
- An undifferentiated mixture of energy savings measures already implemented (early action), business as usual measures and additional measures.
- Weak coverage of both public sector and energy services.
- Differences in ambition level between Member States.

12. See e.g. Annex I of COM(2008) 772 final: Energy Efficiency: delivering the 20% target.
13. For details, see Annex I of the Energy Services Directive.

These findings were confirmed by the Commission (see SEC(2009) 889 final).

The Energy Services Directive could have made a significant contribution to reaching the overall EU energy savings target. This is because a target of 9% *additional* savings in the period 2008 to 2016 would have meant a doubling of the current energy savings rate from 1% per year to 2% per year. Its current implementation target for the EU 27 total is, however, not very ambitious. See textbox.

**Energy Services Directive targets less than one third of HPI savings potential**

Fraunhofer et al. (2009) estimated a cost-effective energy savings potential for activities covered by the Energy Services Directive of around 180 Mtoe of final energy use in 2016. The Energy Services Directive prescribes a non-binding target to save energy in 2016 equal to 9% of the average final energy use in the 2001-2005 period. This represents around 90 Mtoe of final energy. In the first round of NEEAPs, Member States attributed around one third of savings to early actions before 2007 (which is allowed under the Directive), leaving a target savings volume of around 60 Mtoe. This volume compares to one third of the cost-effective savings potential. In practice, however, this share might even be lower, as the current set of Action Plans propose an undifferentiated mixture of business as usual and additional energy savings measures (Energy Efficiency Watch, 2009). The current implementation ambition of the Directive by Member States therefore seems rather low.

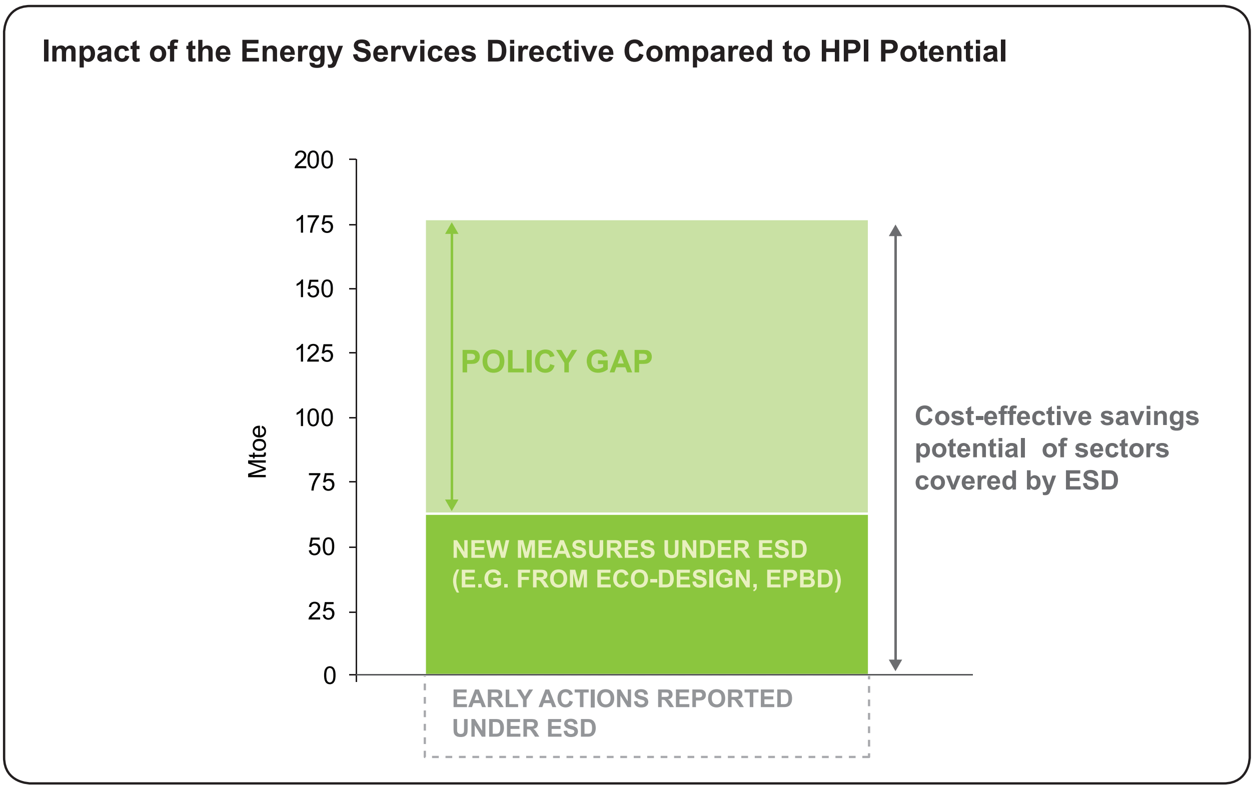


Figure 3 - 6 Reported energy savings in 2016 under the Energy Services Directive (ESD) versus the cost-effective energy savings potential identified in this study. Note that the "early actions" are energy savings that are already included in the baseline and, therefore, do not contribute to the EU-wide 20% energy savings target.

## 3.3.3 ENERGY PERFORMANCE OF BUILDINGS DIRECTIVE

The Energy Performance of Buildings Directive (COM(2008) 780 final, hereafter called EPBD) has recently been recast. Final political agreement was reached in November 2009.

*Extended scope of the Directive*
The scope of the Directive has been extended to include almost all existing and new buildings. Energy performance standards for buildings are the key element of the Directive. Member States shall ensure that minimum energy performance requirements for buildings are set at cost-optimal levels. This level shall be calculated based on a comparative methodology framework that will be defined in detail by the Commission in a delegated act by 30 June 2011. Member States will have to report their specific application of the methodology to the Commission. Member States shall propose a plan outlining additional efforts in case performance standards are significantly less stringent than the cost optimal levels and lack appropriate justifications. Initially, the (comparative) benchmarking method will be applied to set standards for all buildings, existing and new ones. From 2019/2021 on, 'nearly zero energy standards' will be applied on new buildings.

*Existing buildings*
When existing buildings undergo 'major renovation', their energy performance should be upgraded in order to meet the minimum energy performance requirements, in so far as this is technically, functionally and economically feasible. Note, that the implications of a 'major renovation' on requirement on buildings will need some further clarification on the Member State level. For example, Member States will need to clarify whether, at the moment of the major renovation, the energy performance of a whole building or only of the renovated part will need to be improved. Member States shall furthermore develop policies to stimulate the transformation of buildings that are refurbished into nearly zero energy buildings.

*New nearly zero energy buildings*
From 2019 on, Member States shall ensure that new buildings occupied and owned by public administration are nearly zero-energy buildings. By 2021, all new buildings, including those privately owned, will have to be 'nearly zero energy' buildings. According to the Directive, a zero energy building has a very high energy performance (is highly efficient) and a very significant share of renewable energy for the remaining energy requirement of the building. The Directive requires Member States to set up a *national plan for increasing the number of nearly zero energy buildings.* This plan should provide the practical application of the definition of nearly zero energy buildings, which allows for inclusion of national conditions. The plans will also include information on national policies, measures and targets on nearly zero energy buildings. The plans will be communicated to and evaluated by the Commission.

*Energy performance certificates*
Member States shall ensure that an energy performance certificate is issued for any building that is constructed, any building that is sold to a new owner or rented out to a new tenant (either existing or new building) as well as for frequently visited buildings occupied by a public authority of more than 500 $m^2$ (later: 250 $m^2$). Note that the certificates were also part of the 'old' EPBD but implementation of this requirement has not been satisfactory. This should improve through the recast's provision to include information on energy performance in the advertisements in commercial media, when buildings having an energy performance certificate are offered for sale or rent.

**Impact of the EPBD**

In a study for DG-Environment, AEA et al. (2009) assessed the impact of the EPBD in 2020. In this assessment, interaction of the EPBD with other Directives has been taken into account. The main interaction identified is with the Eco-Design Directive (efficiency of space heating appliances). For illustration, Figure 3 - 7 shows the results of the analysis for the residential sector. In the graph the effect of improved boiler efficiency is separately shown next to the remaining effect of the EPBD. A key parameter in estimating the impact of the EPBD is the compliance rate. For existing buildings these rates were set between 45 and 55% and for new buildings at 70%.

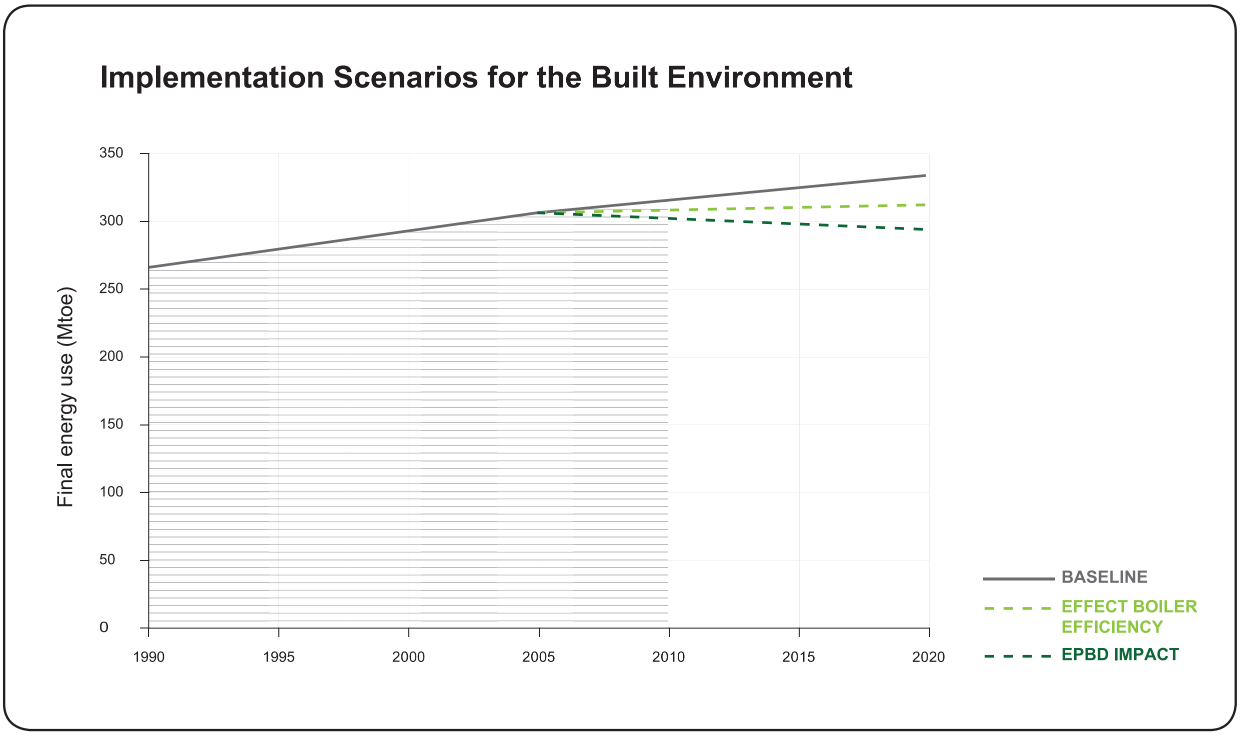


Figure 3 - 7 Scenario for the impact of the EPBD Directive in the residential sector (source: AEA et al., 2009).

## 3.3.4 The Eco-design Directive and the Labelling Directive

### Eco-design

The Eco-design Directive was adopted in 2005 and revised in 2009 (Directive 2009/125/EC). The Directive requires producers to make reductions in energy use and other environmental impacts an integral part of the design process of electrical appliances. The Eco-design Directive itself does not contain specific requirements for products, but sets boundary conditions and criteria. The Directive is implemented by a set of 'implementing measures' in which requirements for product groups such as energy efficiency standards are set and laid down in Regulations[14]. Among the product groups involved are typical household or service appliances that use electricity or fuel, like boilers, fridges and computers,

14. Article 4 of the Directive includes the obligation for importers to comply with the same standards for imported products.

as well as industrial appliances like electric motors and fans. Currently nine product groups have gone through this process. These product groups cover around 40% of total electricity consumption in the EU 27. The process is expected to be finalised for another 11 products in 2010. For 18 product groups preparatory studies are completed, ongoing or planned.

## Labelling Directive

In 1992, the Energy Labelling Directive entered into force (Council Directive 92/75/EEC). This Directive was the framework for implementation Directives for seven household appliance groups: refrigerators, freezers and combinations, washing machines, dryers, dishwashing machines, electrical ovens, lighting, and air-conditioning units. All appliances should be provided with an energy label and an information pack when offered for sale or hire, to provide the consumer with proper information on the energy demand of the appliance.

In November 2009, political agreement was reached to change the energy labelling system (Directive 2010/30/EU):

- The scope of the Labelling Directive was aligned with the Eco-design Directive to include appliances such as faucets and showerheads, but also windows and building materials.
- An $A^{+++}$ label for the most energy efficient appliances may be added to the classification.
- The classification shall be reviewed in particular when a significant proportion of products on the internal market achieves the two highest efficiency classes.

As with the Eco-Design Directive, the Labelling Directive is implemented stepwise. In this case the Directive confers powers to the Commission to adopt delegeted acts that implement the main Directive. Whereas the Eco-design Directive sets common standards for producers of appliances, which cannot—or only under very specific conditions—be overruled at the Member State level, the Labelling Directive aims to stimulate consumers and producers to move beyond these standards.

**Impact of the Eco-design and Energy Labelling Directives**

Figure 3- 8 shows the impact for the EU 27 of the Eco-design and Energy Labelling Directives for the 9 product groups for which Eco-design Implementing Measures (IMs) have already been adopted. Compared to business as usual, these IMs could save 17.5% of the annual electricity consumption of the 9 product groups by 2020 (middle column), equal to 69 Mtoe. Had these IMs have been set at the maximum potential energy efficiency, the savings could have reached 25.4% (right-hand column). There are currently 39 product groups covered in the Work Plan of the Eco-design Directive, so more IMs will be issued and each represents an opportunity for significant energy saving impact.

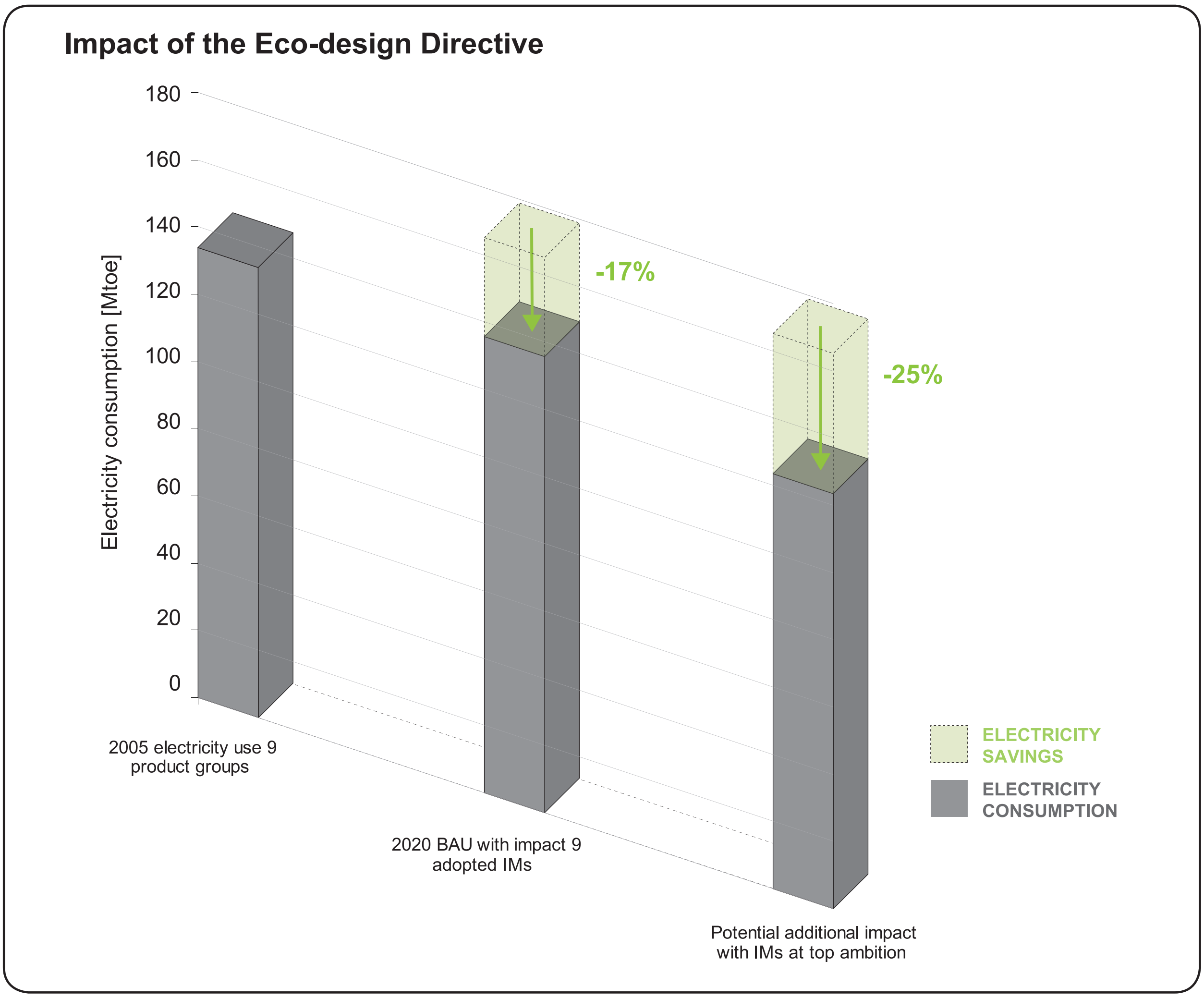


Figure 3- 8 Savings impact of the 9 adopted Implementing Measures (middle column) and potential savings impact had the Implementing measures been set at maximum potential energy efficiency (Source: data compiled by ECOS based on EuP preparatory studies, regulatory measures and internal expertise).

The results in Figure 3- 8 are confirmed by a more detailed study for the Netherlands, in which the effects of the Eco-design and Labelling Directives on electricity consumption of Dutch households were assessed for the period 2005 – 2020 for 20 household appliances (VHK, 2008). With a detailed model on household electricity consumption, it was estimated that the effect of the two Directives would give 11% savings compared to the business as usual scenario. This compares to a potential of around 34% additional savings if all households would buy the Best Available Technology appliances.

### 3.3.5 The CHP Directive

The Directive 'on the promotion of cogeneration based on a useful heat demand' (2004/8/EC, hereafter CHP Directive) aims to stimulate energy savings and the improvement of energy security. The Directive sets definitions for high-efficiency CHP (HE-CHP) and obliges Member States to, i) identify their HE-CHP potentials, ii) ensure that support for CHP is based on the demand for useful heat, iii) to reduce the barriers for CHP regarding grid access, tariffs and administrative procedures, and iv) to set up a system for guarantees of origin for HE-CHP. Many of the CHP installations addressed by the Directive fall under the EU-ETS. The CHP Directive is different from most of the Directives discussed here, as it is a technology specific directive.

Although the Directive dates from 2004, it was only in late 2008 that the Commission Decision 2008/952/EC on the harmonised rules for calculating CHP electricity (referred to in Annex II-e of the Directive) was published. This has severely delayed the full implementation of the Directive and, in particular, the set up of the guarantees of origin. In addition, the Annex II calculation guidelines are subject to multiple interpretations, which dilutes the full impact of the Directive. One of the obligations of the Directive is to study the national potential for HE-CHP and to evaluate the barriers for CHP (mentioned in Articles 6 and 9). To date, only a minority of the Member States have submitted a *full* potential study and barrier analysis, even though the deadline for this was February 2007.

The impact of the CHP Directive will differ country by country. It will have impact when:

- Member States implement national policies to overcome administrative procedures, tariff issues and problems with grid access.
- Guarantees of Origin (GOs) for high efficiency CHP get a market value.
- Member States set national cogeneration targets / focus areas based on the national potential study.
- Member States introduce a support scheme (need-based depending on market conditions) to yield the potential.

The Directive will have less or no impact if:

- Member States have already solved the main grid, tariff and administrative barriers before the implementation of the Directive.
- Member States already have a (need-based) support scheme in place.
- GOs do not get a market value.
- Member States do not show intentions to yield the national potential for high efficiency cogeneration.

## 3.4 Greenhouse Gas Emissions Policies

The overview below focuses mainly on the Directive for GHG Emissions Trading, the so-called Effort Sharing Decision for the non-ETS sectors and the $CO_2$-policy for passenger cars. Note, that the EU policy package on GHGs goes beyond the legislation noted above, e.g. policies for non-$CO_2$ greenhouse gasses from landfills, agriculture, fluorinated gasses, etc.

### 3.4.1 The EU-ETS, the Industrial Emissions Directive and CCS

**The European Union Emission Trading Scheme**
The European Union Emission Trading Scheme for greenhouse gases (EU-ETS) was established as one of the EU-wide measures to ensure achievement of the required emissions reductions under the Kyoto Protocol. The implementation of Directive 2003/87/EC establishing the EU-ETS started in 2005 and is currently in its second phase (2008-2012), where National Allocation Plans set an emissions cap that covers power generation, energy intensive manufacturing industry and, from 2012 on, aviation.

During the third phase, as from 2013, the cap is established centrally for the EU by the European Commission and will be gradually decreased by a linear factor of 1,74% per year up to 2020.

From an environmental perspective, the scheme had little or no impact on emissions reductions in phase-I (2005-2007). A number of lessons were drawn from this, for example that decentralised and non-harmonised allocation mechanisms and cap setting reduce the effectiveness and efficiency of the system. A more centralised and harmonised approach is therefore the key to the recently revised EU-ETS (Directive 2009/29/EC). This includes a shift in phase III of the scheme (2013-2020) from free allocation to auctioning of allowances[15]. Only sectors exposed to international competition and therefore assumed to be affected by 'carbon leakage' will receive a partial free allocation based on so-called benchmarks ($CO_2$/unit-product or unit-heat).

To comply with the Directive, the owner of an ETS installation has to submit in spring of each year a volume of emissions allowances equal to its greenhouse gas emissions in the year before. Compliance is flexible, participants can either take abatement measures, like energy savings, or obtain emissions allowances; either from free allocation, from an auction, bought directly from another company or bought on the open market.

The Directive also announces that the Commission will investigate the option of using credits from non-ETS domestic projects for compliance under the Scheme, see textbox.

**Domestic offsetting under EU-ETS**

In its proposal for a revised ETS Directive, the Commission announced that projects in EU Member States which reduce greenhouse gas emissions not covered by the ETS could issue credits (MEMO/08/35). These 'domestic offset credits' would need to be managed according to common EU provisions set up by the Commission in order to be tradable throughout the ETS system. Such provisions would be adopted only for projects that cannot be realised through inclusion in the ETS. The provisions would seek to ensure that domestic credits do not result in double counting of emission reductions or impede other policy measures to reduce emissions not covered by the ETS, and that they are based on simple, easily administered rules. Article 30 of the revised ETS Directive announces further research of the Commission on this option.

## Impact of EU-ETS

Figure 3-9 illustrates the expected impact of the EU-ETS from a pre- and post-recession perspective. In the pre-recession perspective the ETS was expected to incentivise a large share of EU internal emissions reductions (left-hand graph). The post-recession perspective is quite different: due to lower baseline emissions and excess (CDM) allowances from the current second trading period that can be used for compliance in phase-III of the ETS, the volume and share of EU internal reductions is expected to decrease significantly (right-hand graph). Altough this will *not* affect the achievement of the ETS cap, it will cause a structural drop in carbon prices which will decrease the incentives the EU-ETS provides for energy efficiency and low-carbon technologies.

15. In Phase III $CO_2$ emissions from electricity production will be auctioned whereas for other industrial $CO_2$ emissions full auctioning is gradually introduced up to 2027.

## Impact of Economic Recession on the EU-ETS

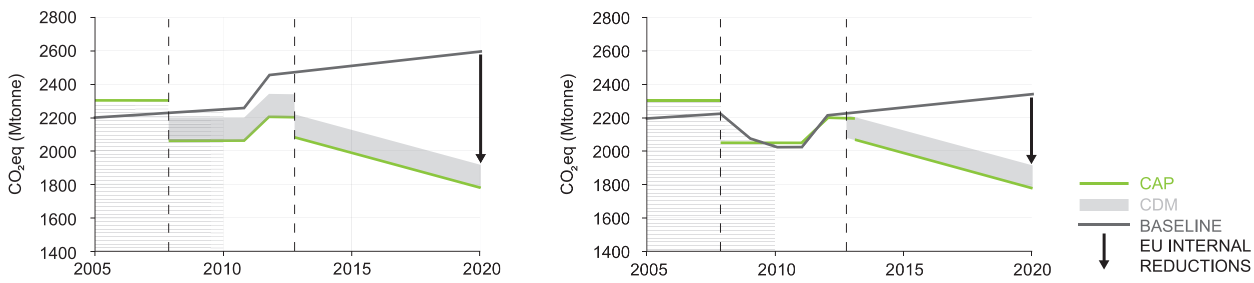


Figure 3-9 Scarcity under the EU-ETS in two scenarios. Left-hand graph shows the pre-recession view on EU-ETS, where EU-internal reductions should provide the main share of abatement in order to achieve the cap. The right-hand graph illustrates that the EU-internal effort is reduced under a recession baseline scenario. Shaded area illustrates the maximum allowed volume of CDM credits (source Ecofys, 2009a). Note: increase in cap and baseline in 2012 reflects expansion of the scope of the scheme due to entrance of aviation in the scheme.

Note that we cannot make any findings about the impact of the carbon price incentives on energy savings, given the prevailing market barriers and other factors described in chapter 5. We do conclude, however, that even with robust carbon pricing under the ETS, a mix of additional policy instruments will be required to keep the EU on track to achieve its long term ambition to reduce GHG emissions by 80-95% by 2050.

## The Industrial Emissions Directive

A Directive on Industrial Emissions was proposed in December 2007 (COM(2007) 844 final). The Directive applies to industrial activities and will be a recast of seven existing directives, among which are the Integrated Pollution Prevention Control (IPPC) Directive, the Large Combustion Plants (LCP) Directive and the Waste Incineration Directive. In June 2009, the Council reached political agreement with a view to the subsequent adoption of a common position with the Parliament.

The key element of the draft Directive, and its preceding Directives, is the enforcement of Best Available Technologies (BAT) that prevent and control emissions into air, water and land, and prevent the generation of waste. This enforcement occurs through a permit procedure by the national, regional or local competent authority. The permit prescribes how industrial installations have to comply with emission limit values according to BAT. If national or local environmental quality standards require beyond-BAT measures, this can be included in the permit.

The Directive, as well as its predecessor IPPC Directive, excludes $CO_2$ from the permit of industrial activities listed under the Emission Trading Directive[16]. The draft Directive also provides the ability to impose requirements relating to energy efficiency, although in the case of industrial activities listed under the Emission Trading Directive they are not obligated[17].

## The CCS Directive

In 2009, the European Parliament and the Council of the EU adopted a Directive to enable $CO_2$ Capture and Storage (CCS) in the EU (2009/31/EC). The purpose of the Directive is to establish a legal framework for CCS, based on a permitting system and specific rules for a liability regime, in order to contribute to climate change mitigation.

16. Note that different views exist on whether the Directive still allows Member States to go beyond the EU environmental provisions and introduce $CO_2$ emission limit values for installations or sectors. Discussion of these views was beyond the scope of our study.
17. Article 10(2) of the draft Directive, which is already included as Article 9(3) in the IPPC Directive (Directive 2008/1/EC).

The Directive does not set targets for CCS nor does it require the use of CCS. However under its article 33 modifying the 2001 LCP Directive (2001/80/EC) Member States are required to ensure that operators of combustion plants with a rated electrical output of 300 Megawatts or more for which a licence is granted after 25th June 2009 have to assess whether they are CCS ready (suitable storage sites are available, transport facilities are technically and economically viable and it is technically and economically feasible to retrofit for $CO_2$ capture).

The Commission is developing a network of 10-12 demonstration projects aiming to demonstrate the commercial viability of CCS plants in the period up to 2015 (SEC(2009) 1295).

### 3.4.2 The Effort Sharing Decision

The 'Effort Sharing Decision' (Decision No 406/2009/EC) sets Member State specific GHG reduction targets for the non-ETS sectors in Member States between 2013 and 2020. The Decision covers the GHGs from the built environment, transport, small industries, agriculture and waste sectors. The consumption of electricity in these sectors is not covered by the Effort Sharing Decision as the $CO_2$ emissions associated with the production of electricity take place in the power sector and are regulated under the ETS Directive. The Decision requires EU wide GHG emissions in the non-ETS sectors to fall by 10% by 2020 compared to 2005. This target is shared by Member States, based on GDP growth, and ranges from -20% for Denmark, Ireland and Luxemburg to +20% for Bulgaria. Member States can offset a share of the required reductions by financing emission reduction projects in third countries (CDM credits).

Article 3 of the Decision requires Member States to define an annual GHG emission limit decreasing in a linear manner to ensure that emissions do not exceed the national limits in 2020. In 2013, if Member States are not on track towards their 2020 target, they need —as a corrective measure— to submit an Action Plan to the Commission.

Article 4.2 of the Decision states: 'If appropriate, in particular in order to assist Member States in their contributions towards meeting the Community's greenhouse gas emission reduction commitments, the Commission shall, by 31 December 2012, propose strengthened or new measures to accelerate energy efficiency improvements'.

### Impact of Effort Sharing Decision

Figure 3 - 10 illustrates four scenarios for the non-ETS sectors under the Effort Sharing Decision:

1. The first scenario shows the expected baseline GHG emissions under 'pre-recession' economic conditions (PRIMES-2007).

2. The second scenario indicatively illustrates the effect of the economic recession (and additional policies) on GHG emissions (indication derived from PRIMES-2009).

3. The third scenario indicates the maximum allowed volume of CDM offsets that can be used. Here, the Effort Sharing Decision allows an annual use of credits up to a quantity representing 3% of the greenhouse gas emissions of each Member State not covered under Directive 2003/87/EC in the year 2005, until a future international agreement on climate change has been reached.

4. Finally, the fourth scenario shows the linear path to the -10% target.

We estimate that under the new 'post-recession' baseline conditions (scenario 2), a policy gap of some 200 Mt remains in 2020 (see also textbox). Energy savings in the order of 75 Mtoe[18] could generate such a GHG reduction, which is well below the energy savings that can be realised in the cost effective HPI scenario (see chapter 4). However, Member States can apply a variety of other measures, like non–$CO_2$ GHG mitigation or CDM offsets (scenario 3), to comply with their Effort Sharing targets.

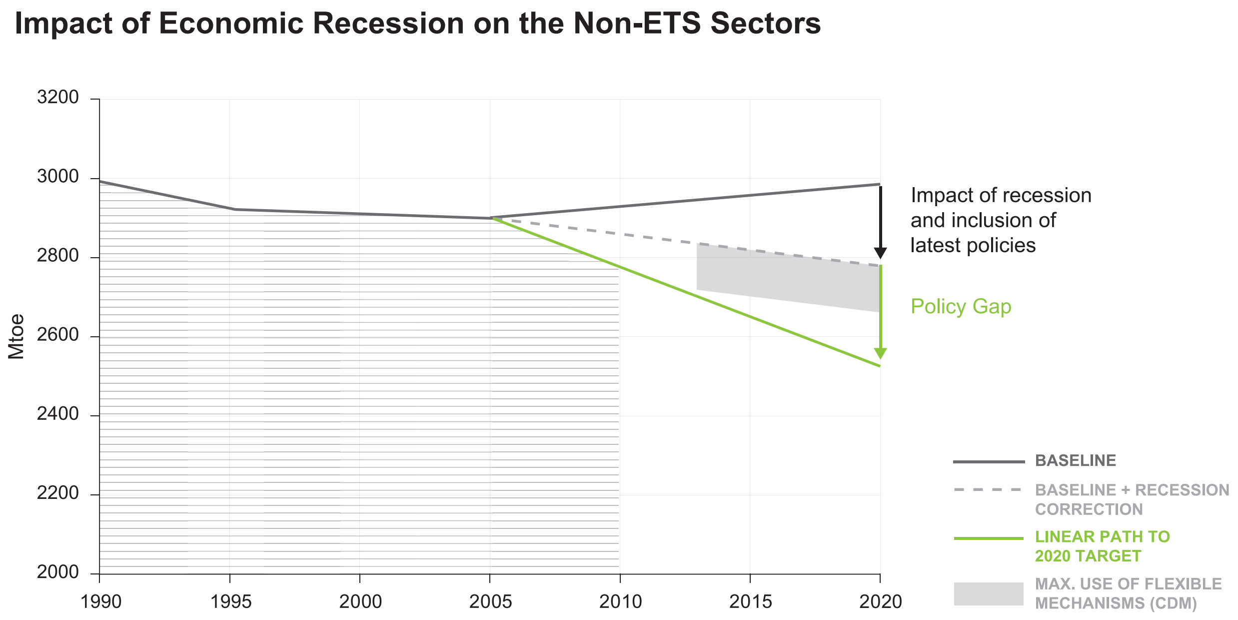


Figure 3 - 10 GHG monitoring, projections and targets for non-ETS sectors at the EU-27 level.

**Achieving effort sharing targets requires additional policies for two-thirds of EU Member States**

To what extent do the effort sharing targets incentivise additional GHG policies in the non-ETS sectors in individual EU Member States? Below, we present 2 scenarios to assess this question:

- The left-hand side of Figure 3 - 11 expresses the difference (in %) between the expected 'pre-recession' GHG baseline emissions in 2020 (derived from PRIMES-2007) and the effort sharing targets. A positive value indicates that the target is more stringent than the expected baseline emission in 2020[19]. To realise these targets, Member States can choose a suite of measures, including energy savings, measures to abate non-$CO_2$ GHG emissions as well as CDM offsets. A negative value in Figure 3 - 11 indicates that the effort sharing target is unlikely to provide an incentive for emissions reductions.
- The right-hand graph in Figure 3 - 11 performs the same analysis, but now the baseline estimated for 2020 has been corrected, in a generic way, for the emissions reduction impact of the economic recession (derived from PRIMES-2009).

Figure 3 - 11 illustrates that in the recession situation there are nine Member States for whom the Effort Sharing targets are not expected to provide an incentive for additional policies. For the other Member States, target achievement is expected to require additional policies.

continue on next page

18. Based on an economy-wide $CO_2$ emissions factor per unit of fossil primary energy of 2.7 (source: PRIMES 2009).
19. The figures have been calculated as follows: (1-(1 + MS Effort Sharing target) x 2005 base year GHG emissions non-ETS) / (2020 baseline GHG emissions non-ETS). E.g. EU 27: (1-(1-10%) x 2871 Mt) / (2940 Mt) = +12%.

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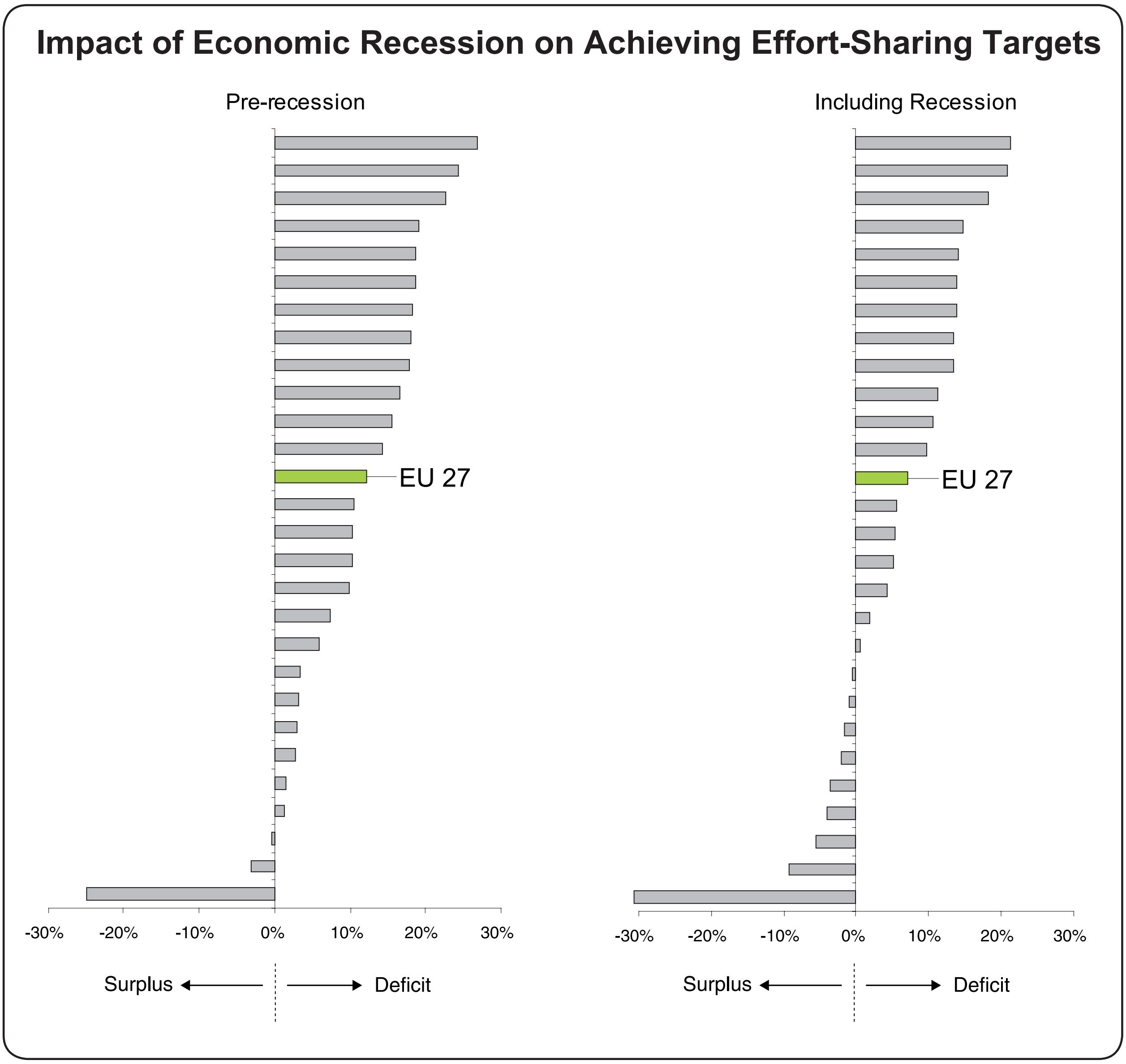



Figure 3 - 11 Difference (%) between non-ETS GHG baseline emissions in 2020 and Effort Sharing targets pre-recession and post-recession. Individual Member States are shown anonymously, the green bar indicates the EU 27.

### 3.4.3 Regulation setting $CO_2$ standards for passenger cars

The Regulation setting $CO_2$ standards for passenger cars (Regulation No 443/2009) is the main piece of EU legislation on $CO_2$ and energy performance in transport. The Regulation prescribes 130 g-$CO_2$/km for the new passenger car fleet entering the market, by means of improvement of vehicle motor technology, to be reached by 2015. In addition to improved motor technology, complementary measures such as low-carbon fuels, co-driving and improved tyres, should contribute to achieving the Community objective of 120 g-$CO_2$/km. With respect to tyres, Regulation No 1222/2009 regulates the labelling of tyres based on their rolling resistance (the lower the resistance, the 'greener' the label), whereas Regulation No 661/2009 sets maximum rolling resistance for tyres.

A review of the Regulation (to be completed by 2013) will define 'the modalities for reaching, by the year 2020, a long-term target of 95 g-$CO_2$/km in a cost-effective manner; and the aspects of the implementation of that target…'. This indicates that the contribution of improved motor technology versus complementary measures in achieving the 95 g-$CO_2$/km target is still undecided.

### Policy impact

The $CO_2$ performance of passenger cars shows a continued downward trend (Figure 3 - 12)[20]. Despite these improvements, the voluntary 'ACEA' (European Automobile Manufacturers' Association) target of 140 g-$CO_2$/km in 2008 was not met. Also, strong volume increases have outweighed the improved car performance, resulting in a 30% increase of $CO_2$ emissions from road transport over the past 2 decades (EEA, 2009). Whereas the recent regulatory target of 130 g-$CO_2$/km target (2015) is fairly close to the long term industry trend, the implementation of a 95 g-$CO_2$/km standard can be regarded as more ambitious (see Figure 3 - 12).

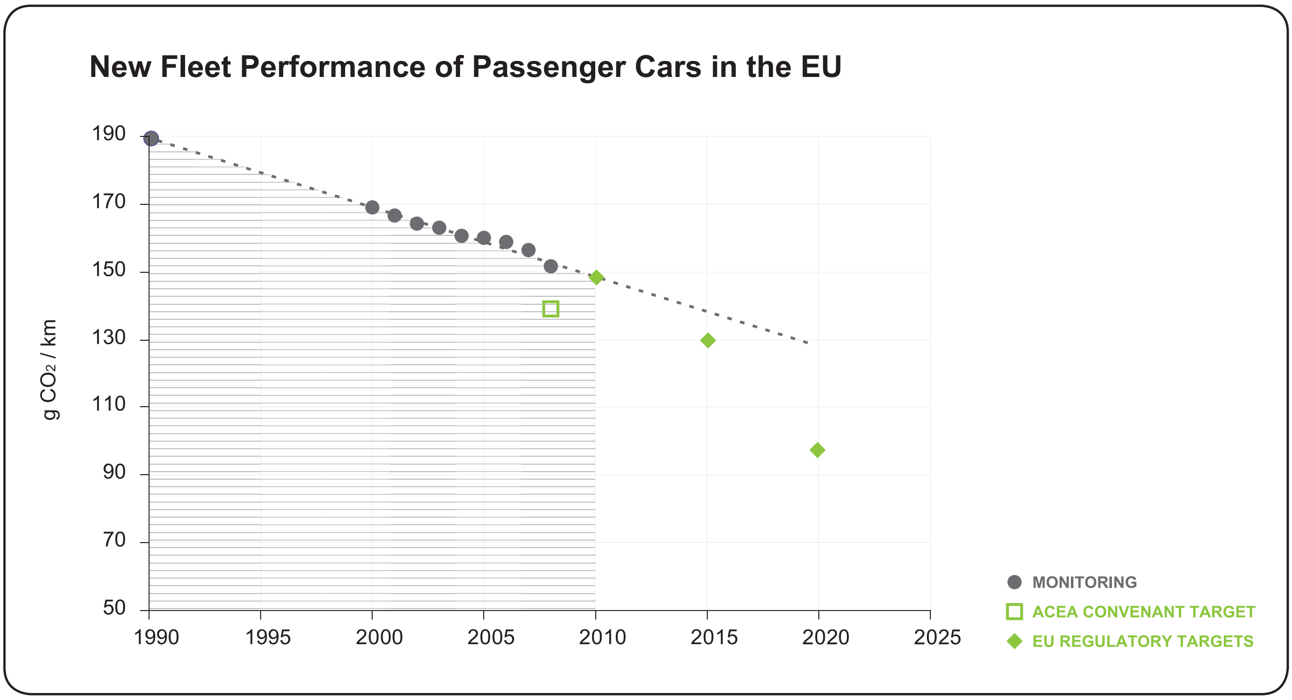



Figure 3 - 12 New fleet performance, monitoring and standards from Directive. Blue dotted line shows trend line (sources: COM (2009) 713 final and T&E, 2009).

20. Note that emissions refer to standardized test conditions. In practice emissions can be 8-9% higher (see Annema et al., 2007).

## 3.5 RENEWABLE ENERGY DIRECTIVE

Directive 2009/28/EC on the promotion of the use of energy from renewable sources (hereafter the Renewable Energy or RES Directive) establishes a common framework for the promotion of energy from renewable sources. It sets binding national targets for the overall share of energy from renewable sources in final energy consumption and for the share of energy from renewable sources in transport:

- At the EU 27 level, a 20% RES share in total final energy consumption should be achieved by 2020. The targets for individual Member States have been burden shared based on a country's share of renewable energy in final energy consumption in 2005 and a GDP/capita index.

- The sub-target for transport is 10% renewable energy in final energy demand for transport. This target is the same for all Member States.

In addition to the renewable energy target, the Directive lays down rules for offsetting:

- statistical transfers between Member States

- joint projects between Member States and with third countries

- joint support schemes

Each Member State had to submit a national renewable energy action plan by end of June 2010. One of the elements which needs to be addressed in the Action Plan is the *efficient* use of biomass which is stipulated in Article 13.6. It is explicitly stated in the Directive that energy efficiency and energy saving policies are some of the most effective methods by which Member States can increase the percentage share of energy from renewable sources[21].

## 3.6 IMPACT OF EU POLICIES

The policy package described in this chapter affects around 90% of the energy use in the EU (see textbox). In this section we assess the overall effects of this package on energy use and GHG emissions by 2020. Note that the assessments should be regarded as indicative as many of the policies are still relatively new.

**10% of EU energy use not directly covered by policies**

The policies summarized in this chapter cover a large share of economic activities in the EU. Nonetheless, there is a share of energy using activities that is not or only indirectly covered by EU energy savings (legal) policies. This mainly refers to the activities of:

- Freight transport (road, rail and shipping)

- Losses during transport and transmission of electricity & heat (indirectly addressed by Internal Market in Electricity (Directive 2003/54/EC), CHP and RES Directives).

We estimate that these activities (with the majority coming from freight transport) cover up to 10% of the overall primary energy use in the EU-27[22].

21. See Recital 17 of the RES Directive.
22. Overall primary energy use in 2005 is 1811 Mtoe (EU27). The share of freight transport is about 9%, whereas the share of energy loss during transport and distribution of electricity is about 1%.

## Energy use in 2020

Figure 3 - 13 shows the total EU 27 primary energy demand growth under 'pre-recession' economic conditions, including baseline energy efficiency improvements and the effect of policies that came into force before 2007. This PRIMES-2007 baseline scenario serves as a reference for the EU's 20% energy savings target. The lower line in Figure 3 - 13 indicates the EU 20% energy savings target.

The key question is what degree of policy intensification is needed to reach that target. This is discussed in the next section in two steps:

1. The impact of the economic recession and new policies adopted since the 2006 EEAP are identified.

2. This policy contribution is compared to the additional policy impact required to reach the 2020 (20%) target.

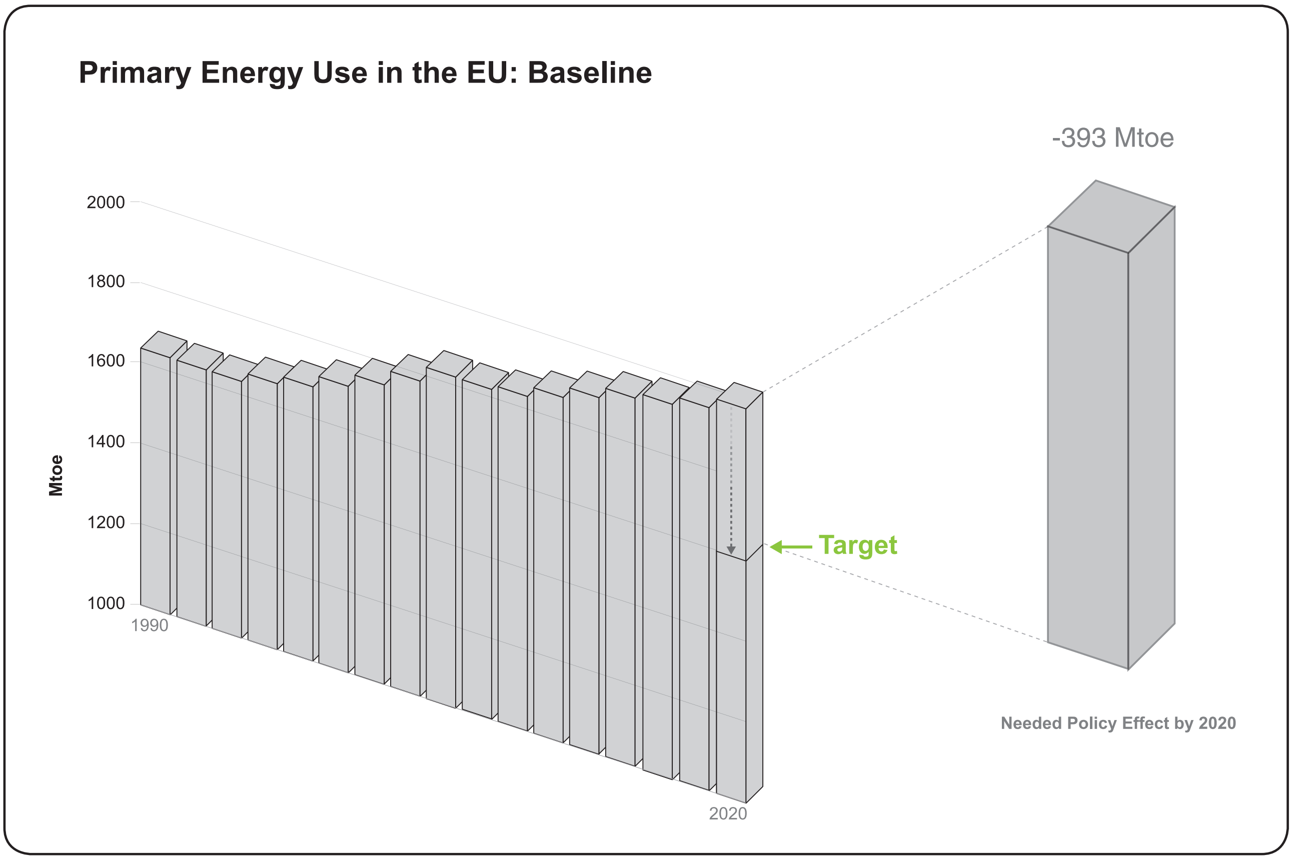



Figure 3 - 13 Primary energy use in the EU 27 in the PRIMES 2007 baseline and the 20% energy savings target.

**Baseline energy savings versus policy impacts**

In general, assessment of the impact of policies is far from straightforward. Whereas in some areas, e.g. renewable energy, the current and near future implementation can be fully attributed to policies, this is different for energy savings where 'autonomous', not policy driven, effects play an important role. The results presented below should therefore be regarded as indicative. Nonetheless, we feel that the bottom-line policy message (see next section) is robust as it is based on several independent information sources.

In separating the impacts of policies, we start from a (theoretical) 'Frozen Technology' reference energy use level in 2020, which we estimate at around 2300 Mtoe. Next, we estimate the impacts of baseline effects (not policy related) and policy effects, separated into the impacts of energy savings policies and the impacts of renewable energy policies on energy savings[23] :

From FTRL to the 'pre-recession' baseline PRIMES-2007 baseline:

1. *Baseline and policy effects*. Compared to a FTRL energy use level of around 2300 Mtoe in 2020, we estimate that 1.1% per year of energy is saved. This energy savings rate, which is included in the PRIMES-2007 baseline, reduces energy use in 2020 to 1986 Mtoe when compared to FTRL. Out of this 1.1% we assume 0.8% to occur autonomously, or independent of policy, and 0.3%/yr can be attributed to policy impact (see also Figure 3 - 5). This compares to a savings volume due to policies of around 88 Mtoe. Of this volume, 24 Mtoe is from increased implementation of renewables between 2005 and 2020 (derived from PRIMES-2007). The remaining 64 Mtoe is attributed to energy savings

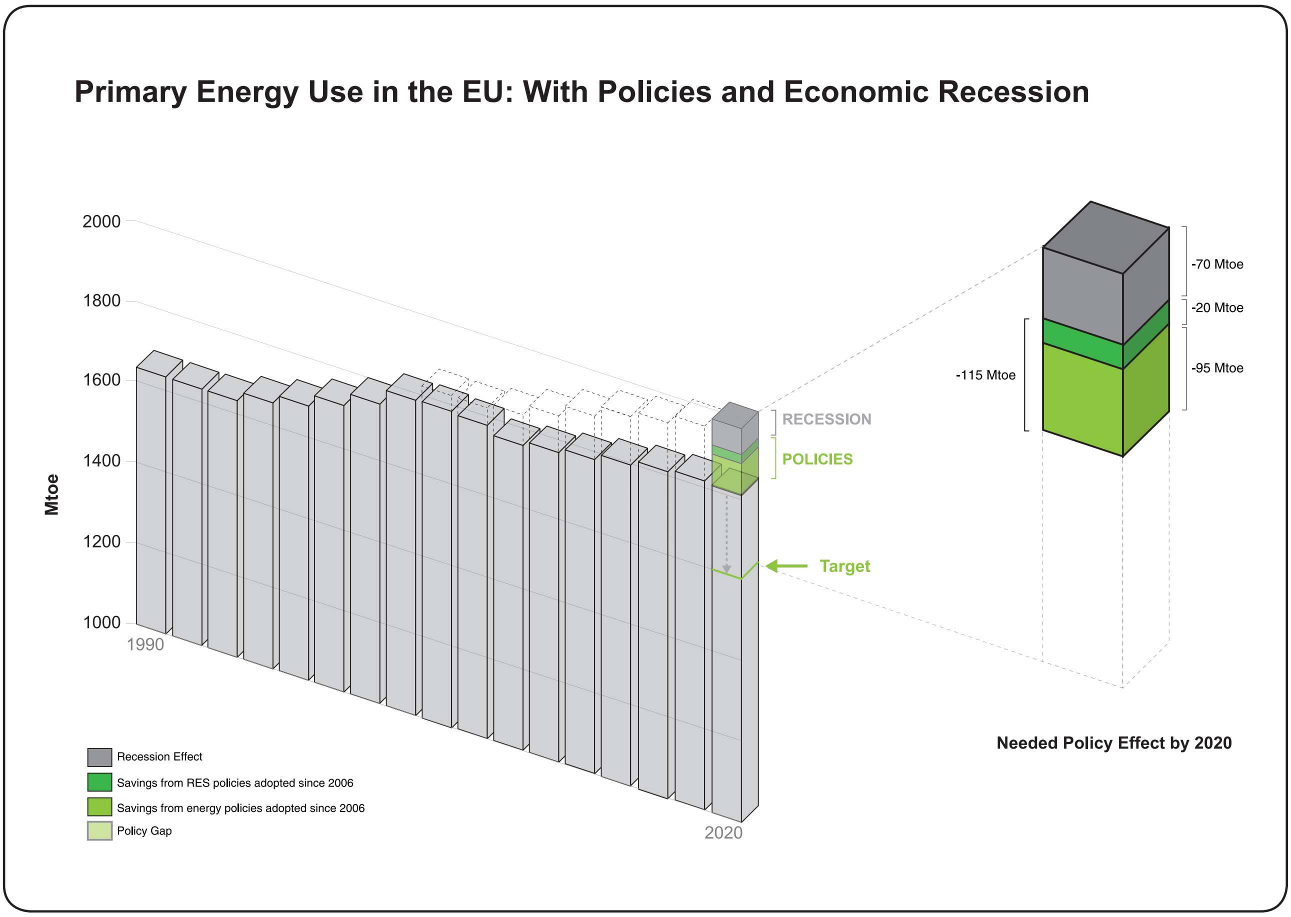



Figure 3 - 14 The impact of the economic recession and energy policies (since the adoption of the 2006 EEAP) on primary energy use in the EU 27.

23. As indicated in chapter 4.6.2, hydro, wind and solar power are assumed to have a conversion efficiency of 100% (Primary Energy Method, Eurostat) which implies that replacing fossil based electricity by hydro, wind or solar power 'saves' primary energy. Although this effect is somewhat counterbalanced by biomass based electricity production, a net 'savings' effect remains.

policies. These values are not further used in this analysis, but serve as a background for the impacts of new polices that we will determine hereafter.

Reduced energy use beyond PRIMES-2007 baseline (see Figure 3 - 14):

2. *Recession*. The impact of economic recession was estimated at 70 Mtoe by Ecofys, building on the PRIMES-2009 results. For the transport and industry sectors this was done by adjusting the 2020 energy use to the reduced activity data (either value added or passenger- and ton-kilometres).

3. *Recent renewables policies*. Here we used the new PRIMES-2009 baseline projection. PRIMES-2009 projects additional renewable energy in 2020 providing some 20 Mtoe of primary energy savings[24].

4. *Energy savings policies adopted since the 2006 EEAP.* From the PRIMES-2009 results, Ecofys has estimated, after correcting for the recession, a policy impact of about 50 Mtoe[25]. This value is in line with the savings from new measures as reported by Members States under the Energy Services Directive (see Figure 3 - 19). The 50 Mtoe includes:

- More efficient passenger cars (the $CO_2$ Regulation), realising around 20-25 Mtoe of primary energy savings. This compares to a 9% overall energy savings in the EU passenger car fleet by 2020. Our own analysis supports this savings volume[26].

- Implementation of other energy savings policies such as Eco-design (5 Implementation Measures), EPBD, Labelling and CHP (25-30 Mtoe).

5. *Latest energy savings policies*. This includes the four new implementation measures that were recently decided under the Eco-design Directive. We attributed 45 Mtoe of energy savings to these measures under the Eco-design Directive.

Steps 2 to 5 reduce the overall energy use in 2020 by 185 Mtoe. The remaining policy gap is around 208 Mtoe[27].

*Ambitious implementation of (new) policies.* In order to bridge the remaining policy gap of 208 Mtoe, ambitious implementation of the recast EPBD and the next set of Eco-design implementation measures will be required. In addition new policies may be required.

| | 2020 PRIMARY ENERGY USE | REDUCTION COMPARED TO PREVIOUS LEVEL | AUTONOMOUS EFFECTS (INCLUDING RECESSION) | ENERGY EFFICIENCY POLICIES | ENERGY SAVINGS AS A SIDE-EFFECT OF RENEWABLES POLICIES |
|---|---|---|---|---|---|
| **FROZEN TECHNOLOGY** | 2300 | - | - | - | |
| **PRIMES-2007** | 1968 | -333 | -245 (1) | -64 | -24 |
| **UPDATED ENERGY OUTLOOK** | 1783 (2) | -185 | -70 | -95 | -20 |
| **-20% ENERGY SAVNGS TARGET** | 1574 | -208 | - | -208 | |

(1) This figure does not contain a recession effect
(2) This value is 45 Mtoe below the new primes 2009 baseline

Table 3 - 2 IndiTable 3 - 2 Indicative quantification of energy savings in 2020 (all figures in Mtoe primary energy). quantification of energy savings in 2020 (all figures in Mtoe primary energy).

24. PRIMES-2009 projects 167 TWh additional wind, hydro and solar power and 7 TWh less biomass. This results in a net savings effect of 257 TWh or 22 Mtoe.
25. PRIMES-2009 includes the effects of measures of the 2006 Energy Efficiency Action Plan that have already been implemented. Neither the achievement of national RES targets, nor the recast of the EPBD have been included in the assumptions. However, implemented national measures on e.g. RES and building codes have been reflected.
26. Under the following assumption we arrive at a 9% energy savings impact in 2020: i) $CO_2$ standards are 1:1 translated into improved energy efficiency, ii) the policy effect equals the difference between the dotted ‘ BAU’ trend in Figure 3 - 12 and a policy target that starts at the BAU level in 2010 and ends at a value of 95 g-$CO_2$/km in 2020. Assuming a lifetime of an average passenger car of 12 years, each year between 2010 and 2020 1/12th of the fleet is refreshed with new cars that have improved their efficiency beyond the baseline and in accordance with the policy target. As a result the overall fleet slowly improves its efficiency to a 9% improvement in 2020.
27. This 208 Mtoe resembles 560 Mt $CO_2$ savings assuming an economy-wide $CO_2$ emissions factor per unit of fossil primary energy of 2.7 (source: PRIMES-2009).

Note, that in PRIMES-2009 national policies to promote renewables are included but the renewable energy target as such is not achieved. Only 15% average share in the EU is assumed to be achieved by 2020 (PRIMES-2009 baseline). Realising the 208 Mtoe through end-use energy savings will as a co-benefit increase the share of renewables by 4% from 15% to 19%. This subsequent analysis is summarised in Table 3 - 2.

**Meeting the energy savings target requires a tripling of policy impact**

In summary, this analysis shows that achieving the 20% energy savings target requires around 394 Mtoe of energy savings in 2020, compared to 'pre-recession' baseline expectations of the 2006 Energy Efficiency Action Plan (EEAP). The economic recession is expected to reduce energy use in the EU 27 by 70 Mtoe leaving a required policy effort of around 323 Mtoe. Current policies are expected to cover around 115 Mtoe of this gap (50 + 45 Mtoe energy savings, 20 Mtoe renewables policies). As a result, we expect that in 2020 a gap of around 208 Mtoe will remain to the EU target. See also Figure 3 - 14.

Therefore, even though several energy savings policies have been adopted since the 2006 EU Energy Efficiency Action Plan, an additional tripling of the expected impact from these policy efforts will be required to meet the 20% energy savings target, see Figure 3 - 15.

In the next chapter we will assess in depth what the actual energy savings potential and the associated costs in the EU are and how this compares to the EU's energy savings target of 20% by 2020.

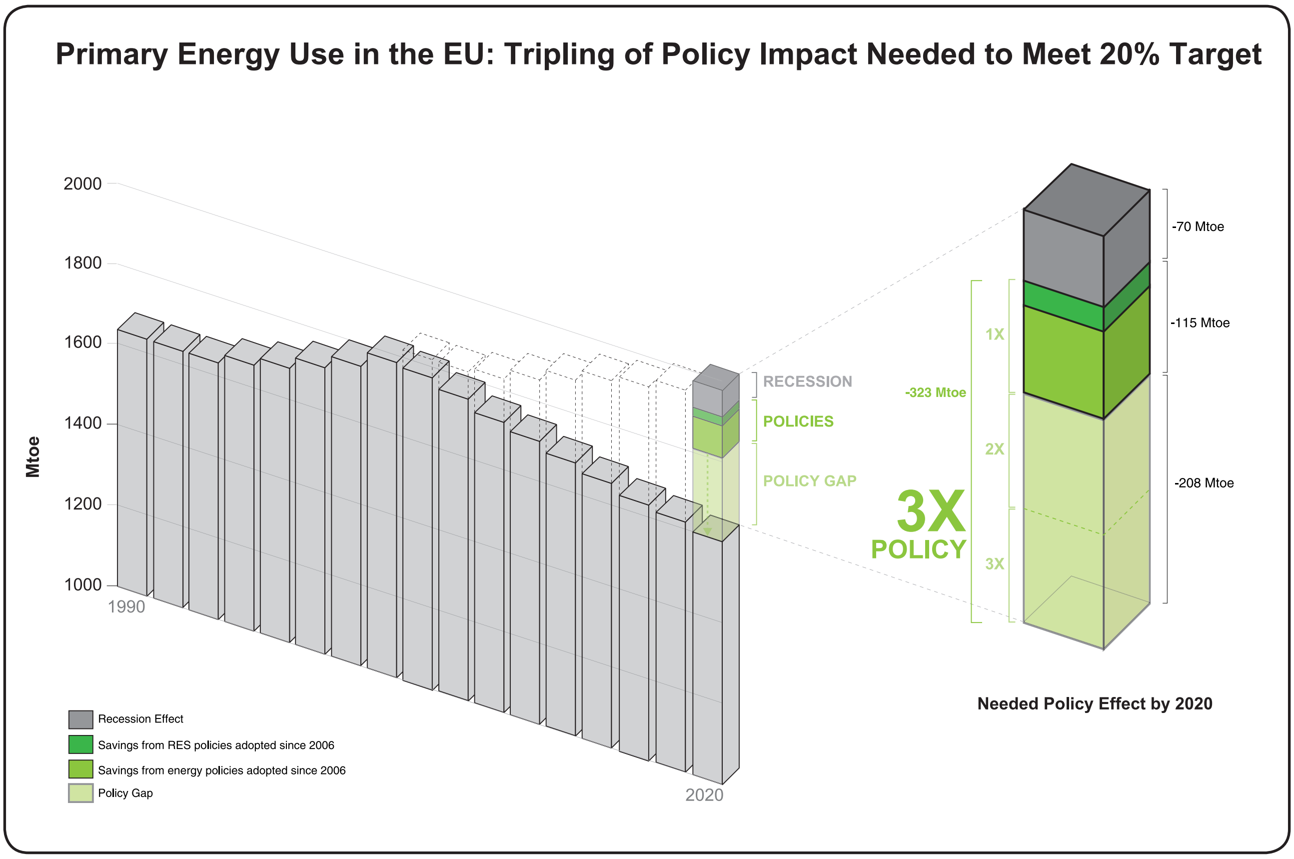



Figure 3 - 15 Even taking into account the economic recession and energy policies (since the adoption of the 2006 EEAP), meeting the 20% energy savings target by 2020 will require a threefold increase in policy impact.

**20% energy savings alone can realise the EU's greenhouse gas target for 2020**

20% of energy savings in 2020 compares to 14% energy savings compared to 2005 energy use levels. When these savings are realised over the average mix of fossil energy carriers, the savings would also induce a 14% reduction in GHG emissions. Coincidently, this equals the EU's GHG target for 2020 (the 20% compared to 1990 target for GHGs equals 14% reduction compared to 2005). On the one hand this illustrates the great potential of energy savings to contribute to achieving deep GHG emissions reductions (see also next chapter). On the other hand, one could also argue that the 2020 GHG target can be met via several other options, like reducing non-$CO_2$ GHG emissions, renewable energy, fuel shifts, carbon capture & storage and CDM offsets, and requires less energy savings. In chapter 2, though, we clearly illustrate the essential importance of deep energy savings starting today, in order to achieve the EU's decarbonisation target in the longer term.

CHAPTER 4

# SUFFICIENT UNTAPPED POTENTIAL EXISTS TO REACH THE 20% TARGET

In this chapter we assess the energy savings potential in the EU by 2020 (and 2030). The data that we present were largely taken from the recent study of Fraunhofer et al. (2009): 'Study on the Energy Savings Potentials in EU Member States, Candidate Countries and EEA Countries' (hereafter called 'Fraunhofer study'). This study took a detailed bottom-up approach to assess energy savings potentials for end-use sectors (residential sector, services sector, transport and industry), differentiated across EU Member States.

In addition to the Fraunhofer study, we also estimate the energy savings potentials for the supply sector (refineries[28] and power and heat production). Together with the results for the end-use sectors, this combines into an assessment of the overall economy-wide energy savings potential in the EU.

The following sections provide a summary of the main energy savings scenario assumptions and outcomes. The key finding of this chapter is that the European Union can achieve 20% energy savings by 2020, and that most of this potential is available from cost-effective options in end-use sectors (and including refineries).

## 4.1 ENERGY SAVINGS SCENARIOS

In order to ensure compatibility with projections from the European Commission, the Fraunhofer study is based upon the economic drivers as defined by the study 'European Energy and Transport Trends to 2030: Update 2007' based on the PRIMES model (EC, 2008; Capros et al., 2008). This is the PRIMES-2007 baseline scenario. Drivers refer to e.g. the growth of the buildings stock, transport volumes, energy prices and the development of industry's value-added production. The PRIMES-2007 baseline scenario assumes an average economic growth of 2.2% per year until 2020 and includes policies and measures implemented in the Member States up to the end of 2006 (see also textbox).

28. Though refineries are strictly speaking part of the energy supply, the sector is regarded as an 'industrial' sector. Therefore, we included the energy savings in this sector in the economy wide cost-curve shown in Figure 4 - 17.

**Change of the baseline**

The PRIMES-2007 baseline does not include the impacts of the recent economic recession. A new PRIMES-2009 baseline that includes the impacts of recession and latest EU policies has been finalized recently, but not yet published. The European Commission has given us permission to make limited use of the latest PRIMES results in this study. The forthcoming PRIMES-2009 baseline includes a new set of economic drivers. Strictly speaking, the energy savings potentials used in this study should be re-assessed against this new baseline. In the frame of this study, this was however not possible. The sensitivities of the energy savings potentials to a change in the baseline are briefly discussed in section 4.7.

The Fraunhofer study considers four scenarios for energy savings:

1. *The baseline scenario (based on PRIMES-2007)*. This scenario extrapolates past autonomous energy efficiency improvement rates, including the impact of early energy savings policies (adopted through 2006).

2. *The low policy intensity scenario (LPI)*. This scenario assumes an increase in policy effort to overcome energy efficiency barriers and takes on board measures that are cost-effective from an 'end-user' perspective (see Table 4 - 3). Note, that the name low policy intensity scenario actually implies an increase in policy effort compared to current policies.

3. The *high policy intensity scenario (HPI)*. This scenario assumes a major policy effort to overcome energy efficiency barriers and takes on board measures that are cost-effective from an 'end-user' perspective.

4. *The technical scenario (TECH)*. This scenario implements savings options to a level that is assumed to be technically achievable. It also takes into account measures that are not cost-effective. However, it does not include extremely costly measures and assumes – with very few exceptions in the building sector – that there is no change in the investment cycles. We therefore regard this as 'moderate' technical scenario.

**THE HPI SCENARIO IS TAKEN AS THE CENTRAL SCENARIO IN THIS STUDY.**

## 4.2 THE COSTS AND REVENUES OF ENERGY SAVINGS

The economic revenues of energy savings are a crucial justification for stringent energy savings policies. These revenues result from the net balance of investment and maintenance costs of new technologies and the revenues from energy saved. This net balance is often called the cost-effectiveness of measures, which is negative when a measure generates net revenues and has a positive value when a measure comes at a net cost. The methodology and key parameters to calculate the cost-effectiveness of energy savings is shortly described hereafter.

### Technology costs

For each of the technology options identified, investment and maintenance costs were estimated. In general, these costs are described as differential costs compared to a standard technology or standard development, unless there is an acceleration of the investment cycle. Note that the differential costs evolve dynamically and that, with time, technology learning and economies of scale, the (differential) costs of new technologies decrease.

The specific reduction costs of a measure (€/unit energy saved) were calculated from the sum of annualised investment costs and annual operation and maintenance (O & M) costs minus the annual financial savings from a measure (lower energy bill), divided by mean annual energy savings of the measure:

$$\text{specific costs} = \frac{\text{(annualised capital costs) + (annual O\&M) - (annual energy cost savings)}}{\text{annual energy savings}}$$

| DISCOUNT RATES USED IN THE FRAUNHOFER-STUDY | LPI | HPI |
|---|---|---|
| INDUSTRY | 30% | 8% |
| SERVICES AND AGRICULTURE | 8% | 6% |
| HOUSEHOLDS | 8% | 4% |
| PRIVATE PASSENGER TRANSPORT | 8% | 4% |
| TRUCKS AND INLAND NAVIGATION | 8% | 6% |
| PUBLIC TRANSPORT ENERGY INVESTMENT | 8% | 4% |

Table 4 - 3 Discount rates used in the Fraunhofer study.

Table 4 - 3 shows how the capital costs were annualised over the technical lifetime of the measure. In the LPI scenario an 'end-user' perspective with high discount rates was used. In the HPI scenario a discount rate of 6-8% was used for 'end-users' dominated by economic considerations while 4% was used for the other 'end-users'. This value is similar to government bond rates. All costs are expressed in 2005 € values.

## Energy prices

Energy prices determine the revenues from energy savings. The Fraunhofer study used the energy price development from the PRIMES-2007 baseline scenario (EC 2008e). Some key values (EU average) are shown in Table 4 - 4. All prices are expressed in 2005 € values. The cost calculations are sensitive to the energy price assumptions. When comparing the results presented here with other studies, it is imperative to look closely at the energy price scenarios used. In our view, the energy price scenario used in the Fraunhofer study can be considered as fairly conservative, meaning that in a high-cost scenario, the cost-effective potential would be larger.

Energy savings are calculated against energy prices before taxation for 'end-users' that can recover taxes such as the industrial sector while prices after taxation where used for other actors.

| WORLD MARKET PRICES | | 2005 | 2020 | 2030 |
|---|---|---|---|---|
| OIL | $ / boe (1) | 54.5 | 61.1 | 62.8 |
| NATURAL GAS | € / GJ | 5.6 | 7.5 | 7.8 |
| HARD COAL | € / GJ | 2.4 | 2.4 | 2.4 |
| ELECTRICITY PRODUCTION COSTS | € / MWh | 59.5 | 63.1 | 65.1 |
| **FINAL USER PRICES (SELECTION, EU AVERAGE)** | | **2005** | **2020** | **2030** |
| PREMIUM UNLEADED GASOLINE, 95 Ron (ALL TAXES INCLUDED) | € / Liter | 1.13 | 1.23 | 1.28 |
| AUTOMOTIVE DIESEL OIL (EXCLUDING TAXES) | € / Liter | 0.43 | 0.49 | 0.53 |
| HEATING OIL (RESIDENTIAL USER) | € / GJ | 17.7 | 21.0 | 22.5 |
| NATURAL GAS (SMALL AND MEDIUM INDUSTRIAL USES, WITHOUT TAXES) | € / GJ | 6.9 | 11.3 | 12.3 |
| HARD COAL (INCL. CARBON PRICE) | € / GJ | 2.6 | 3.2 | 3.5 |
| ELECTRICITY, PRE-TAX RETAIL PRICE | € / MWh | 83.4 | 86.7 | 89.8 |
| ELECTRICITY, RETAIL PRICE | € / MWh | 98 | 101.8 | 105 |

(1) boe = barrel oil equivalent (roughly 7.2 boe = 1 toe, source PRIMES 2007; in the study a conversion rate of 1.18 from US dollars to Euros has been applied)

Table 4 - 4 Energy data (EC 2008e and Fraunhofer et al., 2009).

## The marginal cost-curve of energy savings in end-use sectors

The energy savings options can be sorted by increasing costs per unit of energy saved. This results in a so-called marginal energy savings cost-curve (MACC). The left-hand side of Figure 4 - 17 shows saving options which have negative specific costs. This occurs when, over the lifetime of energy efficient technologies, revenues from energy savings more than compensate for the (additional) investment and O&M costs. Saving options such as behavioural measures have (almost) zero investment costs and are therefore considered as very cost-effective.

The figure illustrates that, under the Fraunhofer scenario assumptions, more than 70% of the technical savings potential is cost-effective. The cost-effective share of this potential resembles the HPI scenario. Even when the remaining measures with positive costs are included (the TECH scenario), it is clear that the overall set of measures is still profitable for EU ‘end-users’.

Note that cost-effectiveness in this study is defined under ‘ideal’ investment conditions. This is further explained in the textbox.

**How to read the Marginal Abatement Cost-Curve**

Figure 4 - 16 illustrates two representations of the Marginal Abatement Cost-curve (MACC).

1. Option 1 illustrates the default MACC approach chosen in this study. The left-hand graph shows the HPI energy savings potential (green line) estimated against the business as usual baseline (grey). The middle graph, option-1, expresses the associated MACC. Here, specific costs (€/Mtoe) are based on a life-cycle approach and low discount rates (4-8%).

2. Option 2 illustrates how the use of high discount rates and/or short pay-back times will shift the MACC to the right.

## Sensitivity of Marginal Abatement Cost Curve to Discount Rates

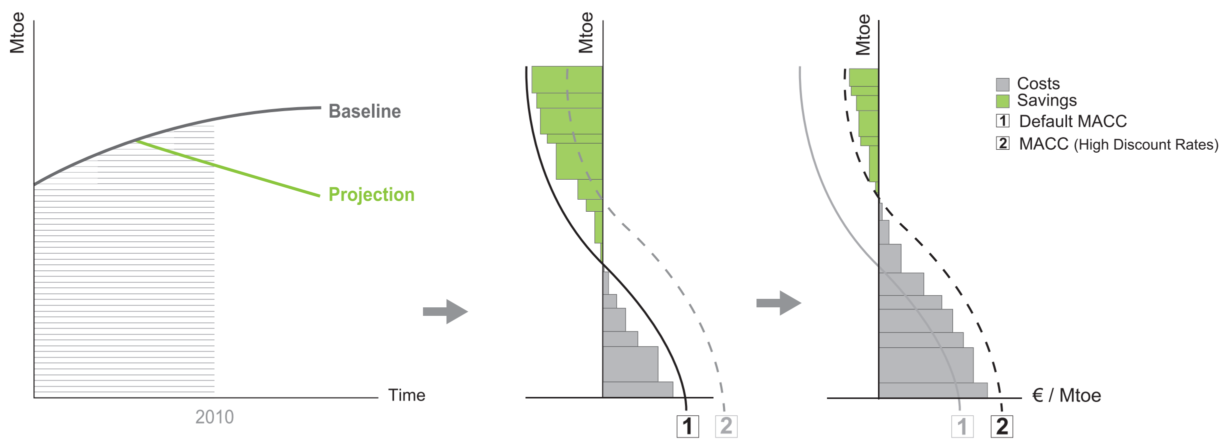



Figure 4 - 16 Visualisation of MACC sensitivity to increased discount rate.

Option 2 may reflect the cost-perspectives of today's 'real life' investors in energy efficient technologies. This perspective can be very different from the 'ideal' MACC presented in this report. Our MACC approach serves as a justification for additional policies that remove today's implementation barriers. A binding energy savings targets is an example of such policies and could than serve as a benchmark for a suite of other policy measures.

## EU 2020 Marginal Abatement Cost Curve for End-Use Sectors

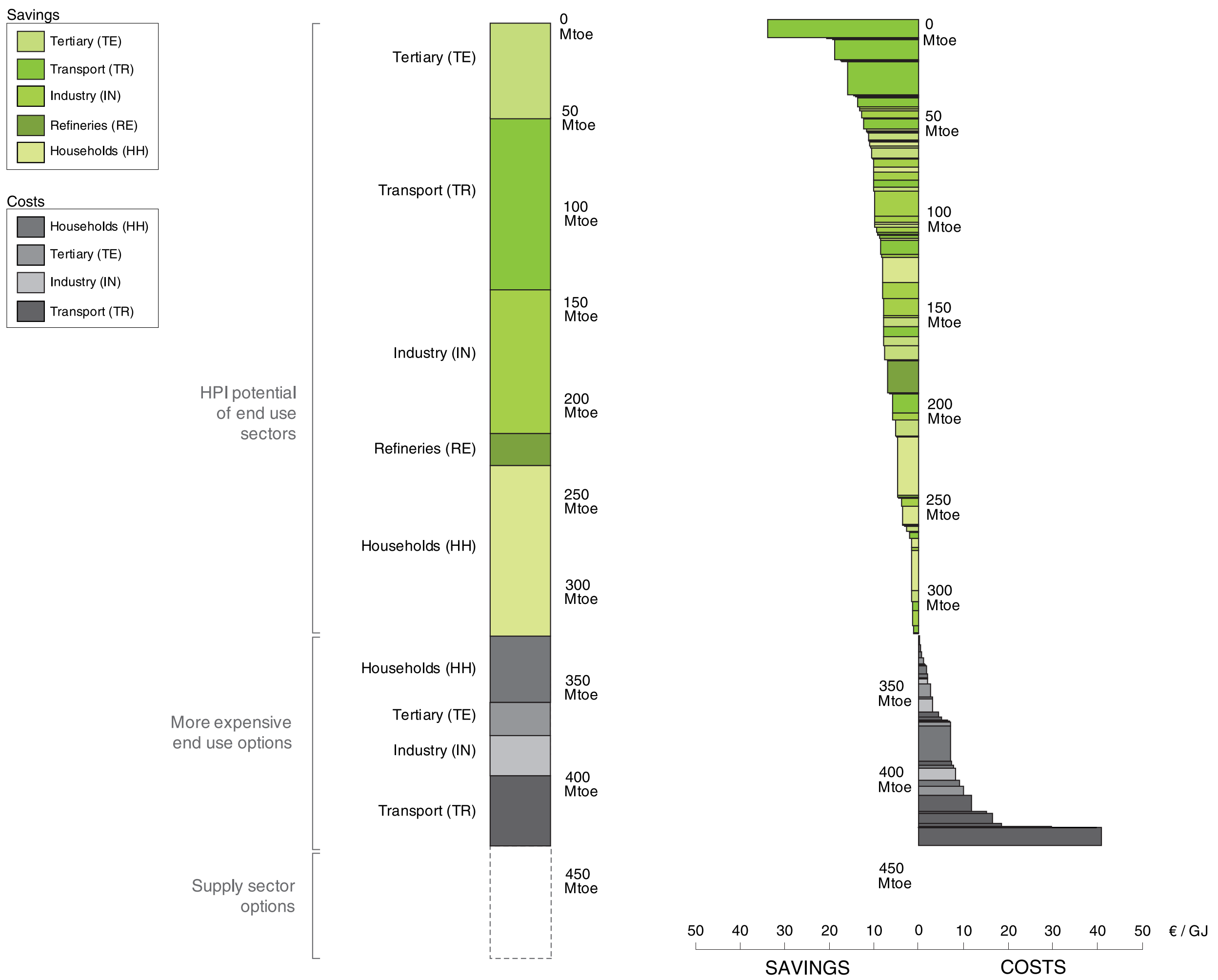



Figure 4 - 17 Overall MACC for energy efficiency options of end-use sectors in the EU 27 in 2020. Energy savings are expressed in primary energy units[29]. Energy savings (Y-axis) are relative to the baseline (source: Fraunhofer et al., 2009).

The MACC in Figure 4 - 17 consists of about 150 individual measures. The different contributions to the overall potential are grouped in the following aggregated categories (see Annex 3 for more details about the potentials):

- *Residential buildings* (split by new and existing buildings, considering heating systems and sanitary hot water, including water preparation with solar technology).
- *Residential sector appliances* (includes refrigerators, freezers, washing machines, dishwashers, dryers, lighting, TVs, set top boxes, desk tops, lap tops, modem routers, IT screens).
- *Tertiary sector buildings* (similar split as for the residential building; further split by small and larger tertiary buildings).
- *Tertiary sector appliances* (includes street lighting, office lighting, computers and monitors, copying and printing, servers, commercial refrigeration and freezing, fans, air conditioning (central), other motor appliances).
- *The transport sector curve* considers the three large categories technical improvements, modal shift and behavioural/organisational savings for passenger transport by cars, goods transport by road as well as other transport means (rail,

29. The sectoral cost curves in this chapter as well as the underlying data in Annex 3 are expressed in final energy terms. A factor 2.5 was used to express electricity savings in primary energy units.

aviation, public road transport and motorcycles). Behavioural/organisational potentials include issues like eco-driving but also load management for goods transport.

- For the *industry sector,* the main distinction is between savings on industrial processes, electric cross-cutting technologies (mainly electric motor applications and lighting) and industrial space heating.

In the next sections the key assumptions and results of the energy savings scenarios for each sector will be described.

## 4.3 BUILT ENVIRONMENT

Built environment includes fuel and electricity use in the residential sector and the services sector, also called the tertiary sector. The energy use comes from fuel and electricity use in buildings, households and offices, from heating, cooling and the use of household and offices appliances. Energy savings measures can be categorised in measures that:

- Reduce the heating and cooling demand of new and existing buildings.
- Improve energy conversion in buildings.
- Reduce the electricity demand in buildings (electric appliances, lighting, sanitary hot water and electric space heating)

### 4.3.1 EU POTENTIALS

All scenarios of the Fraunhofer study assume a growth of floor space of households by 29% towards 2030 and a growth of non-residential (office) floor space by 40%. Member state specific data that were input to the scenarios included:

1. The age distribution of the building stock in three segments (<1975, 1975-2000, > 2000 and new).
2. Volume of four categories of buildings: single and multi family houses, <1000 $m^2$ residential buildings and > 1000 $m^2$ residential buildings.
3. Climate conditions, as measured by 'heating degrees days'.
4. Member state specific material and labour cost indices.
5. Member state specific energy prices (in particular taxation levels).

**Decreased heat demand of buildings**

The reduction of heat demand of buildings was modelled through increased implementation of four sets of energetic buildings standards, so-called U values:

1. Corresponding to current building code standards from 2003 until 2006 (REF1 and NEW1)[30].
2. More advanced standards which are assumed to be promoted by current European Performance of Buildings Directive (EPBD) and from other national standards like the German Energy Saving Directive (EnEV) (REF2 and NEW2).
3. Low energy houses (REF3 and NEW3).
4. An improved standard and comparable to the currently best available standard, which is also called Passive House standard (NEW4).

30. 'REF' corresponds to refurbishment, 'NEW' to new buildings.

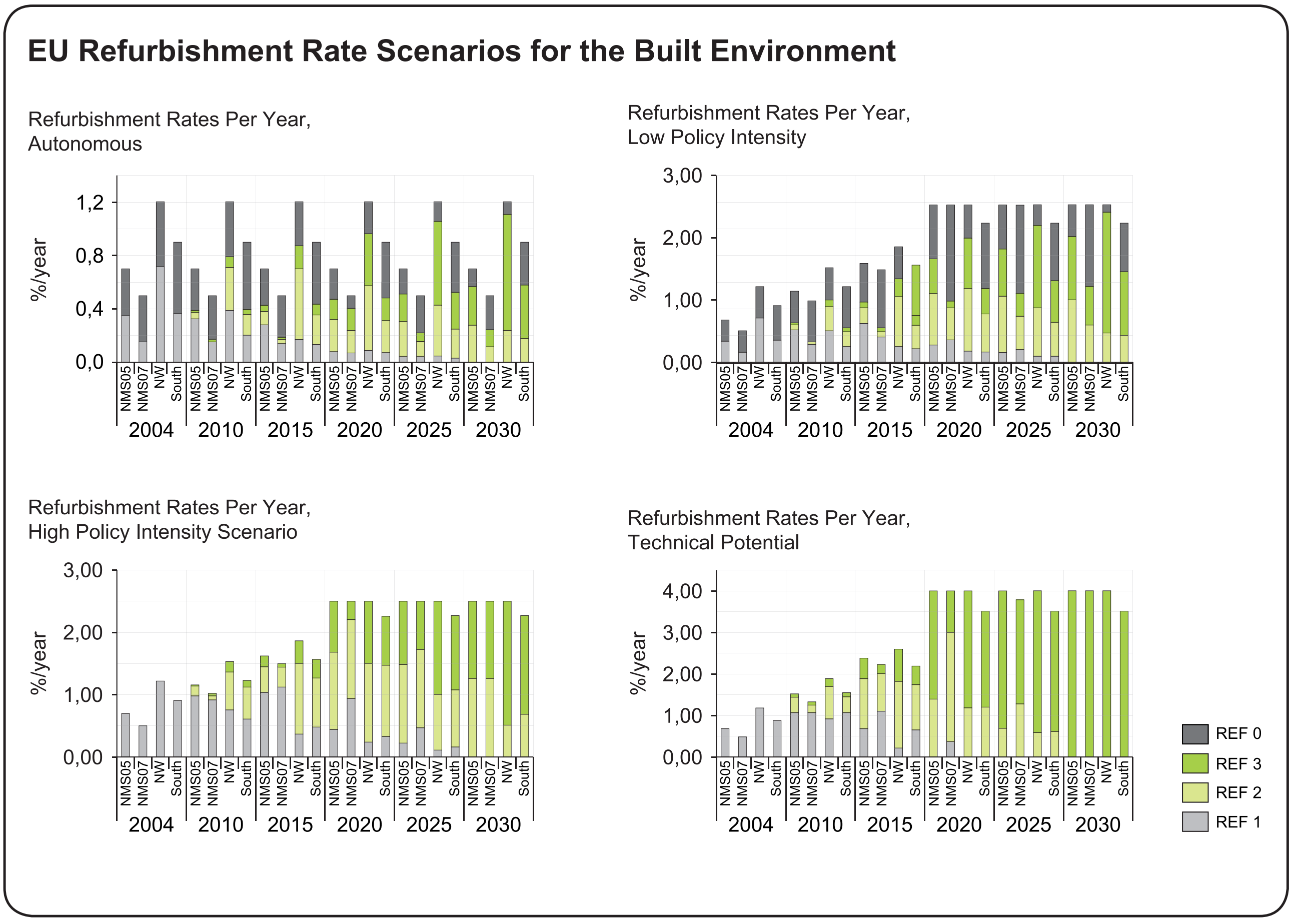



Figure 4 - 18 Illustration of refurbishment rates and implementation of U-values in four scenarios for residential buildings (source Fraunhofer et al., 2009).

The four scenarios for the residential sector are characterised by increasing rates of refurbishment and increased implementation rates of low-energy U-values (see Figure 4 - 18). The same approach was taken for non-residential buildings, only with 50% higher refurbishment rates.

**Improving energy conversion in buildings**

The following heating technologies were considered: gas standard and condensing boilers, heat pumps, biomass boilers (from classic wood to advanced pellet boilers), solar heating systems, traditional oil and coal boilers, electric radiators/stoves and district heating systems.

In all four scenarios the energy efficiency improvements of individual technologies were assumed to occur autonomously, as all technologies are mature and represent mature markets. Subsequently, the energy savings scenarios were driven by substitution of the less efficient technologies by more efficient ones: here, the most prominent growth of market share occurs for solar heating and heat pumps.

**Reducing electricity demand in buildings**

*Residential*

The following electric appliances were accounted for: refrigerators, freezers, washing machines, dishwashers, driers, TV sets and IT appliances. In the baseline scenario, A-label appliances dominate the market, whereas in the subsequent LPI, HPI and Technical Scenario A+, A++ and beyond-A++ appliances dominate the market towards 2030. A similar approach was taken for computers, TVs and monitors. For lighting, incandescent and halogen lamps are substituted by high-efficiency compact fluorescent lamps (CFL), which in turn are substituted by LED technology. In the most ambitious Technical Scenario, 60% of the lamps are CFL and 40% of LED technology in 2030.

*Non-residential*
Appliances that were included in the Fraunhofer study were: street lighting, office lighting, ventilation, air conditioning, commercial refrigeration and freezing, office equipment (computers, monitors, copying and printing) and servers. The potentials were derived from various case studies and standards under the Eco-design Directive. The approach is based on the penetration of Best Available Technology (BAT) which is economically beneficial over the lifetime of the appliances. Given the scarcity of information on some appliances, very little additional technical potential could be calculated.

**Results built environment**
Overall results of the energy savings scenarios for the built environment are shown in Figure 4 - 19. Data refer to the overall final fuel and electricity use of buildings in the residential and services (tertiary) sector.

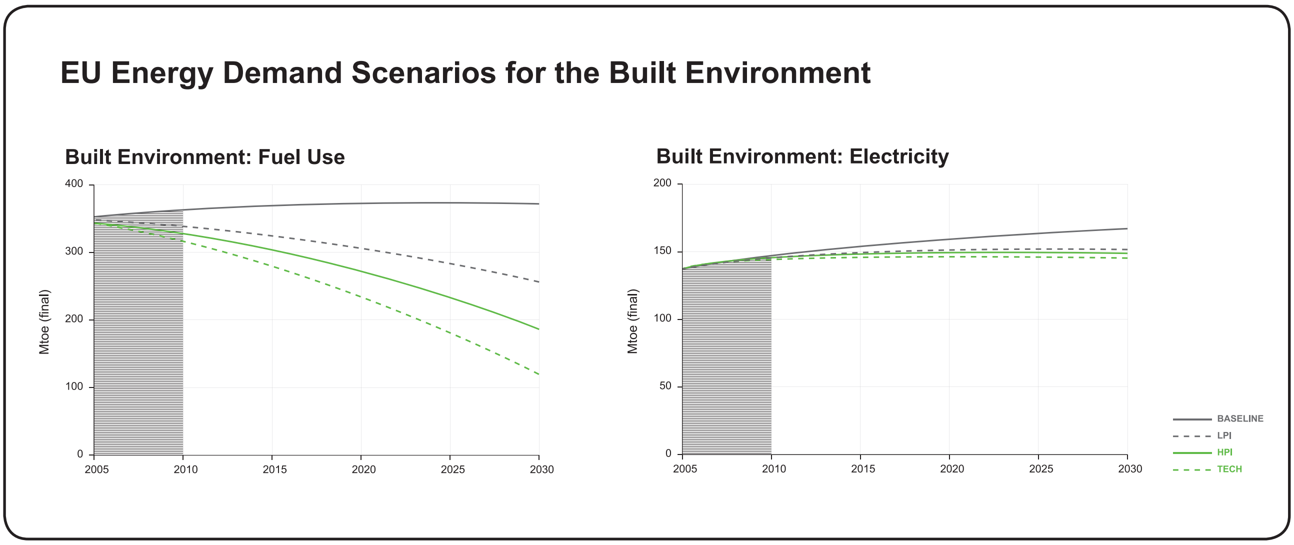



Figure 4 - 19 Final energy demand in the built environment (residential and services sector) in the EU 27 in four scenarios.

Figure 4 - 20 shows the MACC for energy savings in the residential sector and the services sector respectively.

**EU 2020 Marginal Abatement Cost Curve for the Built Environment**

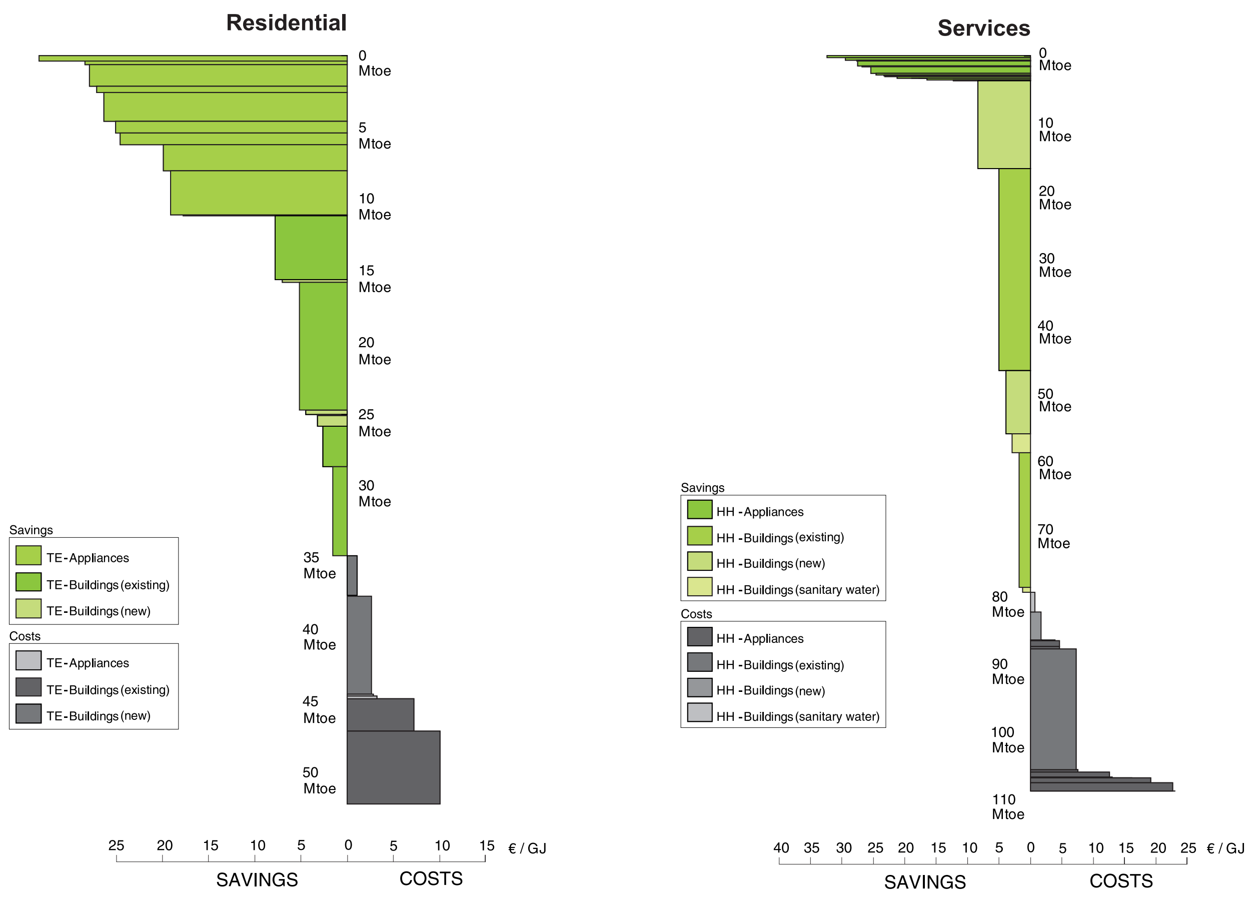



Figure 4 - 20 Overall MACC for energy efficiency options in the EU 27 in 2020 in the built environment, residential sector (HH: right-hand graph) and services sector (TE: left-hand graph). Energy savings are expressed in final energy units. Energy savings (Y-axis) are relative to the baseline (source: Fraunhofer et al., 2009).

## 4.4 TRANSPORT

This sector includes fuel use from road transport, rail transport, inland transport by ships and (national) air transport. Energy savings measures can be categorised in technical measures to improve the fuel efficiency of e.g. cars, behavioural measures such as eco-driving and modal shift measures.

### 4.4.1 EU POTENTIALS

**Technical measures**

The improved energy efficiency performance of passenger cars and light duty vehicles (vans) was derived from scenarios for $CO_2$-performance standards for new cars, as shown in Table 4 - 5[31]. A summary of the energy savings potentials for other transport modes is shown in Table 4 - 6 (HPI scenario).

31. Note, that since the establishment of the Fraunhofer baseline and HPI scenario, new policies have been established (see section 3.4.3), that will at least cover part of the HPI potential. The technical potential identified by Fraunhofer indicates that deeper energy savings are possible.

| SCENARIO | $CO_2$ PERFORMANCE NEW PASSENGER CARS | $CO_2$ PERFORMANCE NEW LIGHT DUTY VEHICLES | ENERGY EFFICIENCY HEAVY DUTY TRAILERS |
|---|---|---|---|
| BASELINE | 165g $CO_2$ /km, decreasing with 1%/year until 2020 and then 0.5% /year after 2020 | 201g $CO_2$ /km in 2005, 195g $CO_2$ /km in 2015, 183g $CO_2$ /km in 2030 | 4% in 2030 (1) |
| ECONOMIC POTENTIAL - LPI | 125g $CO_2$ /km in 2015 (constant after 2015) | 160g $CO_2$ /km in 2012 (constant until 2030) | 9% in 2030 |
| ECONOMIC POTENTIAL - HPI | 95g $CO_2$ /km in 2020 125g $CO_2$ /km in 2012, 95g $CO_2$ /km in 2020; (constant after 2020) | 160g $CO_2$ /km in 2012, 145g $CO_2$ /km in 2020 (constant until 2030) | 14% |
| TECHNICAL POTENTIAL | 125g $CO_2$ /km in 2012, 95g $CO_2$ /km in 2020; 80g $CO_2$ /km in 2025; (constant after 2025) | 160g $CO_2$ /km in 2012, 130g $CO_2$ /km in 2020, (decreasing to 120g $CO_2$ /km in 2030) | 24-41% in 2030 (2) |

(1) Equals 1990-2006 trend
(2) 41% includes behavioural measures like reducing driving speed

Table 4 - 5 $CO_2$ and energy efficiency assumptions for passenger cars and vans.

| HPI POTENTIALS FOR OTHER TRANSPORT MODES (SAVINGS % RELATIVE TO THE BASELINE) | 2010 | 2020 | 2030 |
|---|---|---|---|
| *PUBLIC* ROAD TRANSPORT | 4.9 | 13.2 | 21.8 |
| MOTORCYCLES | 3.8 | 10.0 | 16.3 |
| RAIL | 3.4 | 9.0 | 14.6 |
| AVIATION | 2.6 | 7.0 | 11.4 |
| INLAND NAVIGATION | 0.0 | 0.0 | 0.0 |

Table 4 - 6 HPI potentials for other transport modes (savings % relative to the baseline).

**Behavioural measures**

Behavioural measures include energy-efficient (so-called 'eco') driving and improved load efficiency in freight transport. Eco-driving can increase energy efficiency in 2030 by 5% in the LPI scenario and by 10% in the HPI scenario. Load efficiencies of trucks have almost been constant over the past 15 years and were assumed to improve moderately towards 2030, by 1% in LPI and 3% in HPI.

**Modal shift**

Table 4 - 7 shows modal shares for freight transport in the baseline scenario and the HPI scenario.

| BASELINE | 2010 | 2020 | 2030 |
|---|---|---|---|
| ROAD FREIGHT | 74.8 | 78.7 | 81.7 |
| RAIL FREIGHT | 18.7 | 15.2 | 12.6 |
| SHORT SEA SHIP | 6.6 | 6.1 | 5.7 |
| TOTAL | 100% | 100% | 100% |
| HPI SCENARIO | | | |
| ROAD FREIGHT | 74.8 | 75.7 | 75.1 |
| RAIL FREIGHT | 18.7 | 18.1 | 18.6 |
| SHORT SEA SHIP | 6.6 | 6.3 | 6.3 |
| TOTAL | 100% | 100% | 100% |

Table 4 - 7 Modal shares (% based on ton-km) in freight transport (EU 27).

**Results transport**

The overall results for the transport sector are shown in Figure 4 - 21. In addition, Figure 4 - 22 shows the marginal energy savings cost-curve for the transport sector.

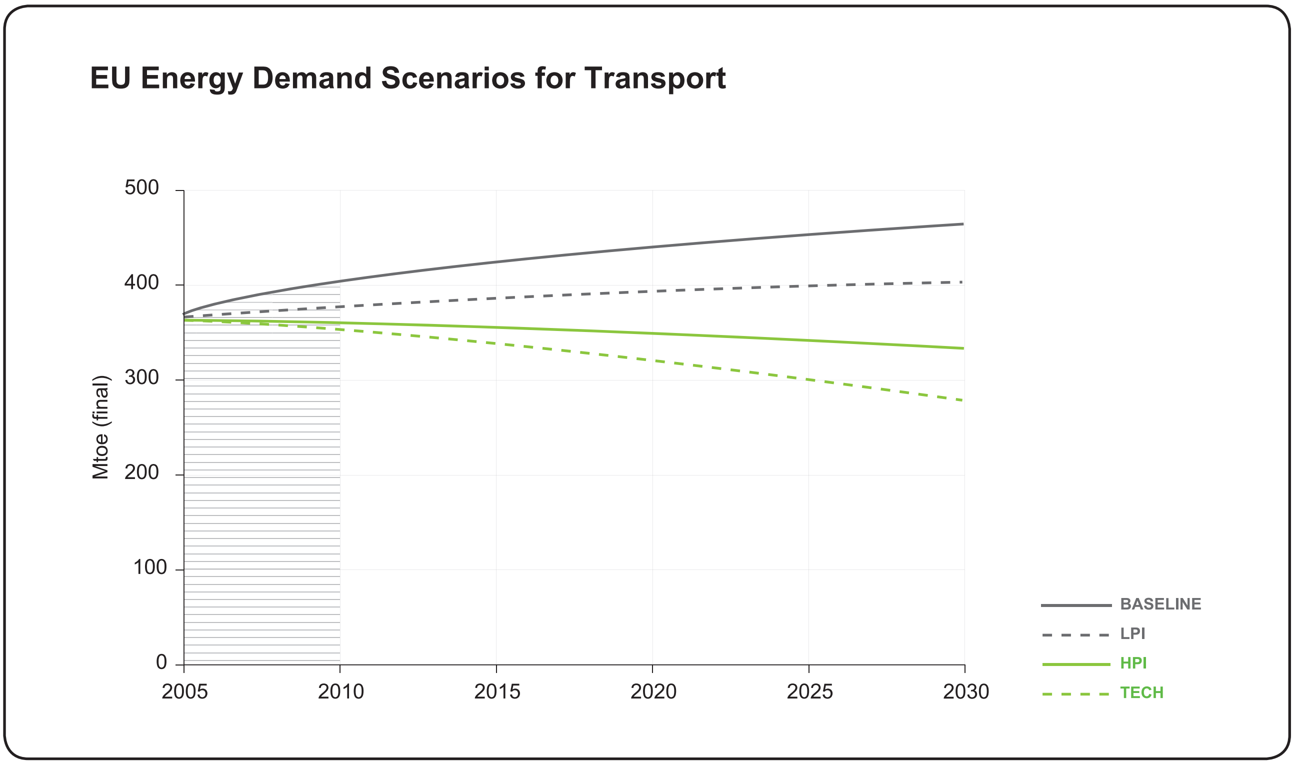



Figure 4 - 21 Final energy demand in the transport sector in the EU 27 in four scenarios.

## EU 2020 Marginal Abatement Cost Curve for Transport

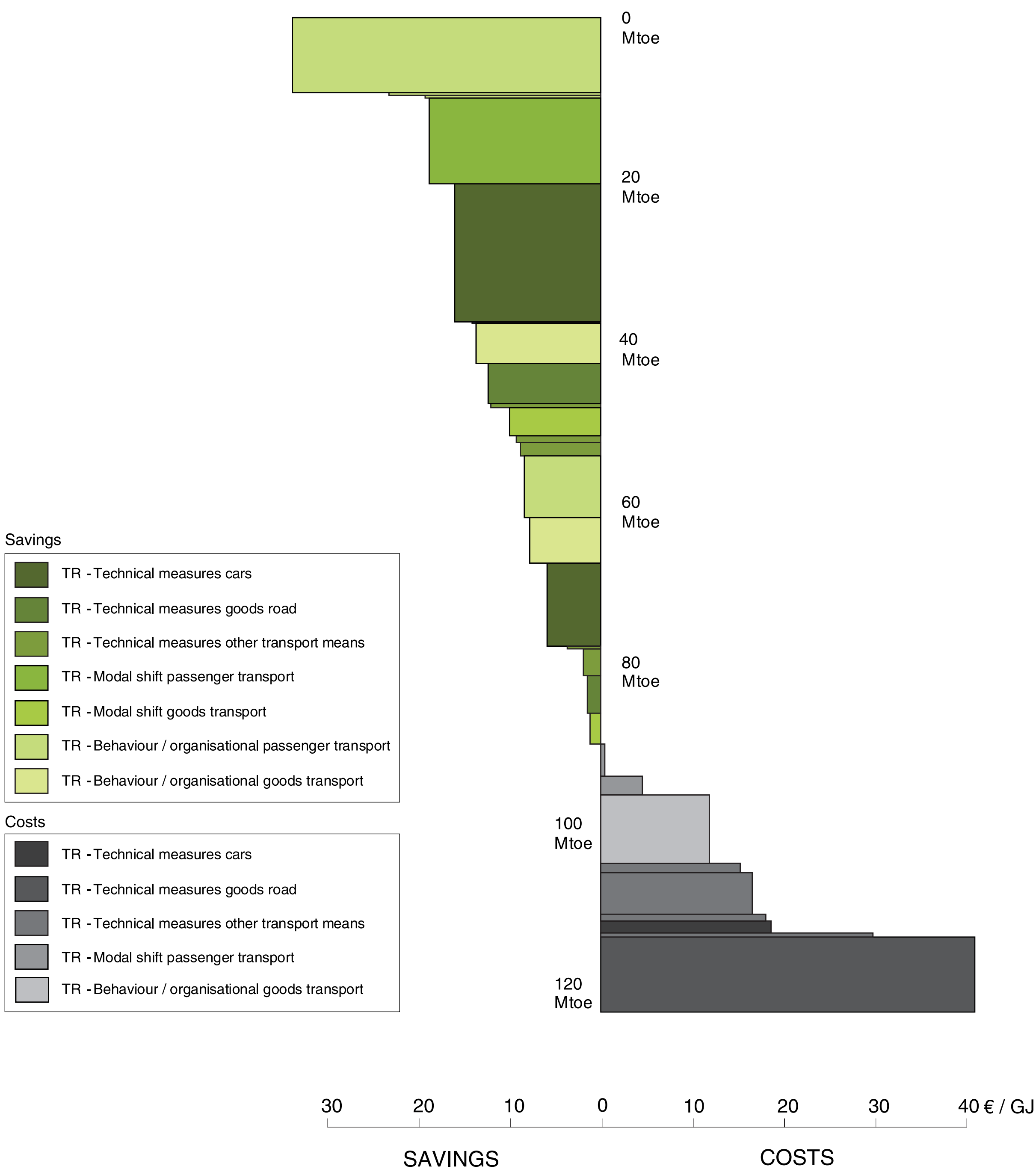



Figure 4 - 22 Overall MACC for energy efficiency options in the EU 27 in 2020 in the transport sector. Energy savings are expressed in final energy units. Energy savings (Y-axis) are relative to the baseline (source: Fraunhofer et al., 2009).

## 4.5 INDUSTRY TRANSPORT

This sector includes the fuel and electricity use in the industry sector. Three categories of energy savings measures were assessed:

1. The electricity savings potential of so-called cross-cutting technologies. These are technologies applied across all industry sectors such as electric motors and motor applications (compressed-air pumps).
2. The heat savings potential of cross-cutting technologies (steam boilers, space heating generators and CHP).
3. The savings potential of sector and process specific technologies.

Note, that certain energy savings options in the industry were considered *structural* changes. These are assumed to occur autonomously in the baseline and excluded from the energy savings scenarios. This refers to options such as shifting to secondary iron and aluminium production, increased used of substitutes for clinker in cement production and a continued shift to the 'membrane' process to produce chlorine.

### 4.5.1 EU POTENTIALS

**Saving electricity in cross-cutting technologies**
Around 70% of industrial electricity use is from cross-cutting technologies, mainly various motor applications and lighting systems. Motor systems are used in electric pumps for e.g. pulp and water pumping, fans for cooling and drying, compressed air and cooling systems. On average these technologies can become 25% to 40% more energy efficient; however, investment cycles can be long[32]. Savings potentials were calculated from equipment renewal —at the end of a piece of equipment's lifetime— at different ambition levels of efficiency standards. This is illustrated for two scenarios in Figure 4 - 23.

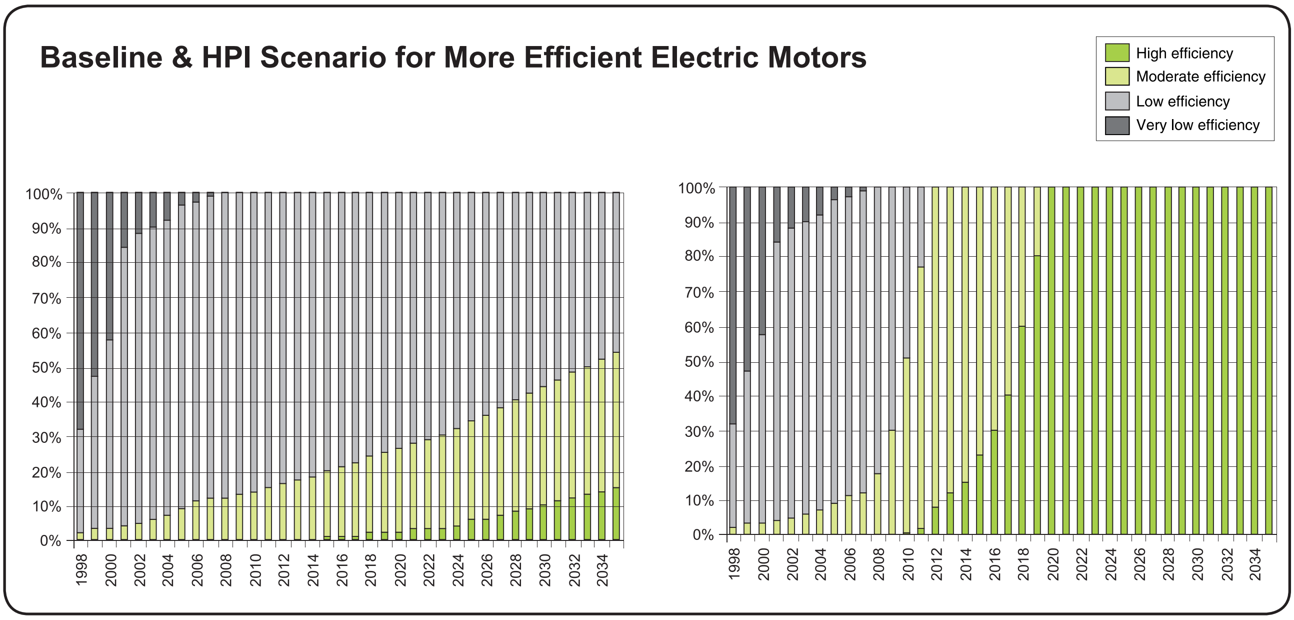



Figure 4 - 23 Diffusion of motor efficiency classes. Data were used as input in the autonomous (left-hand) and HPI (right-hand) scenario. Dark-grey and green bars correspond respectively to the least and most efficient labelling class (IE3) proposed by the International Electro Technical Committee.

32. Derived from Figure 9-8, p.218 in Fraunhofer et al. (2009).

**Saving heat with cross-cutting technologies**
About one third of the heat used in industry is supplied by cross-cutting technologies for heat generation such as steam boilers and combined heat and power generation (CHP). Two general groups of savings options were defined: improved diffusion of CHP replacing separate generation of heat and electricity, and improved efficiencies for boilers and CHP.

The baseline scenario already includes a substantial increase of CHP up to 2020. As a result only the technical scenario assumes additional CHP relative to the baseline, see Figure 4 - 24.

**Process specific energy savings**
Sector specific processes, such as the making of iron and steel, paper, cement and chemical products consume some two thirds of industrial fuel use and 30% of industrial electricity. For these processes the Fraunhofer study identified some 80 savings options, ranging from specific measures like improved heat recovery and improved insulation of furnaces to more general measures like the replacement of standard technologies by BAT or even a substitution of a production process by an improved process.

To a large extent, energy savings in the energy intensive material production industry are assumed to occur autonomously. This is illustrated in Table 4 - 8. As a result, the energy savings potential beyond the baseline scenario developments is fairly small.

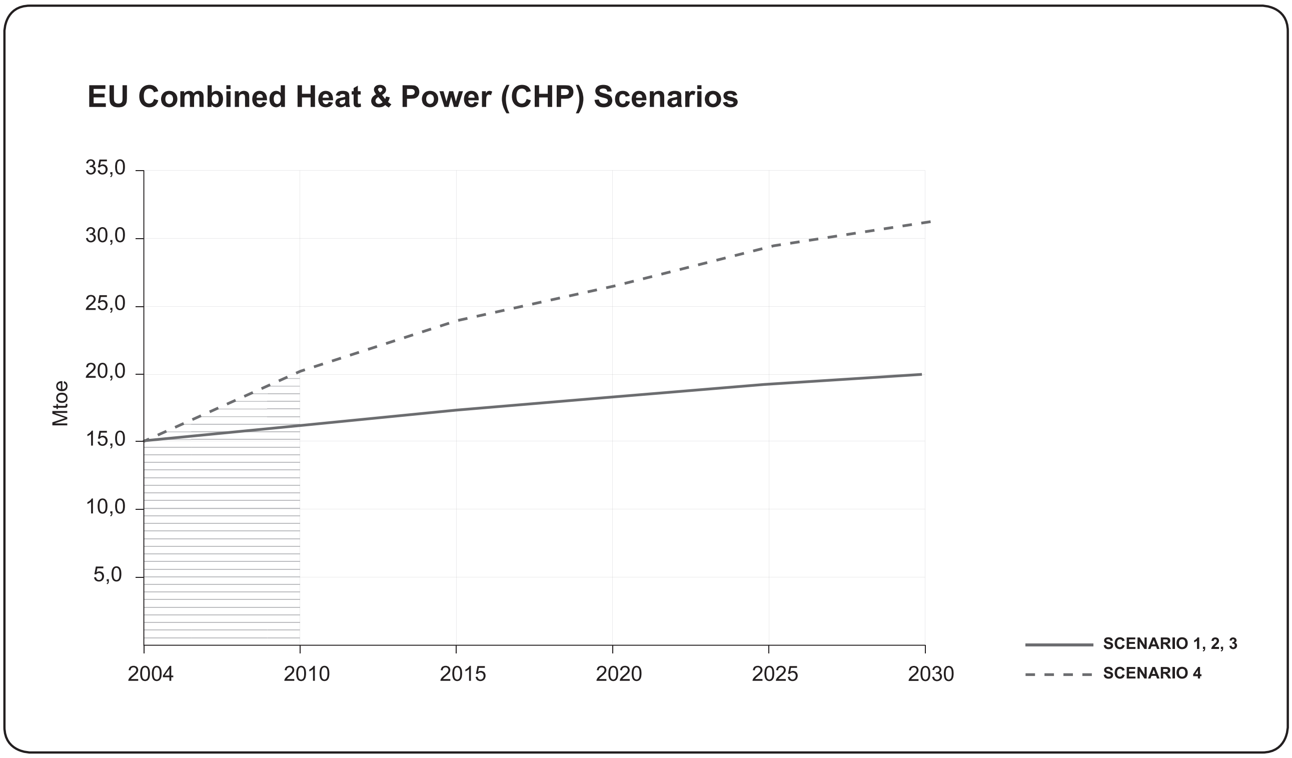



Figure 4 - 24 Share of CHP in industrial heat generation in four scenarios (Fraunhofer et al., 2009).

| IMPROVEMENT OF ENERGY USE PER TON OF PRODUCT IN 2 SCENARIOS | 2004 | 2020 | 2020 |
|---|---|---|---|
| 2004 = 100 | | BASELINE | HPI |
| IRON AND STEEL | 100 | 95 | 92 |
| PAPER | 100 | 98 | 93 |
| GLASS | 100 | 97 | 95 |
| CEMENT | 100 | 99 | 95 |
| ALUMINIUM | 100 | 92 | 88 |

Table 4 - 8 Improvement of energy use per ton of product in two scenarios (Fraunhofer et al., 2009).

**Results for industry**

The overall energy savings in industry are shown in Figure 4 - 25. The left-hand figure includes the overall industrial fuel use. The right-hand graph estimates the energy use in the less energy intensive industry that is not part of the EU Emissions Trading Scheme (ETS) and also includes the electricity use of ETS industries. This was done because electricity use from ETS sectors is not directly affected by the Scheme, but rather by instruments like the Eco-design Directive that applies to the non-ETS industry as well. Figure 4 - 26 shows the MACC for energy savings in the industry sector.

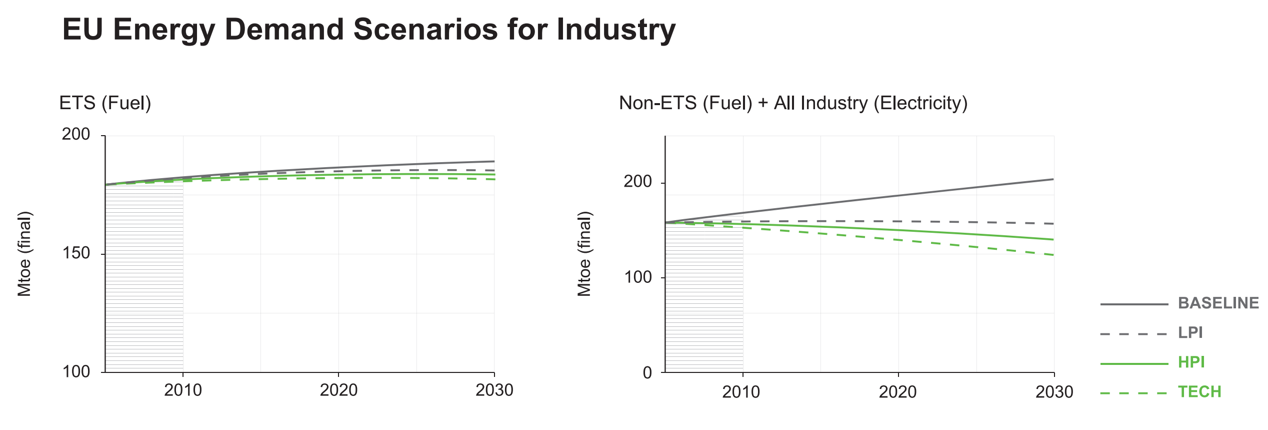



Figure 4 - 25 Energy savings potentials in EU industry in four scenarios. Left-hand: fuel use in ETS industry, right-hand: total electricity use industry plus fuel use of non-ETS industry (Fraunhofer et al., 2009).

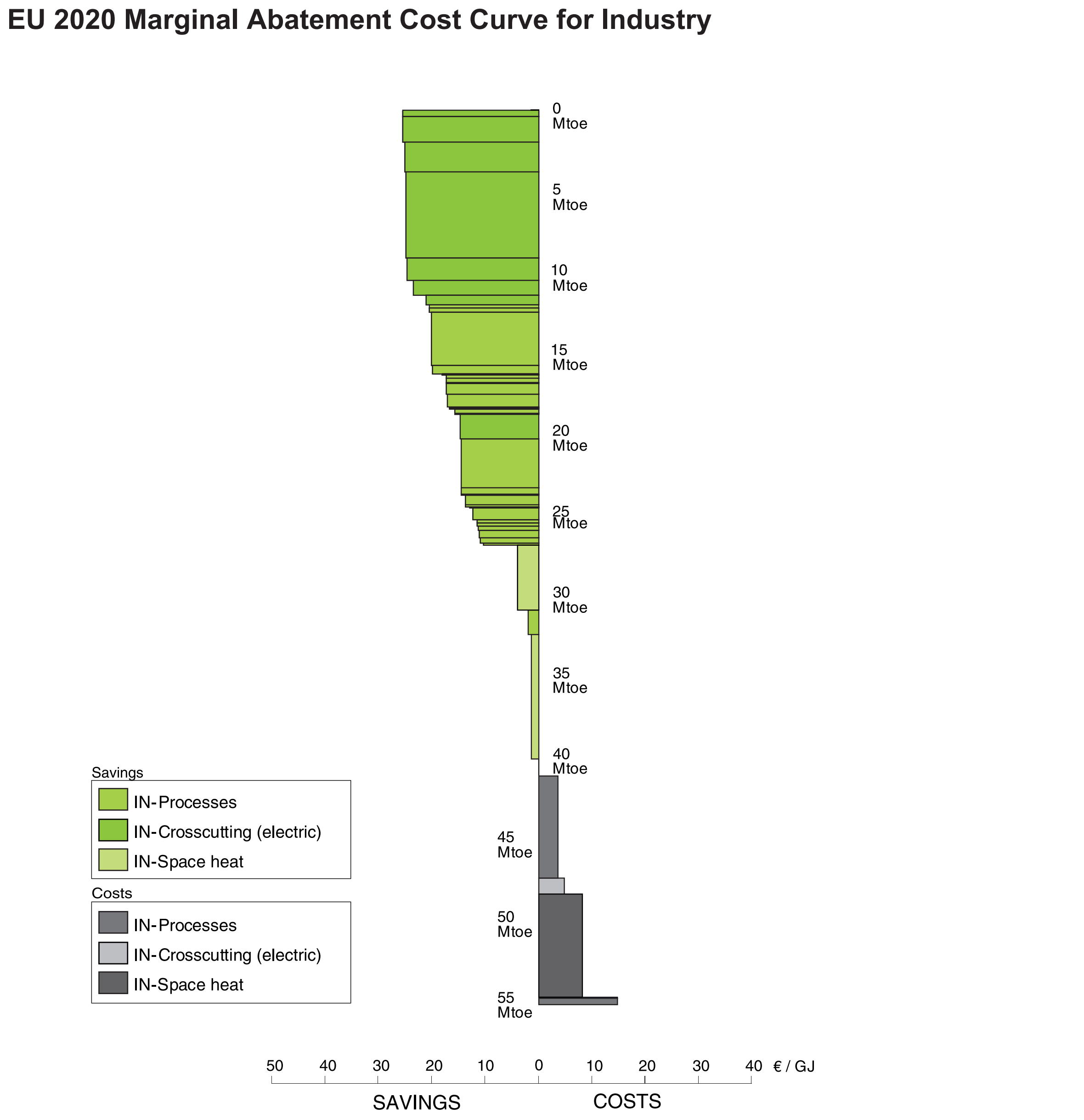



Figure 4 - 26 Overall MACC for energy efficiency options in the EU 27 in 2020 in the industry sectors (ETS and non-ETS). Energy savings are expressed in final energy units. Energy savings (Y-axis) are relative to the baseline (source: Fraunhofer et al., 2009).

## 4.6 ENERGY SUPPLY

The Fraunhofer study focuses on end-use sectors only. In order to provide a complete picture of the energy savings potential, potentials in both the refinery and the power and heat supply sectors are added in the next two sections.

### 4.6.1 REFINERIES

The refineries sector is often regarded as an energy conversion or supply sector. For this reason the sector was not included in the Fraunhofer study. We have therefore used data from the recent SERPEC study (Ecofys, 2009a). The SERPEC study assessed the technical potential for $CO_2$ reductions, which largely stem from energy savings. The construction of new (energy efficient) large-scale refineries is not expected in Europe until 2030. As a result, the SERPEC study focussed on defining a set of cross-cutting measures typical for the refineries sector.

Measures that reduce the energy demand in refineries are:

- *Process Control*: the use of energy monitoring and process control systems.
- *Process Integration*: in plants that have multiple heating and cooling demands, the use of process integration techniques may significantly improve efficiencies.
- *Steam Generation*: various measures can be implemented to improve boiler efficiency.
- *Efficient Drive Systems*: electric motors are used throughout the refinery, and represent over 80% of all electricity use in the refinery. Using a 'systems approach' that looks at the entire motor system (pumps, compressors, motors and fans) to optimize supply and demand of energy services often yields the most savings.
- *Flare Gas Recovery*: reduction of flaring can be achieved by improved recovery systems, including installing recovery compressors and collection and storage tanks.
- *Power Recovery*: various processes run at elevated pressures, enabling the opportunity for power recovery from the pressure in the flue gas.
- *Hydrogen Optimisation*: the major technology developments in hydrogen management within the refinery are hydrogen process integration

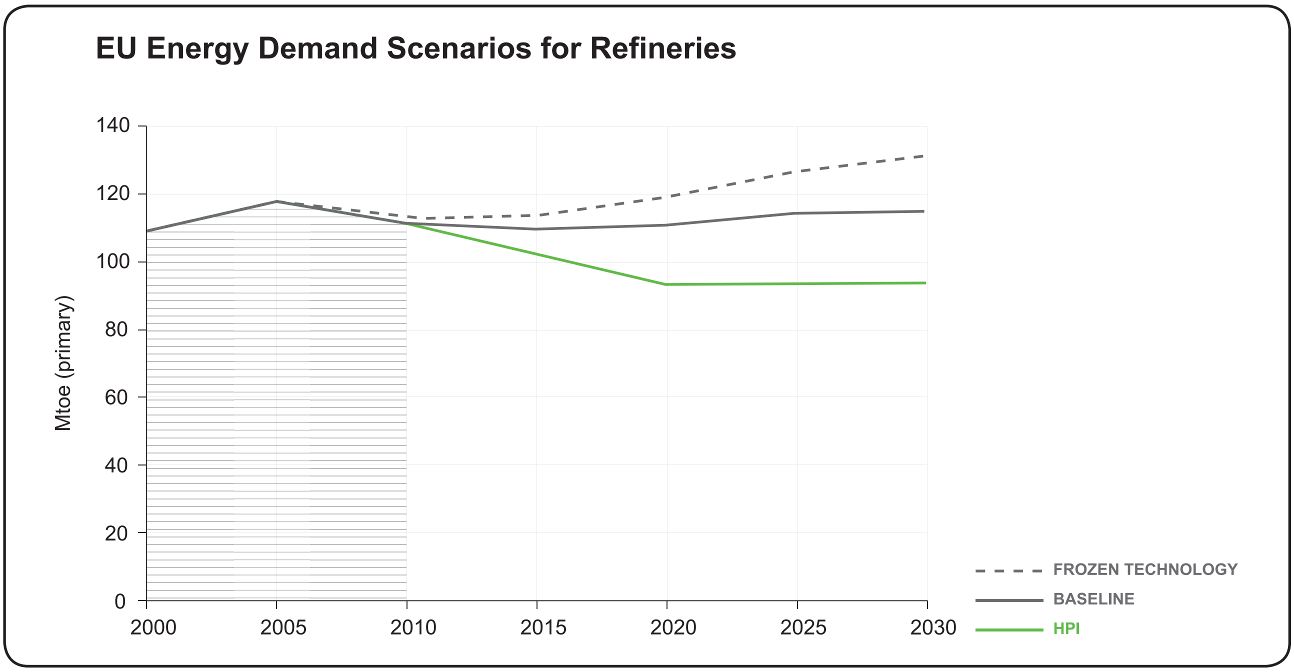



Figure 4 - 27 Primary energy savings potentials in EU 27 refineries sector (source: Ecofys, 2009a).

(or hydrogen cascading) and hydrogen recovery technology.

- *Advanced Distillation*: distillation is one of the most energy intensive operations in the petroleum refinery. Energy efficiency opportunities exist both on the heating side and by optimizing the distillation column.

- *Increased use of CHP:* energy efficiency improvement by replacing separate production of heat and power.

The overall energy savings potential for the refineries sector is shown in Figure 4 - 27. All measures are cost-effective, the 'SERPEC' potential is therefore comparable to the HPI definition in the Fraunhofer study.

### 4.6.2 POWER AND HEAT SUPPLY

A discussion of energy savings in the power and heat production sector can be split into two main categories:

- More efficient fossil power generation and district heating.

- Increased used of renewables.

**Energy efficiency of fossil fuelled power generation**

Energy costs are central to the production costs of fossil fuelled power plants. There is substantial evidence that any new fossil power plant in the EU is built according to BAT standards. This trend is also included in the PRIMES baseline assumptions [33]. This is illustrated in Figure 4 - 28 and Table 4 - 9.

Though a certain potential exists to improve the efficiency of existing fossil fuelled power plants, such potential should be assessed in a context of continued stock turnover and decarbonisation of the power sector. Based on current age distribution of power plants, it is expected that by 2030 only 30% of the current stock of fossil power production plants in the EU-27 is still in production; this could resemble around 900 TWh. Retrofitted energy efficiency measures that improve the control of power plants could increase

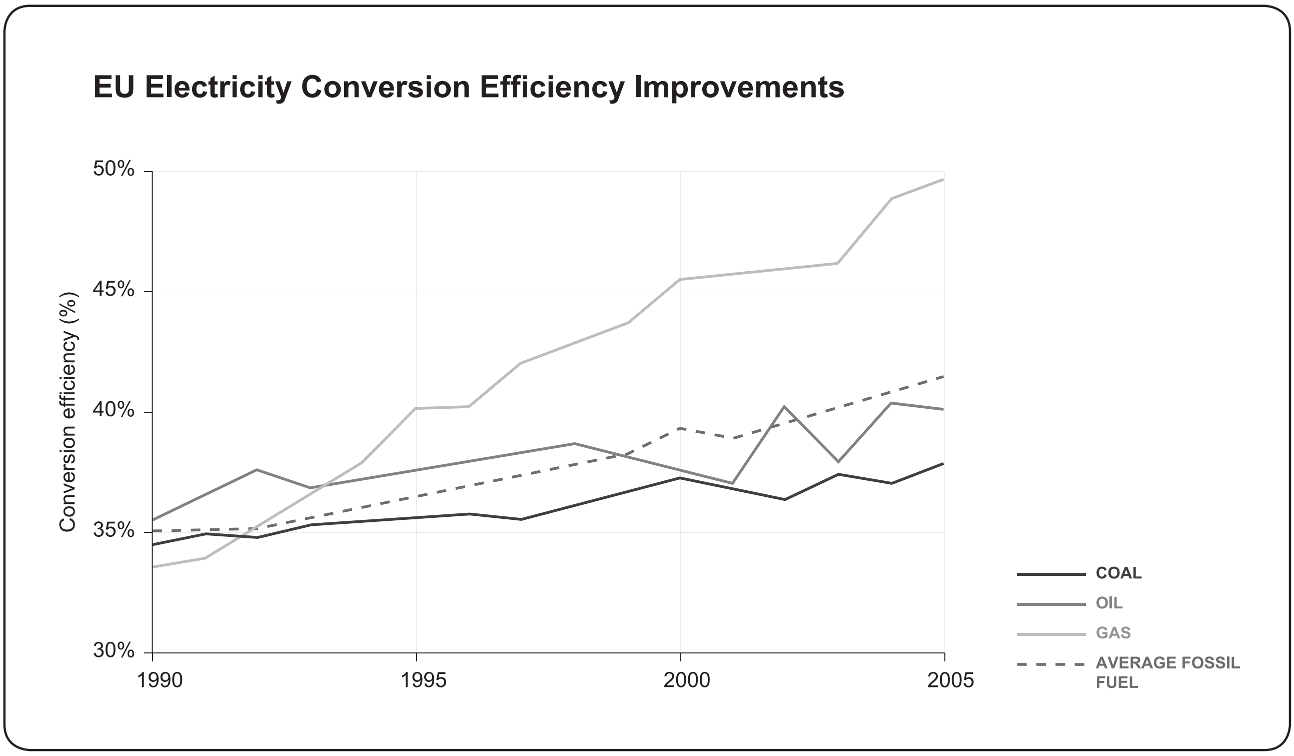



Figure 4 - 28 Average conversion efficiency of fossil fuelled power generation in the EU (Graus & Worrell, 2009).

33. In addition it should be noted that PRIMES-2007 assumes a considerable increase in combined power and heat generation. Large scale deployment of CCS is only expected after 2020.

| | YEARLY EFFICIENCY CHANGE | | |
|---|---|---|---|
| TECHNOLOGY | 1990-2005 (%) | 2005-2015 (%) | 1990-2015 (%) |
| GAS | 2.6 | 0.9 | 1.9 |
| COAL | 0.6 | 0.6 | 0.6 |
| OIL | 0.8 | 0.1 | 0.5 |
| | | | |
| FOSSIL | 1.2 | 1.1 | 1.2 |
| OF WHICH ENERGY EFFICIENCY | 0.9 | 0.6 | 0.7 |
| OF WHICH FUEL SWITCH | 0.3 | 0.5 | 0.5 |

Table 4 - 9 Conversion efficiency of new fossil fuelled power generation in the EU (Graus & Worrell, 2009).

their efficiency with 1-2%. Such measures would save a maximum of 4.4 Mtoe energy inputs to the power generation, assuming 35% average efficiency for the existing plants. This number is indeed very small compared to the overall economy wide savings potential identified in this study. Moreover, the 4.4 Mtoe of savings could partly be offset by increased use of CCS in the case of new fossil power plants. In this context we assumed a zero additional potential for efficiency improvements of existing power plants.

In summary, we considered no additional energy savings beyond business as usual for the fossil fuelled power sector, for both existing and new fossil fuelled power plants.

**Accounting for the impact of renewables on energy savings**

EU climate and energy policies are targeted to achieve a 20% share of overall final energy consumption from renewable sources by 2020. Renewables affect the statistical accounting of energy savings in two opposing ways:

- Hydro, solar and wind power production generation is calculated at 100% conversion efficiency according to Eurostat's 'Primary Energy Method'. Using this calculation methodology, replacing fossil power production with renewables saves 50-60% of energy per unit electricity production.
- Biomass-based electricity and heat production, however, occurs on average at lower conversion efficiencies than fossil based conversion.

**The Eurostat Primary Energy Method**

Eurostat, that provides the data basis for EU energy modelling and polices, uses the so called 'Primary Energy method' for presenting energy statistics. In this method primary energy is defined as the first commodity or raw material which can be used as secondary energy (heat, electricity, etc.). For hydro power, wind energy and solar power energy the first usable commodity is the electricity produced. For electricity from fossil fuels the first usable commodity is coal or natural gas. When electricity is produced from fossil fuels, typically 2.5 units of primary energy are needed to produce one unit of electricity[34]. For hydro, wind and solar power one unit of primary energy is arbitrarily calculated to produce one unit of electricity, i.e. a conversion efficiency of 100% is assumed. This means that the installation of wind, hydro or solar power can contribute to energy savings according to the Primary Energy Method, see Figure 4 - 29.

The conversion of biomass (and waste) to electricity has a lower conversion efficiency than conversion of fossil fuels to electricity. On average, biomass conversion currently occurs at around 30% efficiency, natural gas conversion at 45% efficiency and coal conversion at 37% efficiency[35]. Thus, under the Primary Energy Method, an increase of biomass use in the economy, at the expense of fossil fuels, would lead to additional primary energy use.

**The alternative Substitution Method**

The above mentioned Primary Energy Method disregards the fact that also renewables like hydro, solar and wind face conversion losses (though occurring from a much more abundant energy source) and have potential for improved conversion efficiency. Also, the method can give rise to confusion in the policy debate.

An alternative method is the Substitution Method (e.g. Segers, 2008). In the Substitution Method, renewable energy, for example wind power, is valued in terms of the fuel input required by a hypothetical fossil primary energy source. It is expressed as avoided use of fossil primary energy. For example, for electricity from

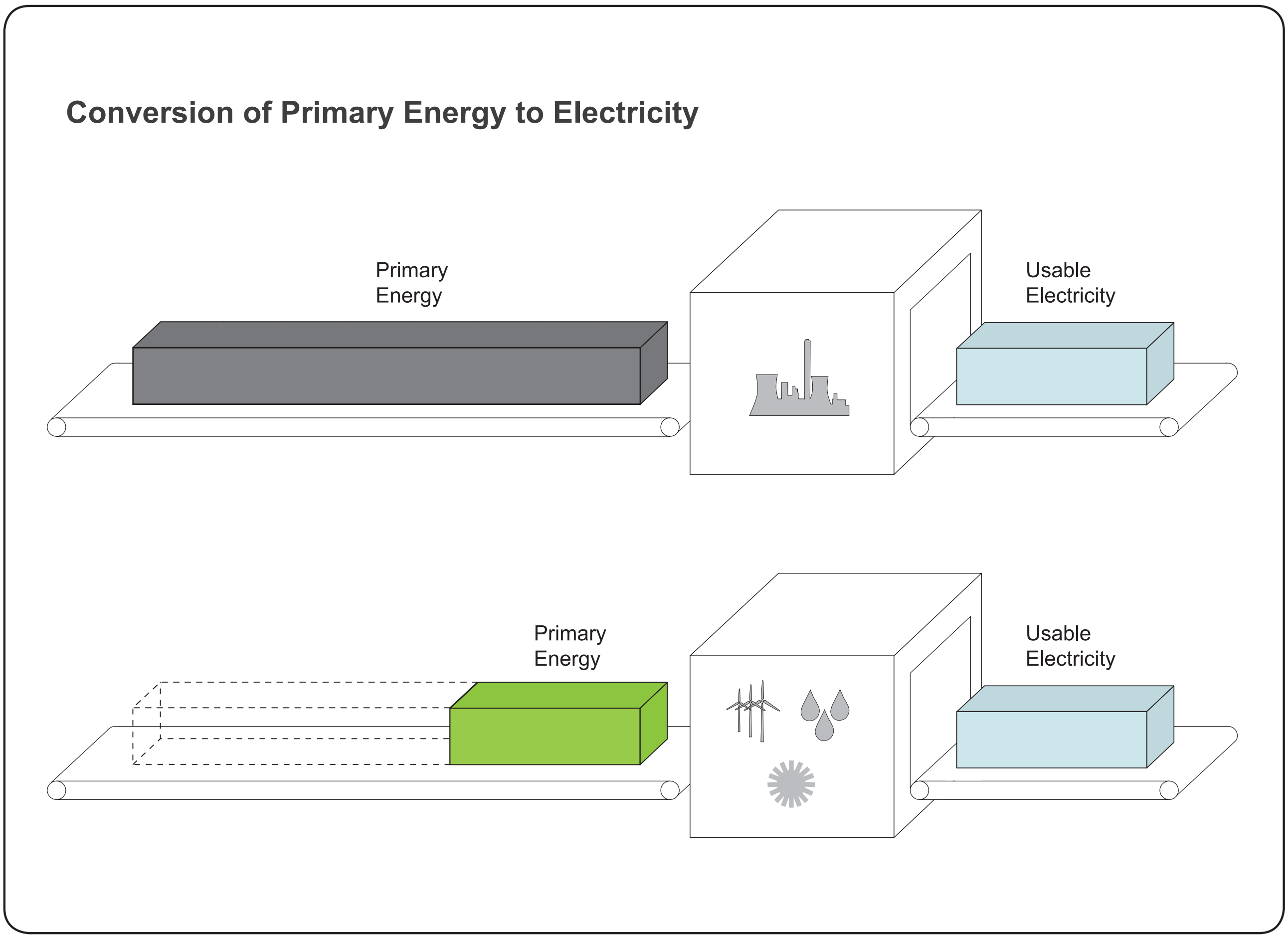



Figure 4 - 29 Impact of calculating energy savings with electricity production from wind, hydro or solar according to the *Primary Energy Method*.

34. This resembles a conversion efficiency of 40%.
35. These are average figures. Average efficiencies of new biomass, gas and coal-fired power plants are significantly higher.

wind energy this could be fossil power production with an efficiency of 40%. In terms of the illustration in Figure 4 - 29, this means that one unit of wind power is expressed in exactly the same amount of primary energy as is the case for the fossil power plant.

Applying this method would avoid both the somewhat complex messages of hydro, solar and wind power 'savings' as well as biomass 'un-savings'. The method is applied in The Netherlands (CBS, Statistics Netherlands). A disadvantage of the method is that it requires (debatable) assumptions on the efficiency of fossil power production. Also the method becomes less valuable when the share of fossil fuelled power production decreases over time.

*Overall, in the Primary Energy Method, renewable electricity saves primary energy*

Towards 2020-30, based on supply forecasts using PRIMES, growth in wind power is expected to outpace growth in biomass such that by the period 2020-30 the share of electricity from wind is expected to exceed the share of electricity from biomass. Because the accounted high primary energy savings from the higher share of wind would more than offset the accounted lower energy savings from biomass, this results in an imputed net primary energy savings from the expansion of renewables.

The resulting imputed additional net primary energy savings from renewables may range between 35 and 110 Mtoe in 2020[36]. Here the lower value gives

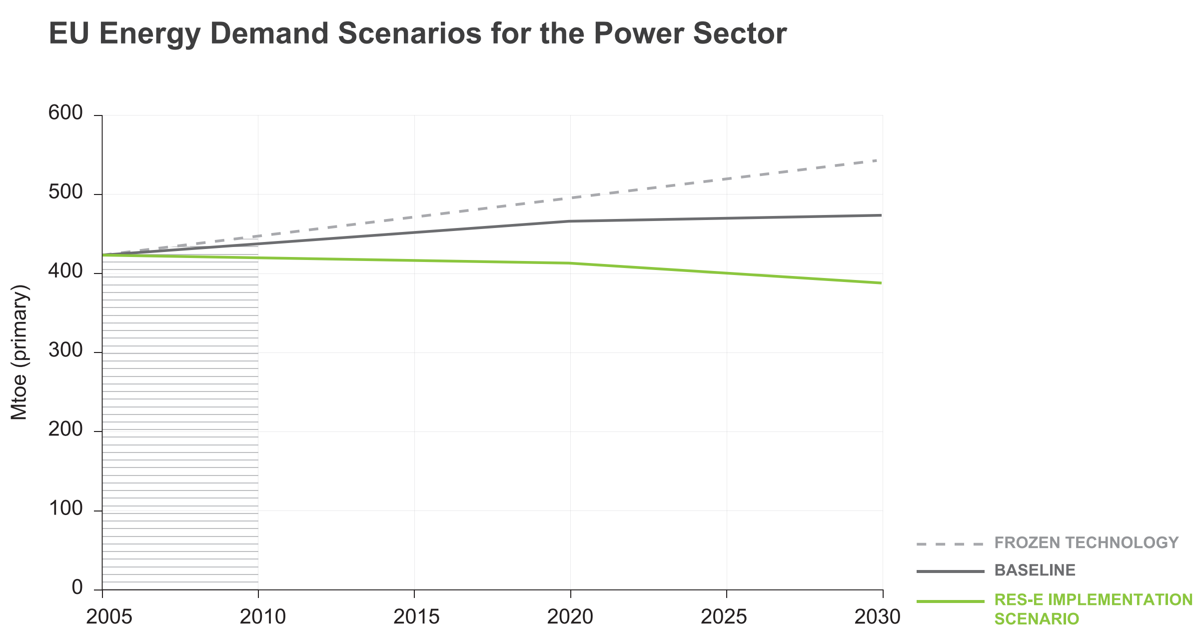



Figure 4 - 30 Primary energy use thermal power plants in the EU 27, baseline scenario (middle line) and after implementation of the 20% renewable energy target. The autonomous effect mimics a further 1% per year energy savings in fossil fuelled power production.

36. In chapter 3.6 we show that the increase of renewables in the PRIMES-2009 baseline, compared to the baseline shown here resembles around 20 Mtoe of energy savings.

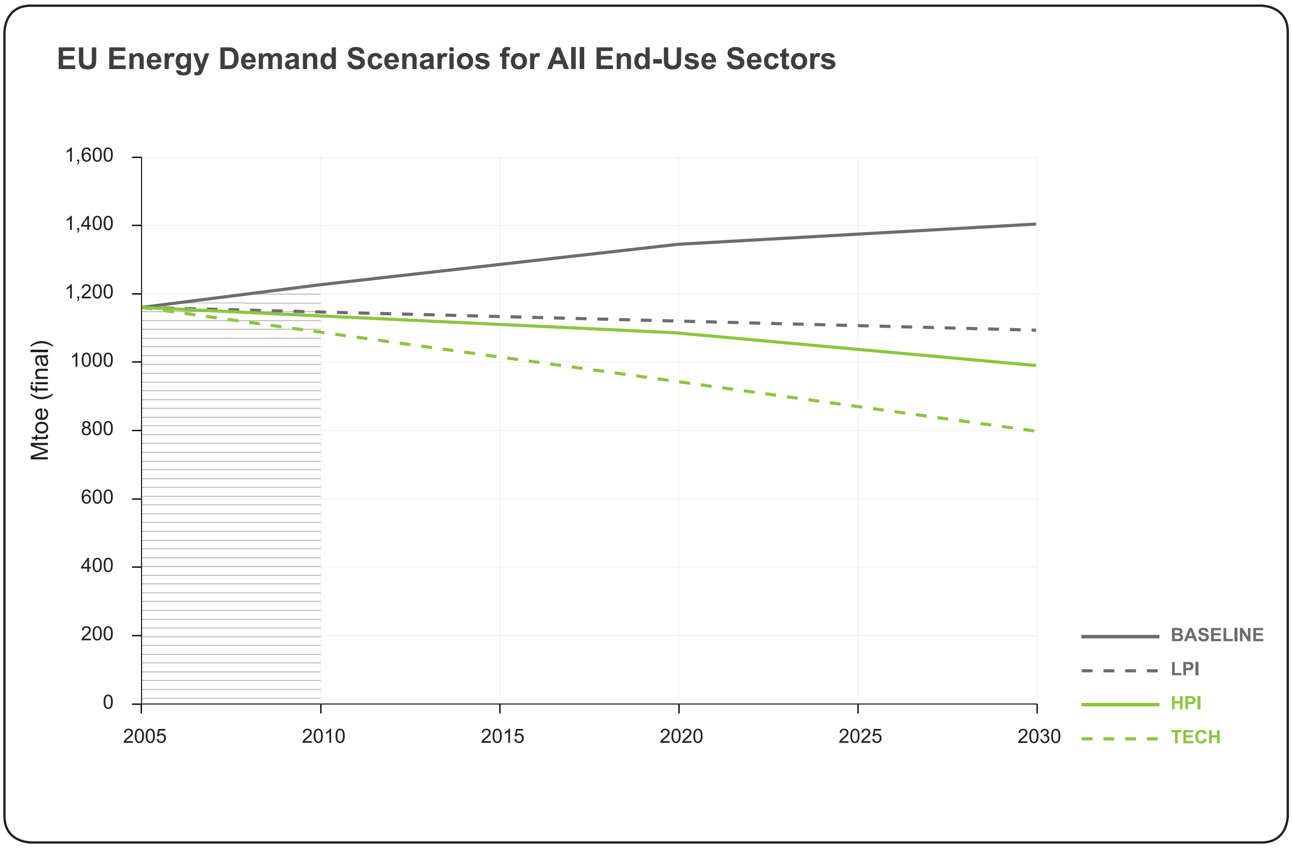



Figure 4 - 31 Final energy use scenario's for end-use sectors in the EU 27 (source Fraunhofer et al., 2009).

priority to end-use energy savings; as a result a 20% renewables share will be reached with a smaller absolute volume of renewable energy production, resulting in lower supply-side energy savings from renewables (35 Mtoe). If no additional end-use savings are assumed, a worse case scenario, the higher absolute volume of renewables required to achieve the RES target will generate 110 Mtoe in supply side energy savings. In Figure 4 - 30 and Figure 4 - 32 we applied a value of 55 Mtoe.

## 4.7 ECONOMY-WIDE ENERGY SAVINGS POTENTIAL

**Final energy savings potentials for end-use sectors**

The overall savings potentials for the demand sectors (industry, services, tertiary and transport), expressed in units of final energy demand, are shown in Figure 4 - 31. Final energy savings in the HPI scenario in 2020 lead to an absolute reduction of energy use of 6% in 2020, compared to 2005. Realisation of the full HPI potential in 2030 would even reduce energy use in 2030 to 15% below the 2005 level.

**Economy-wide primary energy savings potential**

Figure 4 - 32 shows the overall energy savings potential of the HPI scenario, expressed in *primary* energy savings. The figure shows three categories of savings, calculated as follows:

- More efficient use of fuels in the end-use sectors
- More efficient electricity use in end-use sectors. Here electricity savings are recalculated into (primary) fuel savings at power generation assuming a conversion efficiency for electricity generation of 50% (being a mixture of fossil power generation and RES-based power generation of which hydro, wind and solar contribute with 100% conversion efficiencies).

- Energy savings in energy conversion sectors (refineries, electricity and heat supply).

The overall economy-wide HPI energy savings potential in 2020 equals an energy use of around 1600 Mtoe in 2020, which is comparable to the current EU 20% energy savings target (see chapter 3.3.1)[37]. This shows, on the one hand, that the EU target can be regarded as ambitious. On the other hand, it should be stressed that the main share of this potential can be realised via cost-effective measures in end-use sectors.

**Note that the largest share in savings potential can be found in end-use consumption. This share is regarded as cost-effective, provided that 'end-users' have access to capital at 4-8% interest rates.**

The additional savings in the HPI scenario, compared to the baseline, imply an increase of the annual energy savings rate of around 1.3% per year. Note that the baseline already contains a savings rate of 1.1% per year. Thus, the overall savings rate should increase to around 2.4% per year in the HPI scenario.

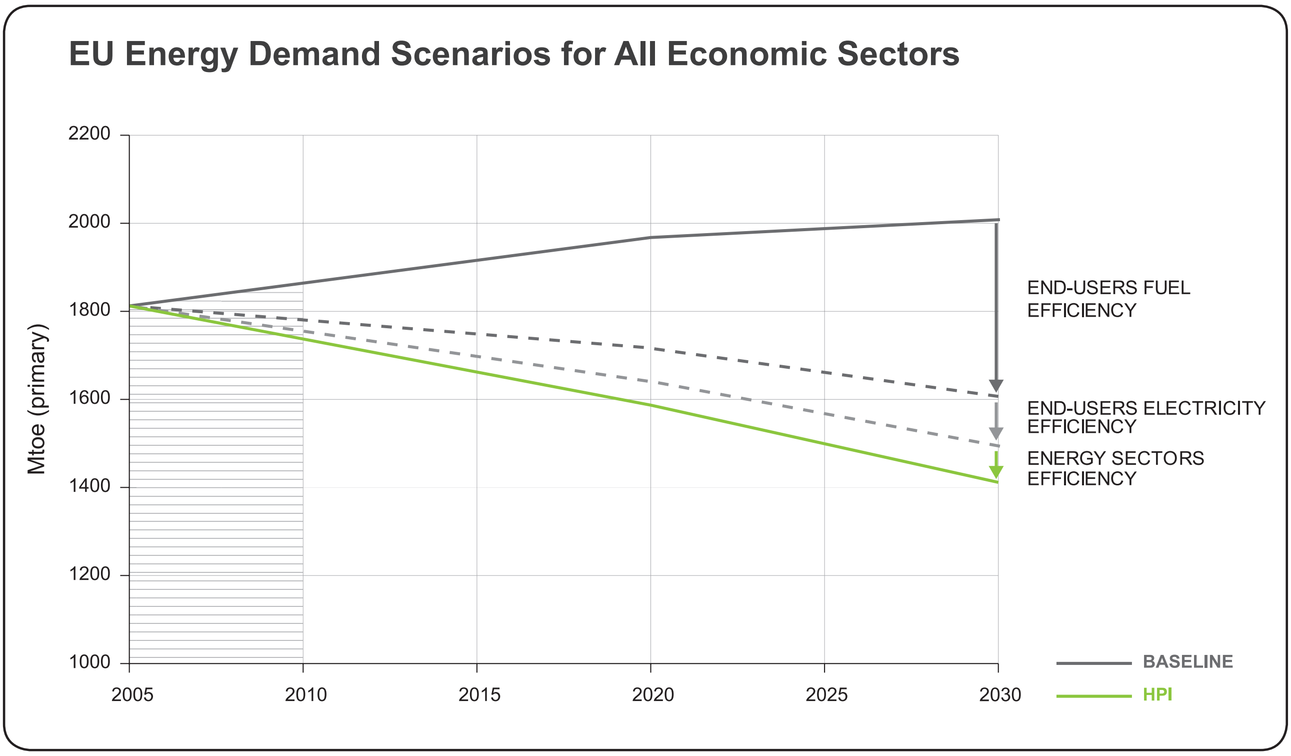



Figure 4 - 32 Economy-wide primary energy savings potentials in the EU 27 according to the HPI scenario.

37. In chapter 3.3.1 we show that the EU 20% energy savings target resembles 1574 Mtoe energy use in 2020. Our economy-wide savings potential falls some 20 Mtoe short of reaching this target. Given the uncertainties in the assessments, however, we find it legitimate to state that the EU has sufficient cost-effective energy savings potential to realise its 20% energy savings target by 2020 in conjunction with meeting its binding target for renewable energy sources.

**Is the HPI potential sensitive to a new baseline?**
Realisation of the HPI primary energy savings shown in Figure 4 - 33 would imply a 1.3% per year of *extra* energy saving as from 2005 and measured against the 'pre-recession' baseline scenario (PRIMES-2007). As shown earlier, in such a scenario the HPI savings potential would suffice to reach the EU's 2020 (20%) energy savings target.

Though savings rates in the 2005-2010 period may have increased somewhat, they have not increased to 'HPI-rates'. This means that even if 'HPI-rates' are realised as from 2010, the impact on energy use levels in 2020 will be reduced. At the same time, this effect may be counterbalanced by the effect of the economic recession which has decreased current and expected near future energy use (PRIMES-2009).

Ideally, the bottom-up HPI assessment as shown in this chapter would have been re-assessed against new baseline conditions. This is, however, an extensive task that could not be carried out as part of the current study. Therefore, we applied a simple top-down approach to assess the impacts of both parameters on the HPI energy use in 2020.

We calculated implementation of energy savings on top of the PRIMES-2009 baseline as from 2010 at the HPI-rate of 1.3% per year. As a sensitivity analysis, a savings rate of 1.05% per year was also applied. This simulates an 'HPI-rate' corrected for the fact that a certain increase in energy savings is achieved through new policies adopted since 2006 (see chapter 3.6). The average results of our analyses are shown in Figure 4 - 33.

Overall, Figure 4 - 33 illustrates that the same energy use level in 2020 can be realised against the new baseline and with full implementation of energy savings policies starting as from 2010. As a result, we conclude that the HPI scenario for 2020 (and 2030) is robust in regard to recent baseline changes.

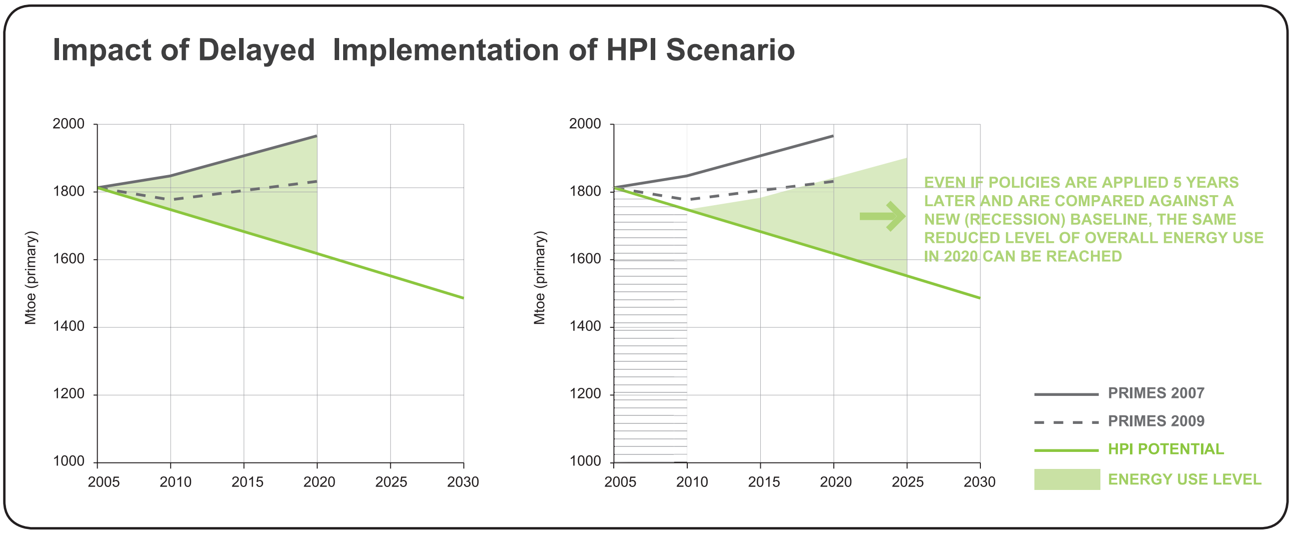



Figure 4 - 33 Sensitivity analysis of the HPI scenario for changes in baseline and base year. For explanation see main text.

*In conclusion*
In chapter 2, we underlined the need for increased energy savings. Chapter 3 identified that in 2020, a gap of around 208 Mtoe will remain to meet the EU energy savings target. As a result, we concluded that closing this gap requires a threefold increase in policy impact compared to energy savings policies adopted since the 2006 EEAP. Chapter 4 illustrated that the gap could be closed almost entirely, and most cost-efficiently, by realising the cost-effective end-use savings potential identified in this study. These building blocks serve as a basis for the next chapters in which we explore the feasibility and design of introducing binding energy savings targets.

CHAPTER 5

# THE ROLE OF A BINDING ENERGY SAVINGS TARGET

As the previous chapters have shown, there are multiple motivations for achieving the EU's 20% energy savings target. Yet the EU is unlikely to meet the target, unless the impact of energy saving policies is tripled compared to the efforts of the last four years. The analysis in chapter 4 has shown that sufficient, cost-efficient, yet untapped savings potential is available.

This chapter discusses the role of setting legally binding energy saving target in order to help catalyse a tripling of energy saving policy impacts and thus meet the EU's 20% energy savings target by 2020. Binding targets are one way to formalise strong government commitment and accountability, which are important overarching factors in creating a step change in energy saving policy effectiveness. Targets — translated into an EU energy savings policy framework — serve as the guiding and coordinating role for the broad mix of different policies and approaches, which are necessary to overcome current barriers to cost-effective energy saving measures.

**The need for a policy framework**

To illustrate the need for a policy framework, which brings together different policies, approaches and tools under one target, we take the EU marginal abatement cost-curve (MACC) for energy savings as a starting point (see Figure 5 - 34). It calculates the net costs of energy savings over the lifetime of technologies discounted against a rate of 4-8%, similar to government bond rates. The results show that a large share of the options, with negative costs, are beneficial for 'end-users'. Other options come at a net cost, but the whole package of measures still results in cost savings. This typical MACC sends a strong signal to policy makers; it is a justification for the strengthening of policies to realise the societal benefits that are so prominently visible on the MACC.

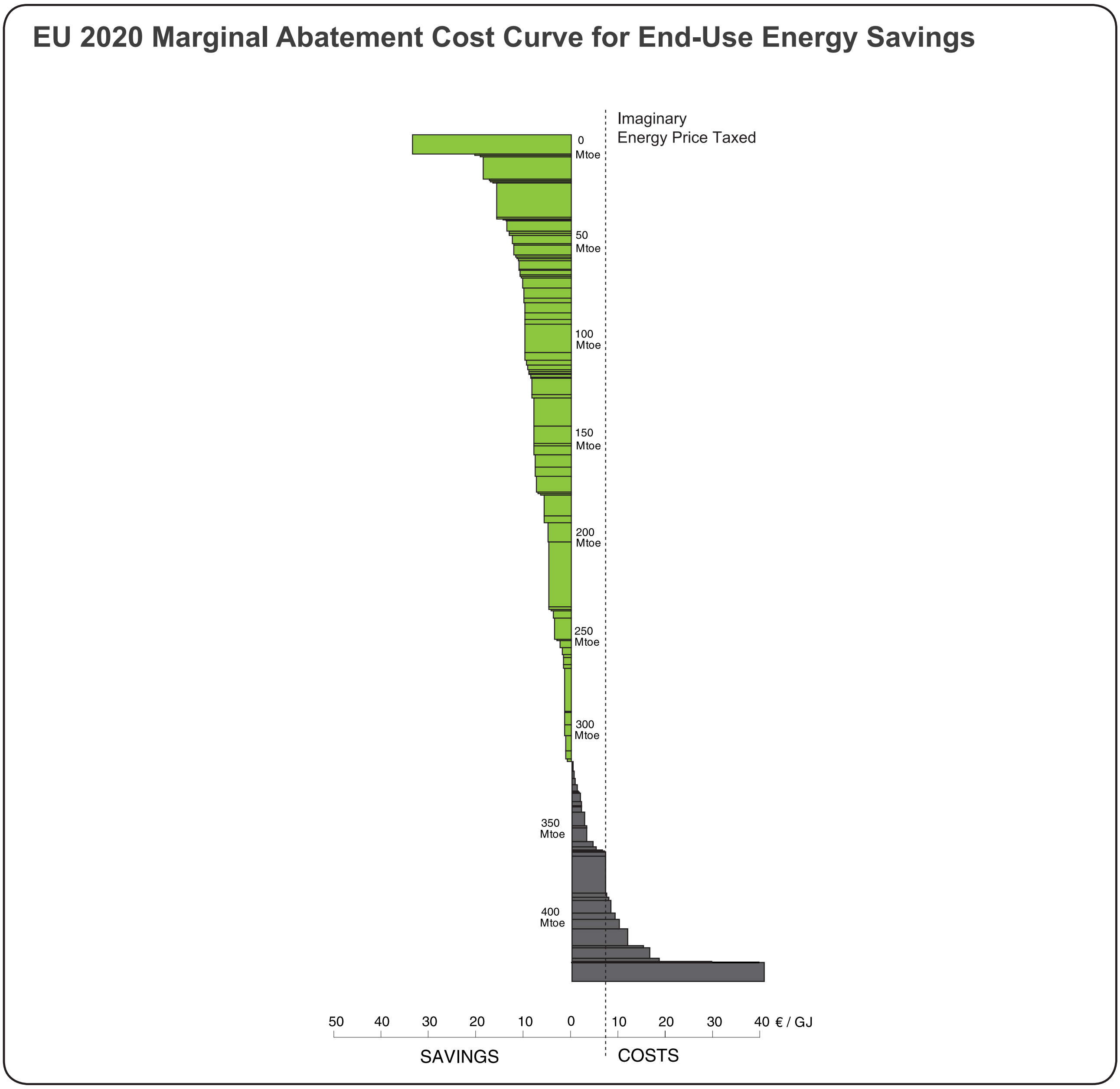



Figure 5 - 34 Aggregated cost-curve for primary energy savings in the EU 27 in 2020. Energy savings are relative to a baseline scenario. The dotted line shows an imaginary taxed energy price and is explained in the main text.

In the ideal marketplace private investors can obtain capital at 4-8% rent, investors accept long payback times, and consumers and small firms respond rationally to price signals. In such an ideal market place a single emissions or energy cap, or a single tax level, would be sufficient to realise all measures up to the 'marginal' option on the cost-curve (illustrated in Figure 5 - 34).

In reality, however, a mix of policy instruments is required to realise the options that lie across the cost-curve:

1. **Consumers do not always respond rationally to price signals.** Energy costs are often only a small fraction of household expenditures. When deciding on new equipment or retrofit measures, rational cost-based decisions are easily overruled by other factors, such as the features of the equipment (e.g. colour and luxury of a car), or the upfront costs as compared to alternatives, etc. (so-called bounded rationality). The response to price incentives is even more hampered when the user of a product, like the tenant of a house or building, is not the owner. Here, the tenant pays the energy bill but does not

decide on energy savings measures (so-called split incentives problem). These barriers can be reduced by a combination of policy instruments like energy efficiency standards, energy performance labelling, time-of-sale requirements, financial incentive/rebates and financing schemes.

2. **The market does not invest sufficiently in new technologies.** Many new technologies, like wind turbines, solar-power or new industrial technologies, will only become profitable after their cost has decreased due to economies of scale and learning effects. Single companies cannot expect that all investments needed during these phases will pay-back when the technology becomes profitable, because innovations and knowledge can be copied by competitors (the so-called free-rider problem). As a result, companies will usually invest less into such new technologies than would be efficient from a societal point of view. In such a case, subsidies can stimulate research or demonstration projects and instruments like feed-in tariffs, obligation schemes or tax-measures (e.g. for electric cars) can speed up market growth and technology learning rates.

3. **The private investment perspective is different.** The investment perspective of a private investor can be quite different from the ideal 'societal' perspective. The costs of capital can be 10-20%, rather than 4%, depending on the investment risk, and an acceptable payback time may be on the order of months rather than years because of uncertain market conditions. These cost barriers can be reduced by e.g. the introduction of energy efficiency funds to provide targeted low-interest loans, publicly backed risk guarantees or other types of incentives.

4. **The price signal is too weak and lacks a long-term perspective.** Policy development is strongly influenced by interest groups that seek political rent. A central instrument like the EU-ETS focusses political power on keeping prices low. This is not so much a market failure but rather a political failure. As a result, additional policies (such as e.g. binding savings targets) might be required.

5. **A policy mix serves multiple objectives.** The policies mentioned above are sometimes interpreted as a mix that serves the single goal of climate policy. However, policies also serve other objectives such as increasing energy security reducing energy poverty, reducing air pollutants and stimulating technology developments. Pursuing several policy objectives usually requires several policy instruments. A policy mix can be designed in a way that policies complement and reinforce each other.

In a policy mix, price incentives from an energy tax, or $CO_2$ price (ETS), could serve as a generic incentive. Labels and financial incentives encourage the development of market leaders. On the other hand, regulations are required to pull laggards along (or eliminate low performing products or harmful behaviour), which creates a level playing field for emerging cleaner technologies and services to compete in the market. National and regional differences, as well as the outcome of EU decision-making will determine specific ways of packaging those policies.

**EU examples of establishing a robust framework**

Over the last decade, EU energy and environmental policy has experienced several regulatory shifts toward setting legally binding targets. In some cases, action was taken after progress on individual and uncoordinated measures was found to be insufficient;

in others, cross-border implications for protecting human health or the internal market necessitated harmonised actions underpinned by binding targets.

*Renewable Energy*

In 2001, the Directive on Electricity Production from Renewable Energy Sources (RES) set a non-binding target of 21% renewable energy sources in European electricity consumption by 2010 (Directive 2001/77/EC). Progress on renewables penetrating the electricity market was slower than required and unevenly spread over Member States. As a result only few Member States were expected to meet their target in 2010. In order to accelerate penetration rates of renewables, the EU decided in 2009 to introduce binding national targets for the renewable share in final energy use (Directive 2009/28/EC): by 2020 a 20% share has to be reached EU-wide. The new Directive not only increases the ambition but also extends the scope from renewable electricity to include renewable heat and biofuels. Over the period 2000-2007, the EU-wide share of renewables in final energy use increased from 7% to around 10%. The legal framework of the RES Directive has been developed to ensure that this share increases to 20% by 2020. Latest data on newly installed RES capacities indicate progress in that direction.

*Air Pollution*

Triggered by the direct impacts of air pollution on human health and ecosystems, the EU started introducing air pollution polices as early as the mid-1970s. During the 1980s and 1990s an substantial EU policy package of air quality standards as well as legislation for stationary sources and transport was developed. The 1988 Directive on Limiting Emissions from Large Combustion Plants (88/609/EEC, revised in 1994 and 2001) was particularly successful in reducing $SO_2$ emissions. At the end of the 1990s the need for a more integral, and cost-efficient approach towards abating air pollution in the EU became apparent. As a result in 2001, binding national emission targets (caps) for sulphur oxides ($SO_x$), nitrogen oxides ($NO_x$), non-methane volatile organic compounds (NMVOCs) and ammonia ($NH_3$) were introduced in the EU's policy mix (The National Emission Ceilings Directive 2001/81/EC). These targets served as the benchmark for an efficient (re-)design and implementation of EU and national clean air policies. Since the introduction of the national ceilings in 2001 emissions continued to fall despite the increasing complexity of abatement options.

**The next step for energy savings policies: setting binding targets**

Over the last decade various industry and civil society stakeholders, along with EU policymakers, have proposed the introduction of binding energy savings targets, but it has not happened to date. In 2003, the Commission proposed binding national targets in the Energy Services Directive, which was supported by some Member States and the European Parliament, though was rejected by the Council. In 2009, civil society organisations (Spring Alliance) and businesses (Energy Efficiency Industry Platform) called for binding targets. The European Parliament has also called for binding targets, most recently in its resolution from 19 February 2009 on 'Follow-up of the energy efficiency National Action Plans'.

As shown extensively in chapter 3, the EU has put in place several pieces of legislation directly addressing energy efficiency (on appliances, cars and buildings). These directives set minimum performance and process standards, as well as national enforcement and reporting obligations. Though this legislation covers most of the EU's energy use, binding targets could provide the necessary push for more ambition and guide better coordination in order to actually deliver the EU objective.

In the next chapter, we explore different options to design such targets. Chapter 6 assesses different features of design options, and in chapter 7 we discuss four main options.

CHAPTER 6

# ENERGY SAVINGS TARGET: CRITERIA FOR DESIGN

In this chapter we assess a set of design features that will play a role in the discution of a new policy for binding energy savings targets. Special attention is paid to the interaction with existing GHG and energy savings policies.

We consider a number of (interrelated) design features:

1. How is a binding energy savings target best *expressed and monitored?*

2. Is a binding energy savings target best set in terms of *primary or final energy*?

3. What *flexibility* can a binding energy savings target provide to Member States to shape their own policies under the binding EU provisions.

4. How would a new binding energy savings target *interact with existing policies*?

Design features 3 and 4 are used in chapter 6 to evaluate the feasibility of four main design options (See Figure 6 - 35):

1. One economy-wide energy savings target at the EU level.

2. Target(s) set at the EU level for section(s) of the economy, for example for 'end-users'.

3. One economy-wide energy savings target for each Member State

4. Target(s) for Member States for section(s) of the economy, for example for 'end-users'.

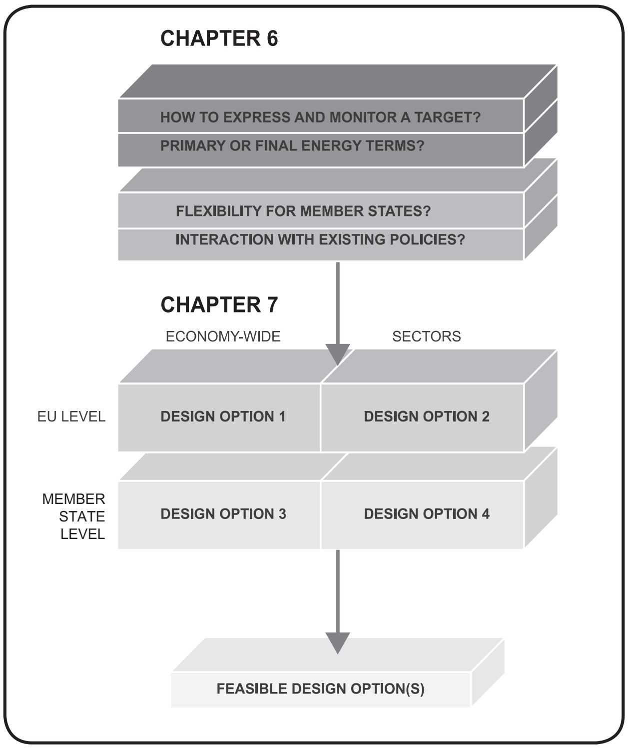



Figure 6 - 35 Approach of chapter 6 and 7 (illustration).

## 6.1 HOW TO EXPRESS AND MONITOR A TARGET

An energy savings target can be expressed in a number of different ways. Figure 6 - 36 illustrates four different ways of expressing the current 20% energy savings target. In all four cases the target is based on the same baseline (i.e. PRIMES 2007) and savings potential numbers. Still the monitoring requirements and the ability to accurately measure the progress towards an absolute reduction of energy use will differ substantially between the options:

1. *Setting a cap on energy use in 2020.* This approach would set a target value of Mtoe of energy use in the EU 27 for 2020. Such an approach would be comparable with the emissions cap set by the EU-ETS. Monitoring would be based on currently available energy statistics.

2. *Setting a target for energy use in 2020 relative to a base year, e.g. 2005.* This approach would be comparable to the current greenhouse gas emissions target of the EU for 2020. The 2020 energy use target would only change over time if the monitoring data of energy use in the base year of 2005 was redefined. Similar to option 1, monitoring would be based on currently available energy statistics.

3. *Setting an energy savings target relative to a projected baseline energy use in 2020.* This is how the current EU energy savings objective is expressed. Because the target is set as a relative target, its implications for the absolute energy use in the target year can be unclear. This is evident from the fact that several EU documents refer to the 20% target as an 'energy efficiency' target, rather than an energy use target. Also, this type of target setting does mostly not make *explicit* how the introduction of a new baseline projection affects the target.

4. *Setting a certain volume of energy savings to be realised by 2020*. This is somewhat comparable to the way current Member States' targets under the Energy Services Directive are defined[38]. Targets set under existing national energy efficiency obligations for energy suppliers (e.g. UK) serve as another example. Typically, monitoring of a savings volume requires bottom-up data from sub-sectors or projects. This requires harmonised and data-intensive monitoring procedures. For example, reference (baseline) conditions have to be defined for each sub-sector or energy savings project. This option does not provide absolute energy use reduction targets.

A fifth approach, not shown in Figure 6 - 36 is to express an energy savings target as an improvement in energy intensity of the economy. Here intensity points to the ratio of energy use over GDP. For example, China has expressed its energy savings target as an energy intensity improvement. A target based on energy intensity allows for absolute growth of energy use, as long as the energy intensity improves. A key-sensitivity of expressing a target as energy intensity is that it masks whether intensity improvement occurs from implementation of more energy efficient technologies or from changes in the structure of the economy: for example, high growth of sectors such as the services sector or the tourism sector, also improves a country's energy intensity.

38. The Energy Services Directive obliges Member States to save 9% or more of their final energy consumption in a base period (2000-2005) in the ninth year of application of the Directive (i.e. from 2008 to 2016).

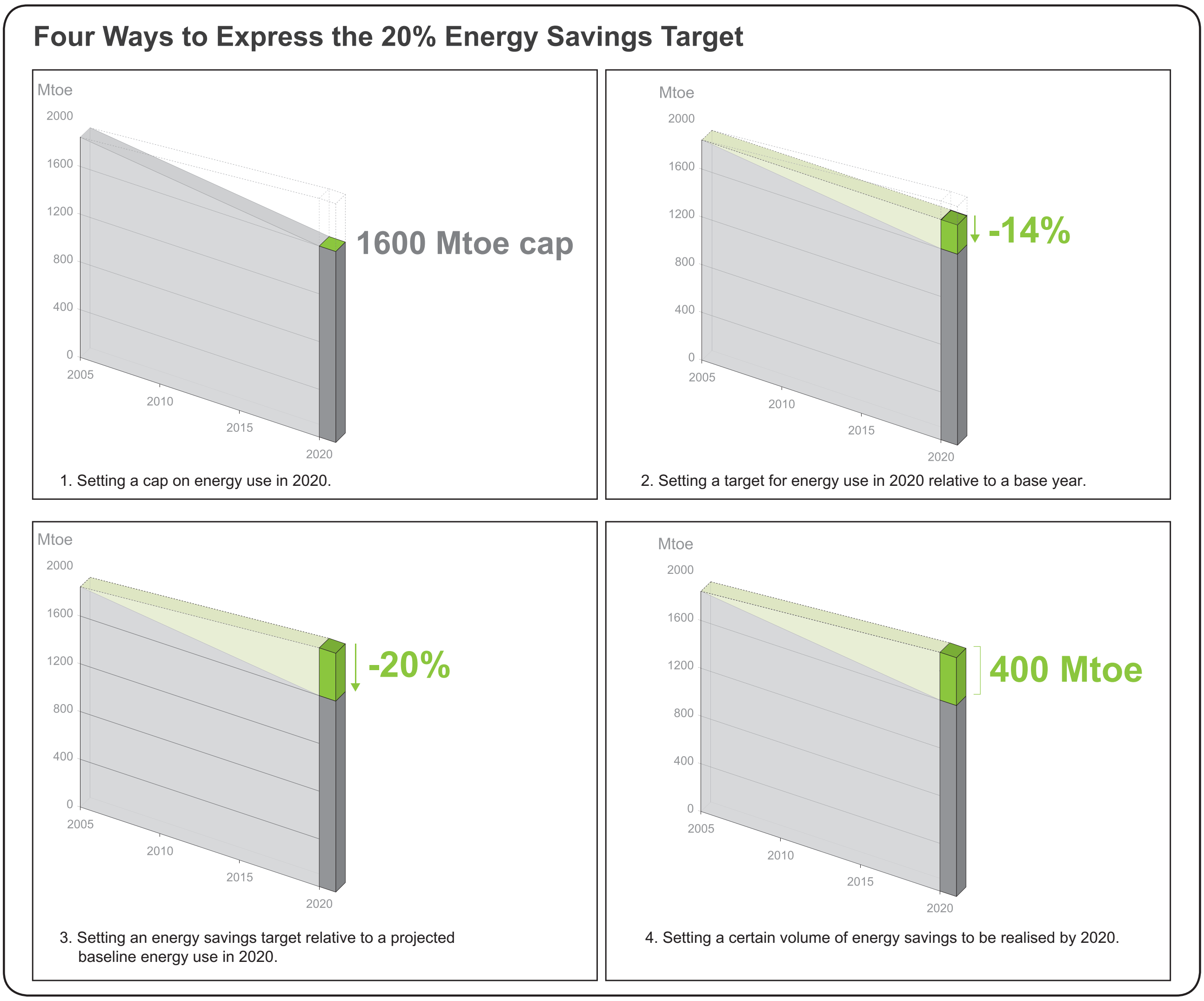



Figure 6 - 36 Four different ways to express the current 20% energy savings target. Upper (dotted) lines indicate baseline development of energy use in the EU 27.

**Energy savings targets should be transparent and easy to monitor**

We have strong indications (see chapter 3.3.1) that the current 20% energy savings target is defined relative to a *fixed* projected baseline energy use in 2020[39]. This means that the target actually expresses an absolute target for energy use in 2020. However, this has never been stated explicitly by the Commission, which gives room for multiple interpretations of the target definition. This is even apparent in the latest 'EU 2020' strategy (EC, 2010) which defines "moving towards a 20% increase in energy efficiency" as a headline indicator, without being precise in its definition. At the same time the strategy postulates that "These targets ….. must be measurable … and based on sufficiently reliable data for purposes of comparison". In other words, a target should be transparent and easy to monitor and measure. In our view, these criteria are a *starting point* for any design of binding energy savings policies.

39. This refers to the PRIMES-2007 baseline which uses 2005 as a base year.

**Recommendation: define a target as absolute energy use in a target year**

By far the most straightforward way to comply with these criteria is to define a target as absolute energy use in a target year and monitor the actual development of energy use over time. This allows for measuring energy use rather than estimating the savings. In this approach, the volume of energy savings, as compared to a baseline scenario, is only estimated once and upfront when setting the target. As a result, existing energy statistics, already implemented in all Member States through statistical offices, provide a straightforward way to monitor progress towards achievement of the target.

This approach implies that other changes in energy use than those stipulated by energy efficiency improvement (e.g. structural change and volume effects due to higher or lower GDP growth) need *not* be corrected for when monitoring target progress. Also other variations in energy use, such as variable weather conditions and business cycles (a target year can be extremely cold or hot and industry can have extremely low or high output), should in principle not be corrected for. This is fully in line with e.g. the GHG emissions reductions target which is also defined without allowing corrections for such variables. Of course, in refining the design of a binding energy savings target, one could include the possibility to make ex-post corrections to the statistics if a Member State can prove that the target year significantly deviated from the long term average in important respects.

## 6.2 EXPRESSING A TARGET IN PRIMARY OR FINAL ENERGY

The choice of expressing a target in primary or final energy (see also Figure 6 - 37) is directly related to the scale of the target.

*An economy-wide target*

An economy-wide target, like the EU's current 20% energy savings target, will by definition be expressed in primary energy terms. This is because inclusion of 'secondary' energy like electricity and heat (see Figure 6 - 37), would lead to double counting.

*A target for end-use sectors*

In case a target is set for end-use sectors, it can be expressed in final energy terms or in primary terms. A final energy target relates to the sum of the fuel, electricity and heat demand of 'end-users' (see Figure 6 - 37). In the case of a primary energy target the 'secondary' electricity and heat use are not counted, but rather the primary energy needed to produce them.

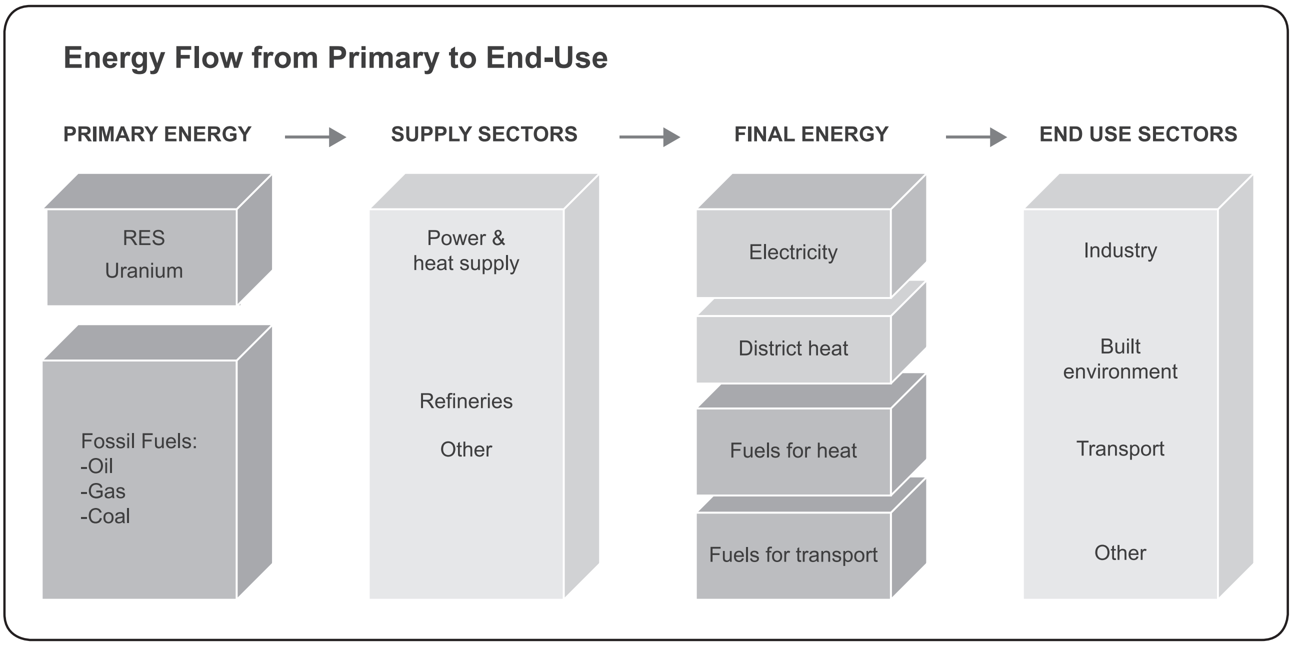



Figure 6 - 37 Simplified representation of primary versus final energy[40].

40. Note that final energy statistics do not provide heat consumption data, but rather fuel deliveries to 'end-users'. The only exception is the heat that is sold (district heat), which is a separate category in energy statistics.

Table 6 - 10 summarises some pros and cons of an end-use target based on final or primary energy.

| | PROS | CONS |
|---|---|---|
| **FINAL ENERGY** | No electricity and district heat conversion efficiencies needed. | Fuel savings are weighted stronger than electricity savings. |
| | Progress in final energy consumption can be directly extracted from existing national and Eurostat Energy Statistics. | Switching from fuels to electricity will be counted as energy savings. Though such shift may be a required feature of a future sustainable energy system (ECF, 2010), it is not the prime aim of an energy savings target. |
| **PRIMARY ENERGY** | Electricity and district heat (savings) are expressed in primary energy units that precisely resemble the efficiencies in the power and heat supply sector. | Exact conversion efficiencies need to be defined to translate electricity and district heat consumption into primary energy. A tendency to apply Member State specific data could result in inconsistent definitions for fuels and fuel-related technologies across Member States (see main text below). |
| | Electricity and heat savings are weighed similarly to fuel savings. | |

Table 6 - 10 Overview of pros and cons of basing end-use targets definitions on final respectively primary energy use.

**A third way: 'adjusted final energy'**

The main argument for expressing an 'end-user' energy savings target in primary energy is that it provides a more holistic picture of the economy-wide impact of end-use savings and does not discriminate between savings in fuels, district heat and electricity. However, it may be preferable to use a definition of 'adjusted final energy use' which resembles the primary energy use definition but may be more transparent:

- Rather than applying a conversion factor on final electricity and district heat, we suggest using the term 'weighing factor'. The aim of such a factor is to count electricity and (district) heat savings in a similar way as fuel savings, rather than to apply the exact, Member State-specific, conversion to primary fuels savings. The different wording, with similar meaning, may reduce the tendency to use Member State specific energy conversion data.

- For electricity, this factor could reflect the 'marginal' or 'average' European power plant that supplies electricity to any European client in an increasingly interconnected European power market.

- We recommend the application of a weighing factor that is constant across Member States and over time:
  - A constant factor over time would provide the most transparent view on end-use energy savings achieved.
  - A constant factor across Member States would ensure that fuel, district heat and electricity savings are weighted the same way across Member States, which would provide an EU-wide level playing field for end-use energy savings.

- We suggest using a factor around 2.5 for electricity conversion[41] and 1.2 for district heat conversion.

A further advantage of applying the 'adjusted final energy' approach is that the direct connection with existing final energy statistics is maintained. It is also in line with the approach of the current Energy Services Directive.

## 6.3 FLEXIBILITY TO SHAPE MEMBER STATE SPECIFIC POLICIES

The flexibility that a binding target provides for Member States is an important governance feature. Here, we define flexibility as the extent to which Member States can shape their own policies under binding EU provisions. Flexibility is defined to a great extent by the type of legal instrument through which binding targets might be introduced. As discussed in chapter 3.2, EU legislation provides a wide range of options:

1. Binding EU product standards (Regulations) that are entirely and directly applied in national legislation in all Member States. Examples are the $CO_2$ standards for passenger transport and the Eco-design standards.

2. Sectoral Directives that provide EU-wide rules such as EU-ETS or binding national targets which allow for flexible national implementation, like the Renewables Directive.

3. Framework Directives that focus on prescribing binding procedures rather than targets and allow the highest flexibility. Examples are the Effort Sharing Decision, the Energy Services Directive, the EPBD and the CHP Directive.

41. A weighing factor of 2.5 links to Annex II of the Energy Services Directive which allows Member States to apply such a default coefficient reflecting the estimated 40% average EU generation efficiency during the target period.

Figure 6 - 38 provides an overview of the current landscape of policies that are directly or indirectly targeted at increasing energy savings. The figures illustrate:

1. The wide diversity and levels of flexibility observed in current EU-policies.

2. The bundle of policies at work, in the context of which interaction with a new energy savings target needs to be considered.

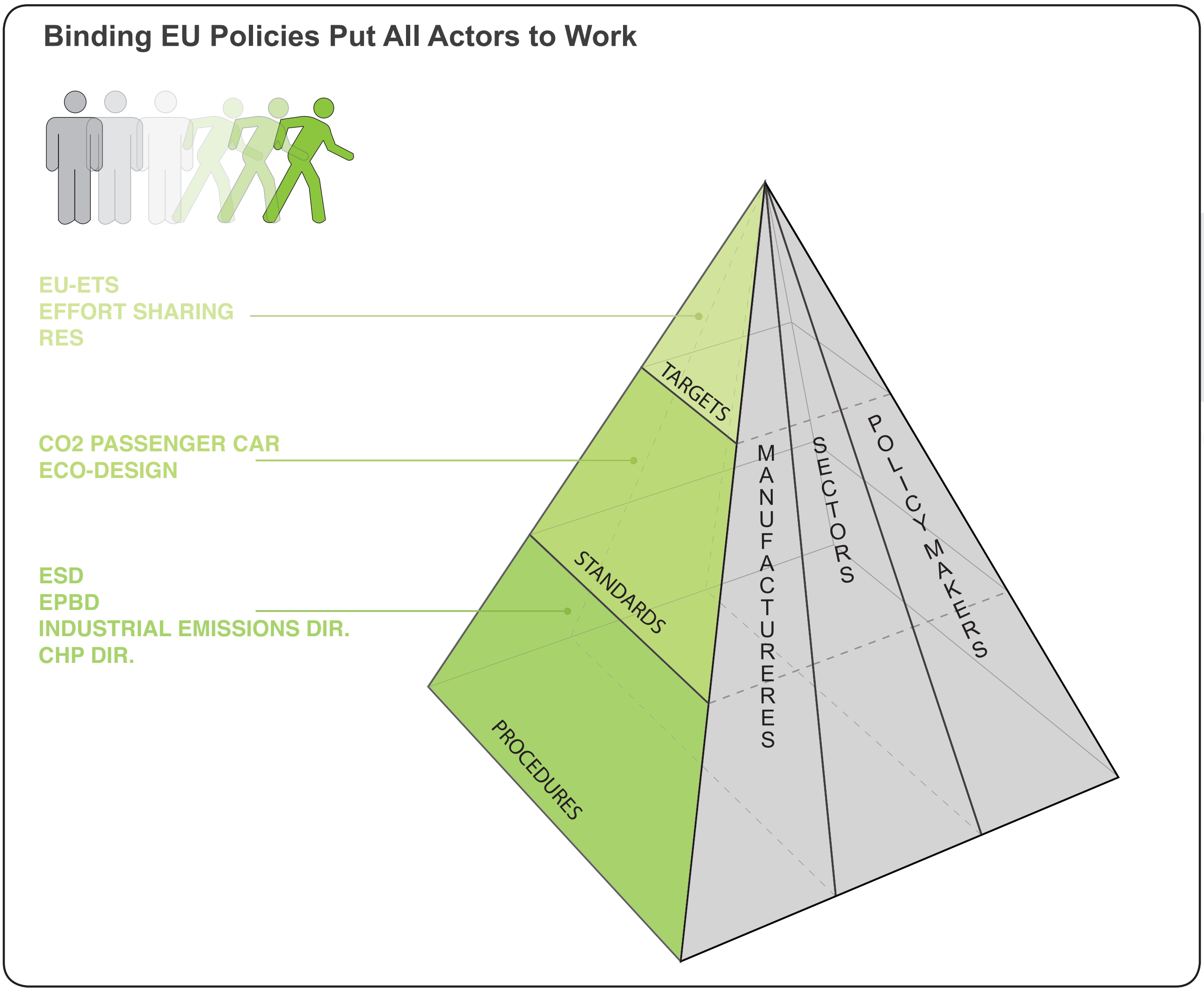



Figure 6 - 38 Illustrative representation of the EU policy landscape. Narrowly defined Regulations for products generally provide little flexibility for Member States, whereas Framework Directives (such as the Energy Services Directive) only prescribe a procedure and therefore offer more flexibility for Member States. Current EU Climate and Energy policies are positioned within this policy landscape.

Interactions with existing EU policies are discussed extensively in the next section.

## 6.4 INTERACTION WITH EXISTING POLICIES

Ideally, a new policy should strengthen current policies. This is the 'coherency' argument that is introduced in the White Paper on Governance (COM(2001) 428 final) and is an important element of the EU Impact Assessment Guidelines (SEC(2009) 92). Maximising coherence means maximising the mutual reinforcing of policy actions across government departments and agencies, creating a synergy that promotes the achievement of EU objectives. It is worth noting however, that if a policy design for a binding energy savings target is not coherent with existing policies this does not necessarily mean that the option should be discarded. Alternatively, suggestions for change of current policies, in order to optimally fit a new policy in, could be provided.

In the next section we analyse the interaction between binding energy savings target and the following policies/regulations:

- Eco-design and Labelling Directives
- $CO_2$ emission standards for passenger transport
- EU-ETS Directive
- Renewable Energy Directive
- Effort Sharing Decision
- Energy Services Directive
- Energy Performance of Buildings Directive (EPBD)
- Industrial Emissions Directive (IED)
- CCS Directive
- CHP Directive

The interactions of current policies with a binding energy savings target depends on the design of such binding target, e.g. an economy-wide target versus an end-use target and a target on the EU level versus one on the Member State level. Where required, we indicate where an interaction is related to a specific design option.

### 6.4.1 INTERACTION WITH THE EU LEGAL ACTS FOR PRODUCT STANDARDS

The Eco-design and Labelling Directives, more specifically their Implementation Measures that set actual product standards, as well as the Regulation for $CO_2$ standards in passenger cars represent EU legal acts that work directly into Member States.

*Positive interaction*

A binding energy savings target, whether for the full economy, or 'end-users' on EU or Member State level, will be a strong driver for national representatives to pursue more ambitious Implementing Measures (new measures and existing ones that need to be revised) and strict compliance to standards on imported products. As shown, current Eco-design Implementation Measures are modestly ambitious and do not exploit the full cost-effective potential for energy savings (see chapter 3).[42]

A binding energy savings standard for transport could increase the (future) ambition level of regulations setting $CO_2$-standards for cars, including incentives for electric cars. A binding target could warrant the introduction of a 95 g-$CO_2$/km standard for 2020. In addition, a binding energy savings target for transport would stimulate standards for trucks and structural changes in the sector that would save energy (e.g. modal shift of freight to rail, etc).

*Coherence requires attention*

When energy savings targets are set on a Member State level, for the whole economy or a subset of sectors, incoherence could occur where product standards have not been set at a high enough level

42. Annex II of the Eco-design Directive provides that the level of ambition standards should be determined by an analysis of the least life cycle cost for the user of equipment (based on use of realistic discount rate, purchase price and realistic estimate of the lifetime of a product).

to achieve national targets. This is because Member States are not, or only to a very limited extent, allowed to tighten product standards at national level. In this case, Member States have to rely on the softer labelling instrument or design more expensive programs for accelerated replacement of old equipment. An example of such incoherence is reported for national air quality standards (Folkert et al., 2005)

## 6.4.2 INTERACTION WITH EU ETS

*A target that promotes end-use electricity savings interacts positively with the EU-ETS*

A binding target that promotes electricity demand savings by 'end-users' will reduce the emissions of the power producers that participate in the EU-ETS. How to judge this interaction? The following arguments are often heard:

1. The EU-ETS scheme sends a $CO_2$-price signal to electricity 'end-users' which in theory should already provide sufficient incentives for electricity demand savings.

2. Additional incentives for end-use electricity savings are redundant, because the EU-ETS cap will guarantee that the emissions associated with electricity are reduced one way or another (e.g. by fuel shift from coal to gas in power production, demand-side savings, shift to renewables, etc.).

3. Stronger electricity end-use savings than envisaged in the ETS cap could endanger the EU-ETS as it reduces the scarcity of permits under the scheme, reducing the $CO_2$ price and thus reducing the incentive to make long term investments in clean technology[43].

How to respond to these arguments?

1. In chapter 5 we illustrated that a policy mix is always required, as price incentives alone are not sufficient to stimulate electricity end-use savings due to the so-called 'bounded rationality' of 'end-users'.

2. From a societal, economy-wide, cost-perspective electricity end-use savings are often cheaper than alternative options like a shift to low carbon fuels, renewables, CCS, etc. Realising cheap emissions reductions outside the scheme reduces costs for ETS-participants, which is fully in line with the primary aim of the EU-ETS, i.e. to achieve the emissions cap at the lowest cost.

3. At the same time, while realising this most cost-effective option first, the ETS cap should be decreased for the purpose of maintaining a price signal that provides the incentives for investments in clean technology that are required to achieve deep GHG emission reductions in the long term (see chapter 2.1)[44].

The last point is further illustrated in Figure 6 - 39 and Figure 6 - 40. Figure 6 - 39 shows the impact of HPI end-use electricity savings on overall electricity production in the EU. Note that estimates are indicative as they are measured against the 'pre-recession' expectations of EU electricity demand (PRIMES-2007). Potentially, electricity savings could reduce $CO_2$-emissions in the power sector by some 300 Mt $CO_2$ in 2020 (assuming an average $CO_2$ emission factor of fossil-based electricity generation of 0.5 Mt $CO_2$/TWh). Next, Figure 6 - 40 illustrates how this *potentially* impacts the EU-ETS scheme. Indeed, substantial electricity savings can potentially reduce the scarcity of permits under the EU-ETS scheme significantly. This illustrates that policies for greater electricity savings should be designed in conjunction with future adjustments of the EU-ETS cap, in order to maintain an effective price signal from the ETS.

43. Note that this potential interaction also exists between the Eco-design and ETS Directives.
44. This is particular true in case the additional electricity savings have not, or only to a limited extent, been accounted for in the cap setting. Note that due to the recession, incentives for additional savings have been reduced anyhow (see chapter 3.4.1).

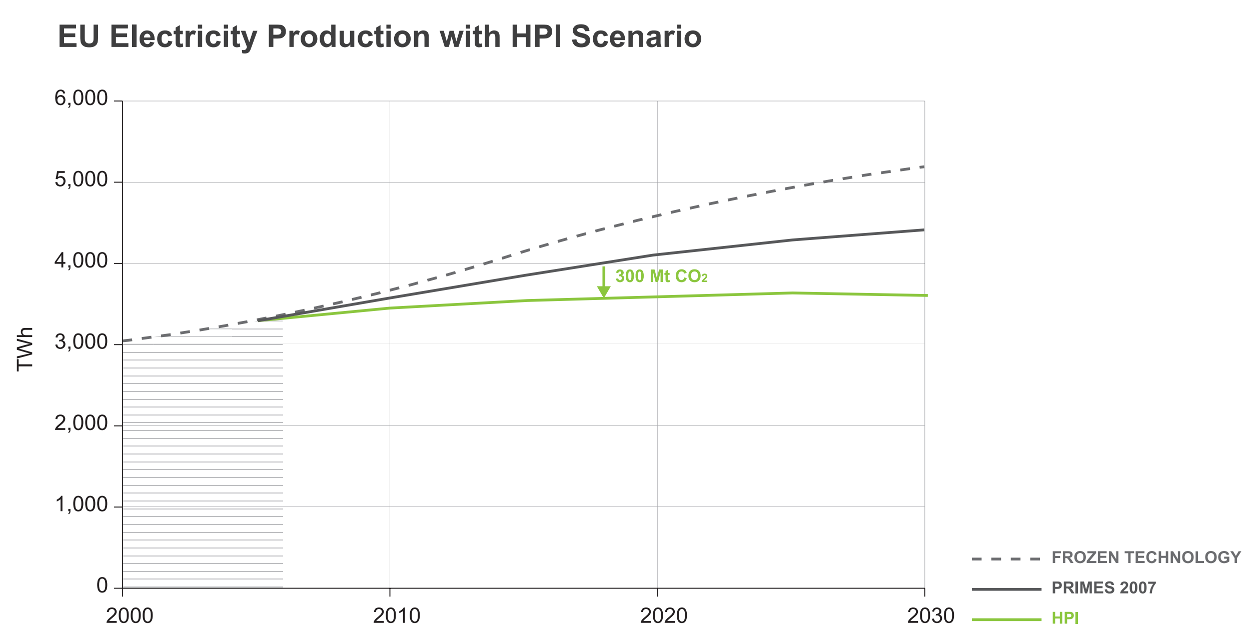



Figure 6 - 39 Impact of electricity savings (HPI scenarios) on electricity demand in EU27. The savings in 2020 compare to 300 Mt of $CO_2$ reduction, at a $CO_2$ emissions factor of 0.5 Mt-$CO_2$/TWh.

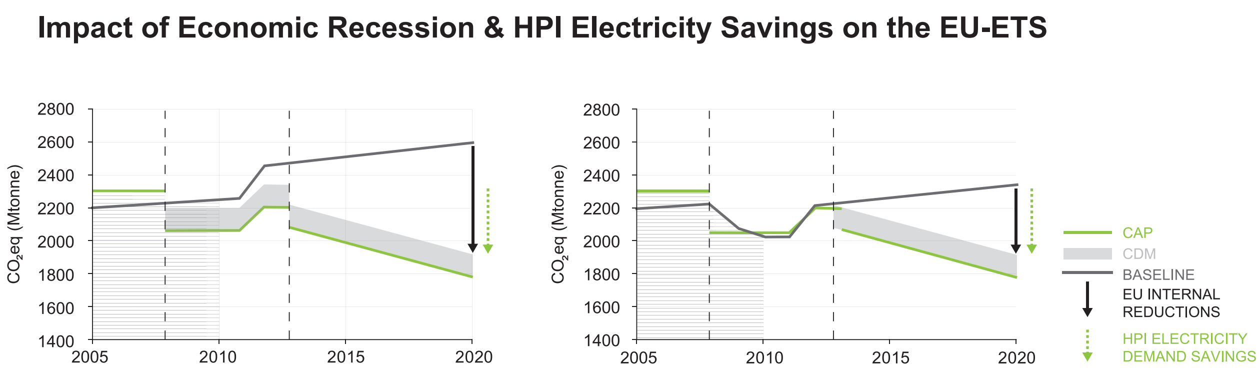



Figure 6 - 40 Scarcity under the EU-ETS in two scenarios. Left-hand graph shows the pre-recession view on EU-ETS, where EU-internal reductions should provide the main share of abatement in order to achieve the cap. The right-hand graph illustrates that the EU-internal effort is reduced under a recession baseline scenario. In both scenarios the maximum abatement from electricity savings is illustrated (green arrow) (source Ecofys, 2009a). Note: increase in cap and baseline in 2012 reflects expansion of the scope of the scheme due to inclusion of aviation.

In summary, we conclude that end-use electricity savings may provide an important positive interaction with EU-ETS. This is also the case for district heating (see textbox).

*A national binding energy target that includes fossil fuels from ETS-installations limits the flexibility that EU-ETS provides*

After the recent review of the EU-ETS, the principle control of the scheme (cap setting, allocation rules) has been transferred to the EU-level. Here, any binding energy target that puts an obligation on national ETS-sectors can potentially introduce a limitation in the flexibility that the EU-ETS provides. To illustrate this, where national ETS-sectors, or participants, may increase their fuel use (and related $CO_2$ emissions) as long as this is compensated elsewhere in the Trading Scheme, a national binding energy target for ETS sectors would reduce this flexibility.

**Interaction of district heating savings with the EU ETS**

Today about 7.5% of household heat consumption in the EU is supplied by district heating. For the tertiary sector the figure is slightly higher. We assume that most of the district heating is supplied by ETS companies, which means that energy savings (e.g. through insulation) in buildings that are served by district heating interact with the ETS. Note that this policy interaction is not new and also exists between the EPBD and EU-ETS.

To estimate the potential size of this interaction we used heat-demand savings scenarios: 20% and 30% heat savings due to insulation. At a (rather conservative) $CO_2$ emission factor of 0.2 kton/GWh heat (own estimate based on PRIMES), the insulation of buildings supplied with district heating would, at the EU27 level, result in a 15 to 23 Mton reduction of $CO_2$ emissions from district heating companies that fall under the EU-ETS (see Figure 6 - 41). This is a relatively small impact as compared to the electricity savings (see Figure 6 - 39).

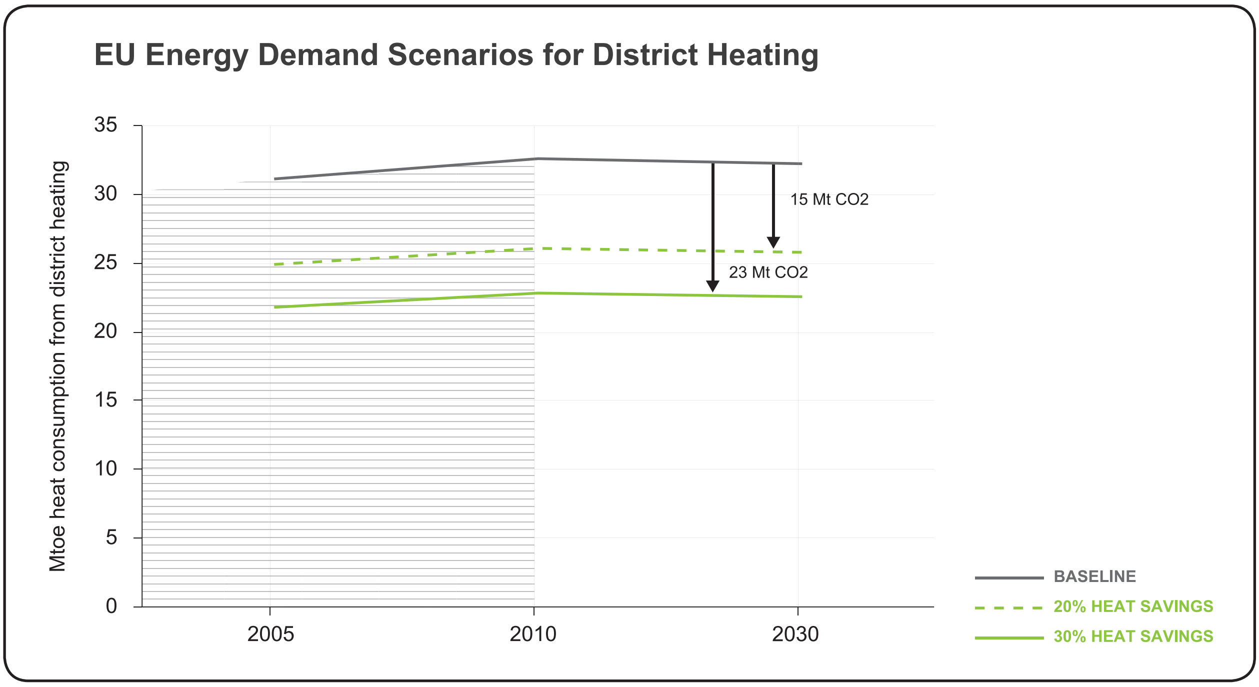



Figure 6 - 41 Energy savings potential for EU 27 from district heating expressed in $CO_2$ reduction potential.

## 6.4.3 INTERACTION WITH THE RENEWABLE ENERGY DIRECTIVE

The interaction between the RES Directive and a binding energy savings target is relevant for all target designs that are considered in chapter 6.

*Energy savings are an economical path to reach the renewable energy target*

The objective of the RES Directive is to realise an overall 20% share of renewables in total EU 27 final energy consumption and 10% renewable energy in transport. It is explicitly stated in the Directive that energy efficiency and energy saving policies are some of the most effective methods by which Member States can increase the percentage share of energy from renewable sources.[45]

45. See Recital 17 of the RES Directive.

Thus, a binding energy savings target will help to meet RES targets. The cost-curve in Figure 6 - 42 shows the double societal profit that arises from energy savings. Savings in themselves are very cost-effective from a societal perspective, whereas renewables still come at a net cost—disregarding external costs. This emphasises the cost-efficiency of energy savings measures.

*A binding energy savings target can strengthen the efficient use of biomass in end-use sectors*
Regarding biomass use, the RES Directive states in Article 13.6 that Member States should aim at biomass conversion efficiencies of at least 70 and 85% respectively in industry and in the built environment. It is however not evident that the RES Directive will lead to more biomass efficiency on its own, see textbox.

**Binding energy saving targets may contribute to efficient use of biomass**
The RES Directive aims to promote the efficient use of biomass in all sectors. In practice however, the RES target could provide conflicting incentives. This is illustrated as follows. The RES target is defined as a total share of renewable energy in final energy use. Biomass that is supplied to households is statistically monitored as final energy. If for example 1 MJ of final RES is delivered to an end-user and burnt in an inefficient stove with an efficiency of 10%, only 0.1 MJ of useful heat is produced. Still 1 MJ of final RES is registered in statistics. Practically, this means that replacement of inefficient wood stoves in the built environment by more efficient ones does not contribute to achieving the RES target. Since replacing inefficient stoves would be in line with Article 13.6 of the RES Directive, a binding energy savings target might help strengthen the promotion of efficient use of biomass in the built environment.

*The RES Directive promotes efficient energy supply*
As recalled at several places in this report, wind-, hydro- and solar-electricity perform by EU-definition at 100% energy efficiency (see section 4.6.2). This means that an increased share of these renewables in power supply increases energy efficiency.

In summary, the interaction between the RES Directive and binding energy savings targets works as follows:

- A binding energy savings target helps in meeting the RES target.
- Vice versa, the realisation of the RES target with wind, hydro and solar power leads to additional energy savings (see also section 4.6.2 ).
- Moreover, a binding energy savings target can be a further incentive to promote efficient use of biomass (which is in line with Article 13.6 of the RES Directive)

### 6.4.4 INTERACTION WITH THE EFFORT SHARING DECISION

The targets under the Effort Sharing Directive are for *direct GHG emissions* from the built environment, transport, non-ETS industry, agriculture and waste sectors (the 'non-ETS sectors'), and do therefore not include electricity consumption. The interaction between the Effort Sharing Decision and binding energy savings targets is therefore relevant for all target designs that include fuel consumption in the non-ETS sectors.

The overall EU 27 Effort Sharing target is -10% GHG emissions in 2020 compared to 2005, with individual Member State targets ranging between -20% for e.g. Denmark and +20% for Bulgaria.

*A binding energy savings target could strengthen the Effort Sharing Decision*
How would a binding target that realises a Member States' HPI energy savings potential (see chapter 4) interact with the Effort Sharing targets for 2020? Figure 6 - 43 illustrates to what extent realisation of the HPI energy savings potential in 2020 contributes to realisation of the effort sharing target when no

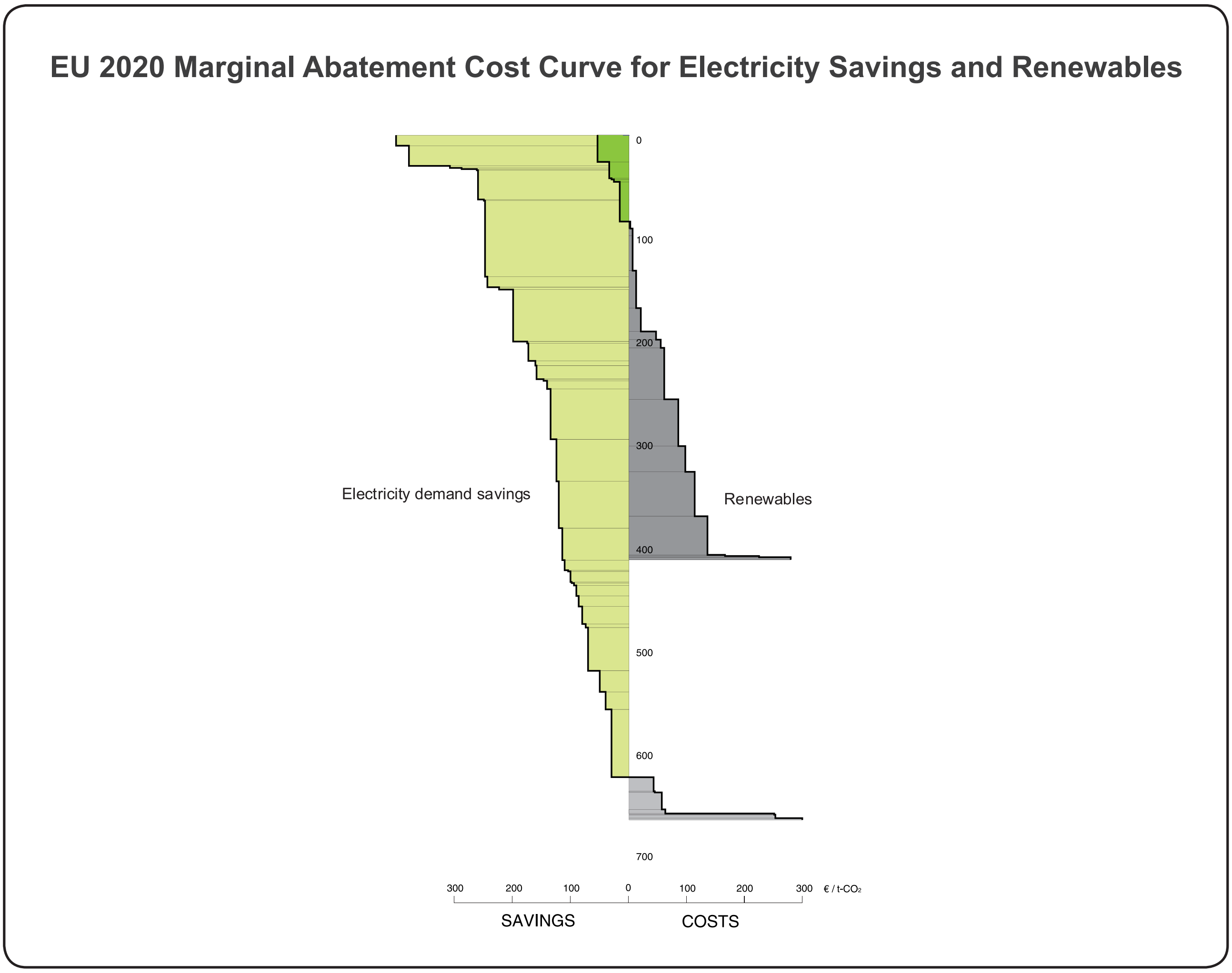



Figure 6 - 42 MACC for electricity end-use savings versus renewables. Y-axis shows $CO_2$ abatement potential in 2020, measured against a frozen technology reference development. X-axis shows specific costs (€/t-$CO_2$) (source: SERPEC, Ecofys et al. 2009a).

other GHG abatement measures, other than those assumed in the baseline, are taken into account.

A positive gap in Figure 6 - 43 indicates that realising the full HPI energy savings potential alone is not sufficient to achieve the Effort Sharing target. However, after accounting for the impact of the recession on energy use, most Member States face an overshoot (negative gap) which means that less than the HPI potential is needed to achieve the Effort Sharing target. This does not take into account the fact that Member States can choose a suite of other measures to fulfil their Effort Sharing Decision target, ranging from measures that reduce F-gases in industry and appliances, $N_2O$ in industry and agriculture, $CH_4$ in agriculture and waste, to CDM offsets (see also Figure 3 - 10). In other words, we expect to see limited incentives from the Effort Sharing Decision to specifically increase energy savings.

A binding energy savings target, therefore, would clearly provide a new and additional policy incentive for energy savings on top of the Effort Sharing Decision. Alternatively, one could argue that political resistance may occur when a stringent binding energy savings target (i.e based on HPI) overrules a modest Effort Sharing target.

## Impact of HPI Implementation on Achieving Effort-Sharing Targets

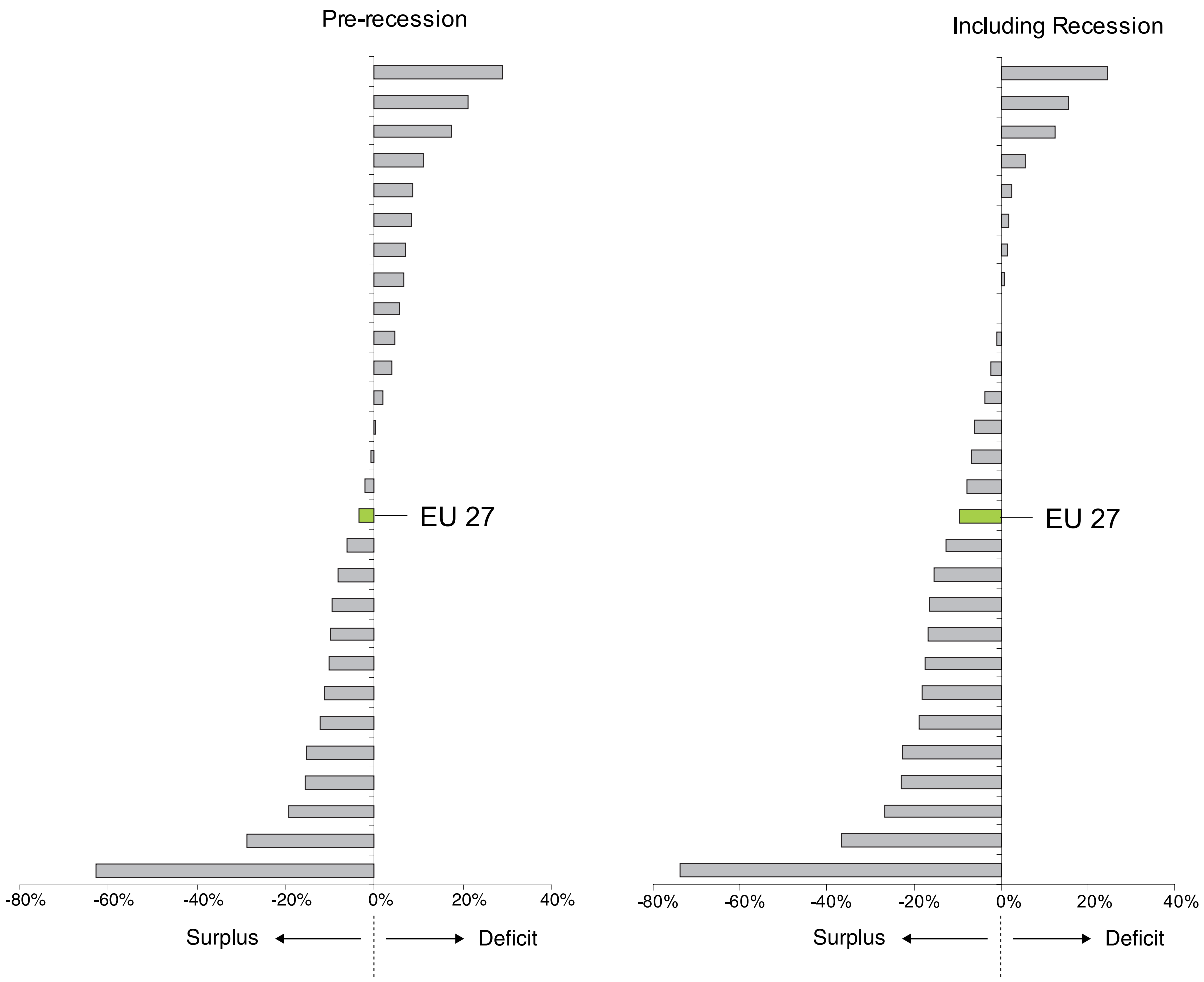



Figure 6 - 43 Distance to effort sharing target in 2020, after realisation of HPI energy savings. Individual Member States are shown anonymously, green bar indicates EU 27. A positive gap indicates that additional measures beyond implementation of HPI savings potential will be required to meet the Effort Sharing Decision target. A negative value indicates an overshoot of the target. The left-hand graph is assessed against a pre-recession (PRIMES-2007) baseline[46]. The right-hand graph includes a first order estimate (based on PRIMES-2009) of the recession impact.

### 6.4.5 INTERACTION WITH THE INDICATIVE ENERGY SAVINGS TARGET OF THE ENERGY SERVICES DIRECTIVE

Almost any design for a binding energy target will interact with the Energy Services Directive. Currently this is the only Directive that contains a multi-sectoral energy savings target for end-use sectors (with target year 2016).

Any binding energy savings target that covers end-use energy consumption and is implemented before 2016, would overrule the indicative savings target of the Energy Services Directive. Any revision of the Directive should account for this.

46. E.g. EU 27 (pre-recession): EU 27 as a whole has to reduce its 'effort sharing' energy use (non-ETS fuel use) by 17.3% in 2020. The 2020 HPI potential for EU 27 is 20.7% (see Table 13 in Annex 2). This means that after full implementation of HPI, EU 27 needs -3.4% additional savings to meet its overall Effort Sharing target. These should come from non-$CO_2$ GHG mitigations measures, domestic RES or CDM offsets.

### 6.4.6 INTERACTION WITH THE EPBD

The recent revision of the EPBD has increased its scope and ambition level substantially. The nature of the Directive is that it provides a flexible framework for Member States to define standards and develop plans and national measures. Binding savings targets could stimulate Member States towards a fast and ambitious implementation of the EPBD.

This positive interaction is relevant for all design options that include fuel and electricity use in the built environment.

### 6.4.7 INTERACTION WITH THE PROPOSED INDUSTRIAL EMISSIONS DIRECTIVE (IED)

The key-element of the IED is the enforcement of the implementation of Best Available Technologies (BAT), for prevention and control of emissions into air, water or soil, for waste management, for efficient use of energy and for prevention of accidents. It gives Member States the option to impose requirements relating to energy efficiency, although in the case of industrial activities listed under the Emission Trading Directive, they are not obliged to do so. A binding energy saving target could strengthen the implementation of BAT.

The interaction between the proposed Industrial Emissions Directive and binding energy savings targets is relevant for all target designs that include heavy industry and large energy suppliers.

### 6.4.8 INTERACTION WITH THE CCS DIRECTIVE

Capture, transport and storage of $CO_2$ consume energy. CCS decreases the net efficiency of a power plant by 15 to 25% (Hendriks et al., 2004). Large-scale application[47] of CCS will therefore interact with all target designs that include the fossil fuel power supply sector (CCS for coal- or gas-based power production) and, to a lesser extent, power production from biomass plants and large industrial boilers.

### 6.4.9 INTERACTION WITH THE CHP DIRECTIVE

The CHP Directive does not impose a CHP target on Member States. The Directive:

- Sets definitions for high-efficiency CHP (HE-CHP)
- Obliges Member States to identify their HE-CHP potentials and to remove barriers that hamper implementation of CHP
- Obliges Member States to set up a system for guarantees of origin for HE-CHP
- Aims to stimulate energy savings and does not discriminate between fuels

Interaction between the CHP Directive and binding energy savings targets is relevant for all target designs that include energy supply and end-use fuel consumption (i.e. efficient heat production in the built environment).

*A binding energy savings target and CHP Directive could reinforce each other*

A binding energy savings target could support faster and more thorough implementation of the CHP Directive (removal of barriers to enable realisation of high-efficiency CHP potential by the market). In principle, this would help in achieving a binding energy savings target. Note, however, that the provisions in the current version of the Directive are weak and would have little, if any, impact on achieving a binding energy saving target.

47. Note that large scale application of CCS will only occur after 2020.

## 6.5 FRAMEWORK FOR SCANNING OF DESIGN OPTIONS

Figure 6 - 44 shows the legal EU instruments discussed in the previous sections, in relation to energy system-, energy carrier- sector definitions, and positions them in the flexibility 'hierarchy' of EU legislation. In the next chapter this diagram will be used to illustrate the position, coverage and interaction of different design options with existing EU legislation.

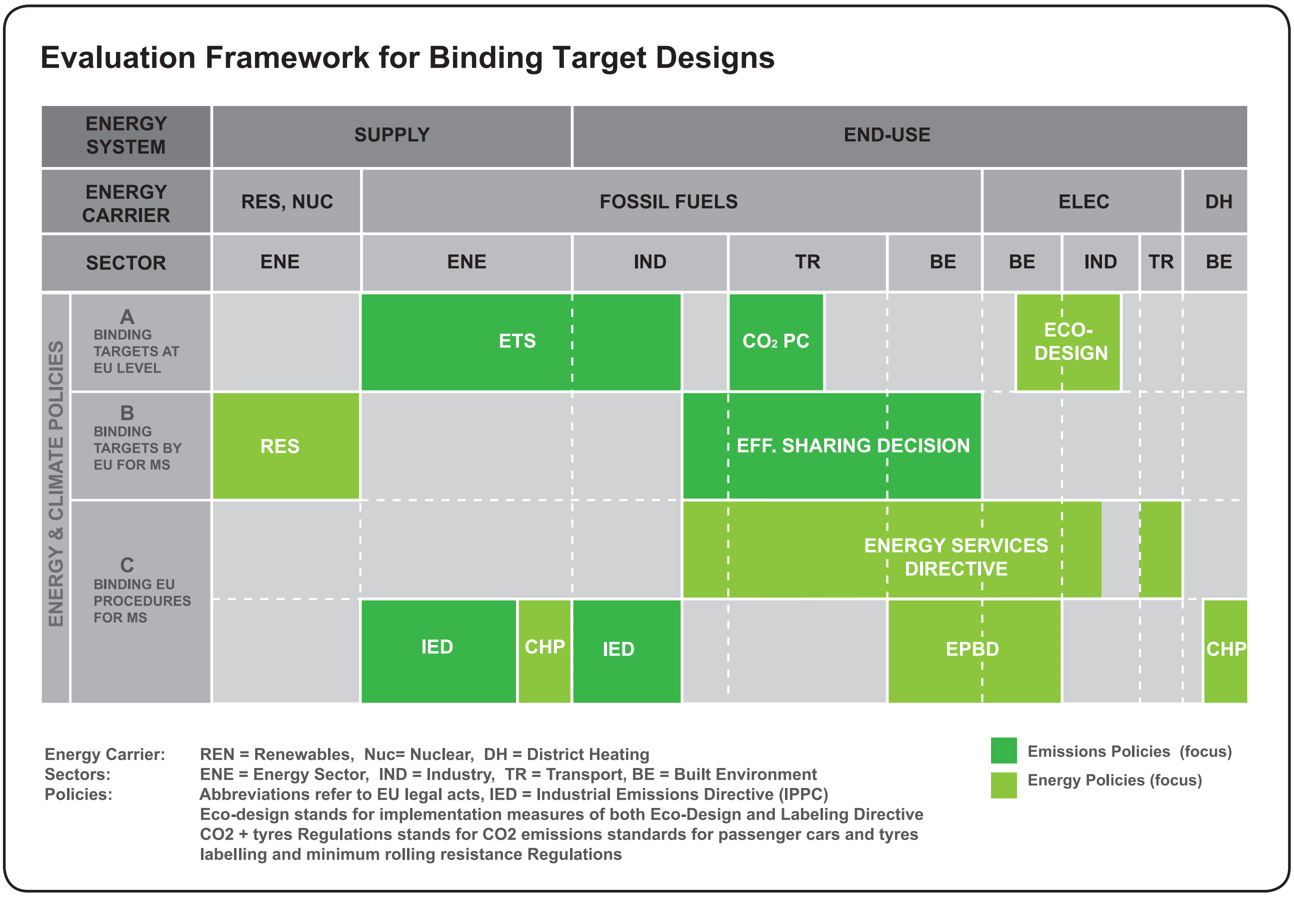



Figure 6 - 44 Illustrative summary overview of the scope of current EU policies in relation to the different definitions of the energy system (supply, end-use) (upper row), energy carriers (second row) and sectors (third row). Rows 4-7 illustrate the hierarchy of policy that set binding targets at EU level (row 4), or national level (row 5) to legal acts that set more procedural obligations (row 6 and 7).

# CHAPTER 7

# ENERGY SAVINGS TARGET: DESIGN OPTIONS AND POLICY RECOMMENDATIONS

The closing chapter of this study looks at the opportunities and challenges of four different design options for a binding energy savings target (see Figure 7 - 45):

1. One economy-wide energy savings target at the EU level.

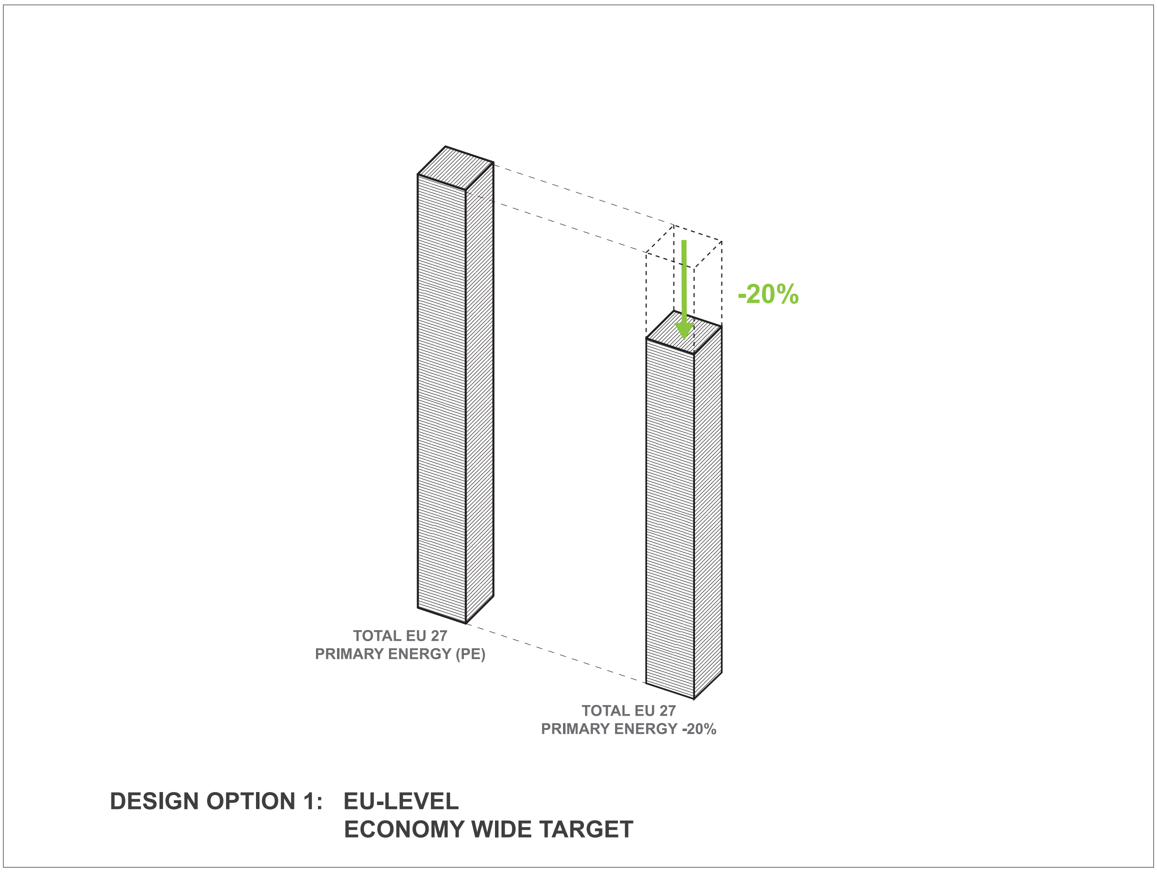
2. 'End-user' targets set at the EU level for sections of the economy.

3. One economy-wide energy savings target for each Member State

4. 'End-user' targets for Member States for sections of national economies

Here, the main criteria on which we evaluate the options is the flexibility that the options provide to Member States and the interaction with existing EU-policies. Combined, both criteria can be more broadly interpreted as the 'coherence' of a design option with existing EU policy.

# Four Design Options for a Binding Target



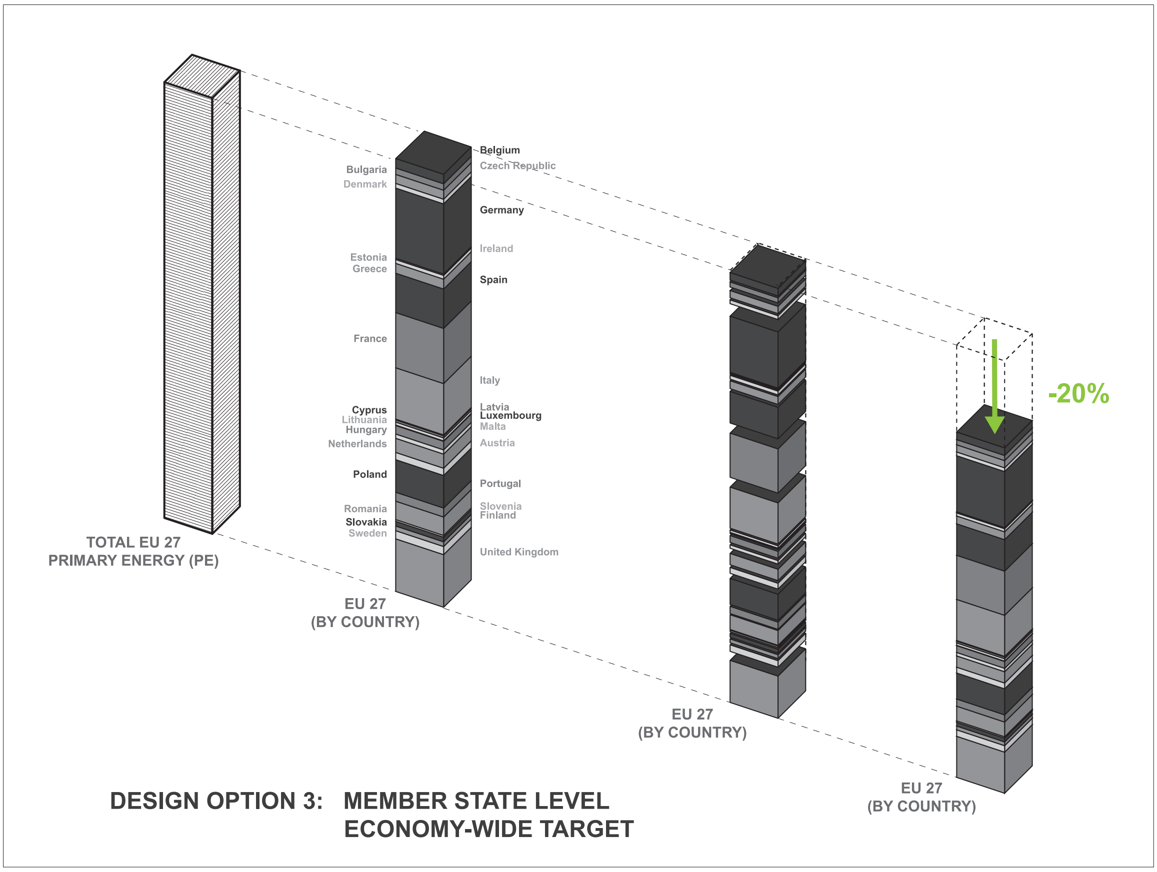
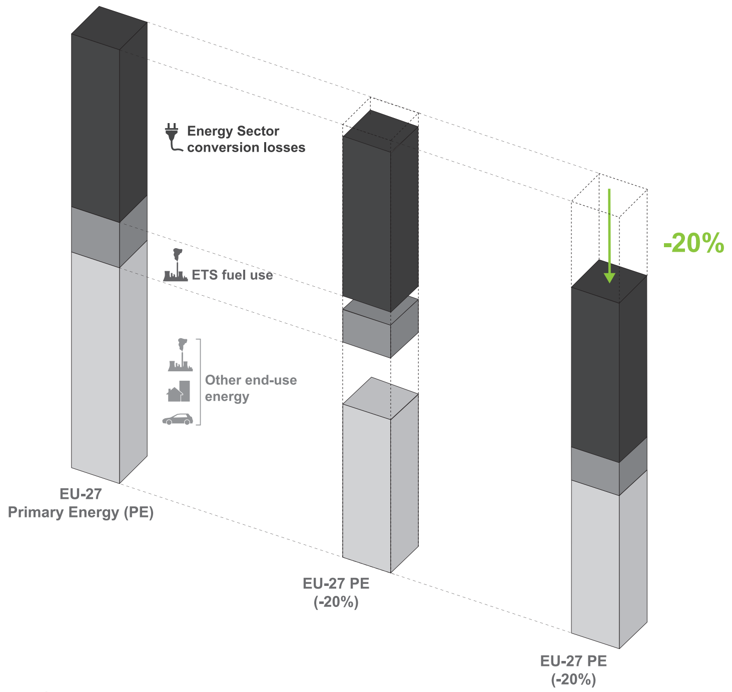
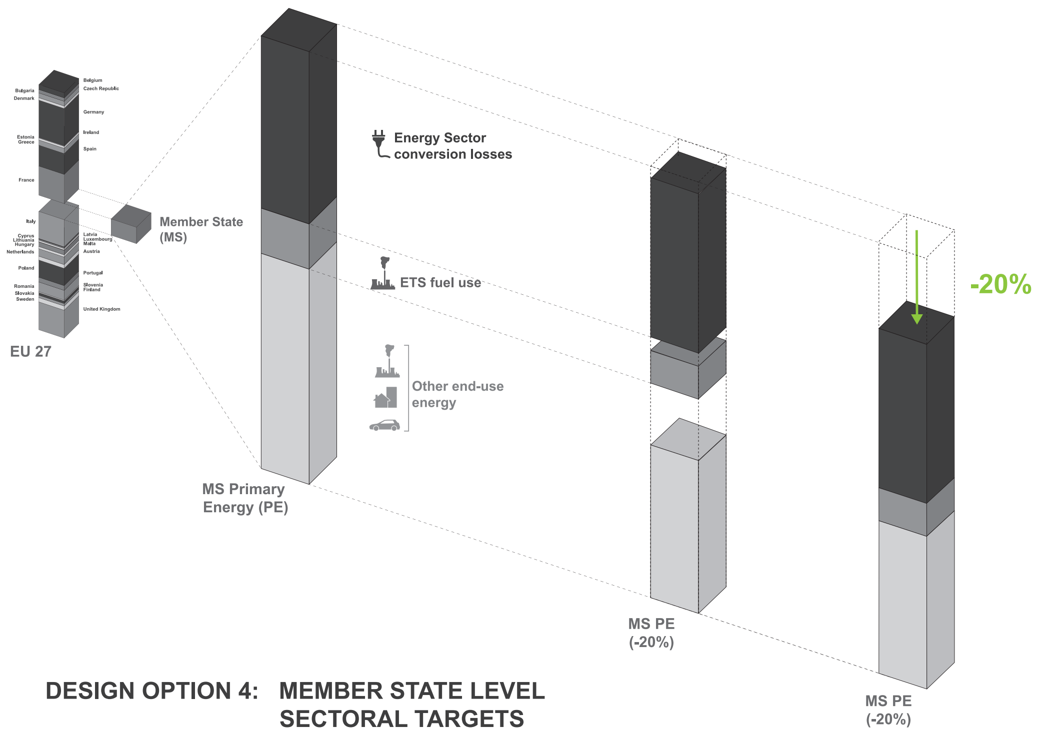




Figure 7 - 45 Visualisation of the four different design options for binding energy savings targets.




**DESIGN OPTION 2: EU-LEVEL SECTORAL TARGETS**




**DESIGN OPTION 4: MEMBER STATE LEVEL SECTORAL TARGETS**

Again, note that binding targets should establish high level accountability and be regarded as the benchmark for the implementation of energy savings policies such as energy efficiency obligations for energy distributors, soft loans for renovations of buildings, high ambition for product energy-use or emissions standards, etc. Such instruments should be tailored to move 'key-players' or 'obliged parties' towards achieving the overarching binding target. The figure in Annex 2 shows the possible obliged parties, from fuel suppliers to power and industry installations, retail, consumers and appliances producers.

Relevant for the design options is the share of the identified energy savings potential that is covered by an option. Here, Table 7 - 11 provides an overview.

| SECTOR | % OF SAVINGS POTENTIAL COVERED |
|---|---|
| **ECONOMY-WIDE** | 100 |
| | |
| **COST-EFFECTIVE HPI POTENTIAL** | 85 |
| END-USE SECTORS EXCLUDING ETS FUEL USE | 79* |
| END-USE ETS FUEL USE | 6** |
| | |
| **EFFICIENCY IMPROVEMENT IN THE POWER SECTOR (MAINLY RENEWABLE ELECTRICITY)** | 15 |

* This figure decreases to 72% in case the total energy use of ETS facilities (i.e. fuel and electricity) is excluded.
** Note that the HPI potential is assessed against the business as usual baseline development. For ETS installations, more than in other sectors, the baseline already assumes a considerable amount of energy savings as a result of autonomous improvement and impact of adopted policies. As a result the HPI potential of the industry and energy sector is comparatively low (see also chapter 4).

Table 7 - 11 Identified energy savings potential in 2020, compared to the PRIMES-2007 baseline (source: chapter 4).

## 7.1 BINDING ENERGY SAVINGS TARGET(S) AT THE EU-LEVEL

**One binding target for the overall EU economy**

A single EU economy-wide binding energy savings target would mean that the current non-binding 20% energy savings target of the EU would be incorporated in a new legal instrument. On the one hand, this could be envisaged as a master 'frame' for a new set of energy policies under the new energy chapter of the Lisbon Treaty (see chapter 3.1). Note, however, that this requires innovative policy making and we are not aware of comparable examples in other EU policy areas.

Figure 7 - 46 illustrates that a single EU economy-wide binding target would create a new 'boundary condition' for EU legislation that already set targets at the EU level, like the EU-ETS, the emissions performance of passenger cars and the Eco-design implementation measures. Also it would incentivise the introduction of new policies like $CO_2$ standards. Figure 7 - 46, however, also shows that such a target would be disconnected from EU policies like the EPBD, the IED, the CHP Directive and Energy Services Directive, which typically allow Member States a good deal of flexibility in compliance. Thus, it would be unclear which parties could actually be obliged to implement the target. This would significantly limit target compliance.

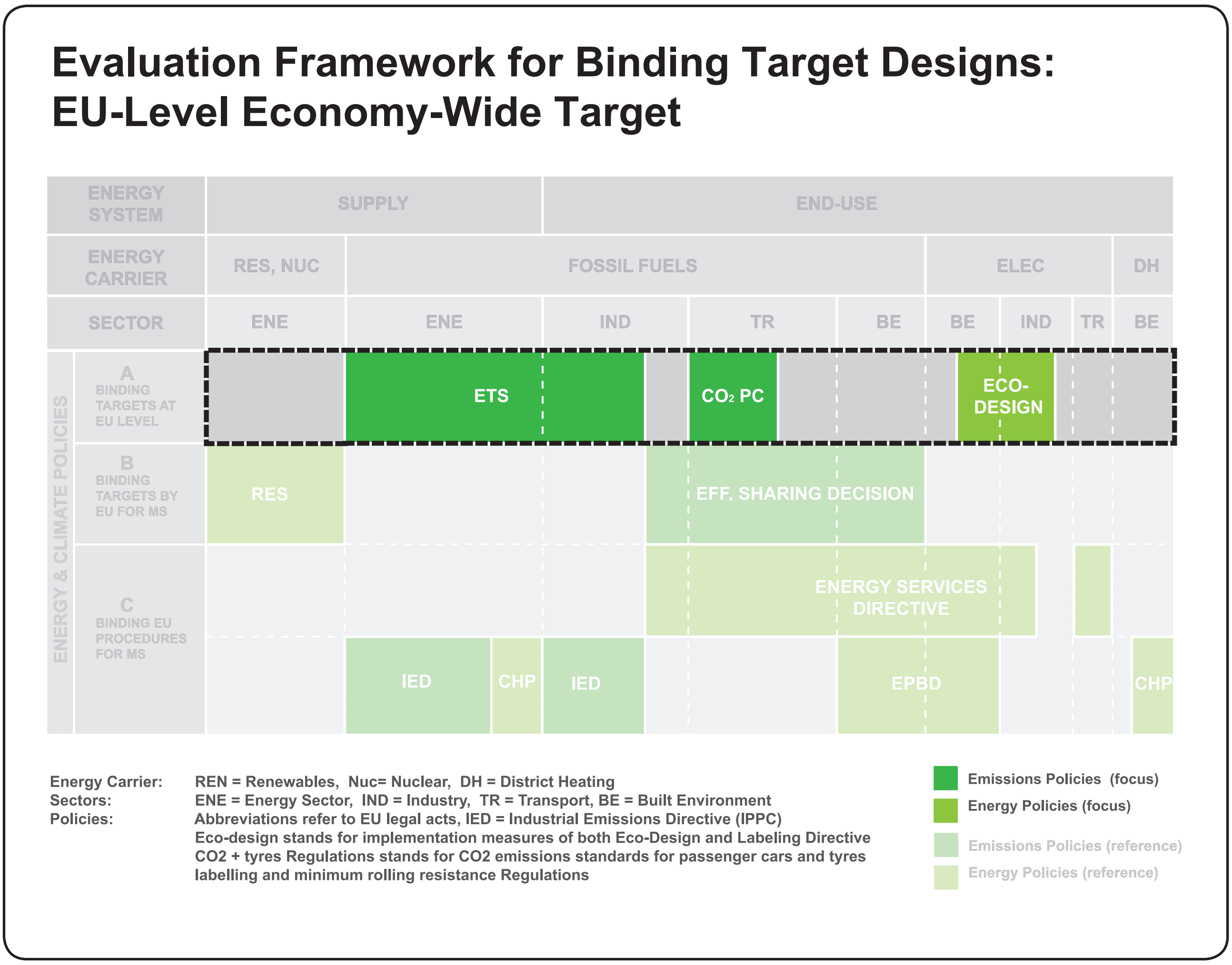



Figure 7 - 46 Illustrative summary overview of the scope of current EU policies in relation to the different definitions of the energy system (supply, end-use) (upper row), energy carriers (second row) and sectors (third row). Rows 4-7 illustrate the hierarchy of policy that set binding targets at EU level (row 4), or national level (row 5) to legal acts that set more procedural obligations (row 6 and 7). Dotted lines around row 4 illustrate the option of one single economy-wide EU energy savings target.

**Binding target(s) set at EU level for section(s) of the EU economy**

An alternative design option is to introduce one or more binding targets at the EU level, each covering a part of the EU economy. In Figure 7 - 47 three options for separate targets are shown: 1) renewable energy supply, 2) fossil fuels covered by EU-ETS and 3) the energy use of end-use sectors excluding ETS. These targets respectively cover 15%, 6% and 79% of the economy-wide HPI primary energy savings potential identified in this study.

## Evaluation Framework for Binding Target Designs: EU-Level Sectoral Targets

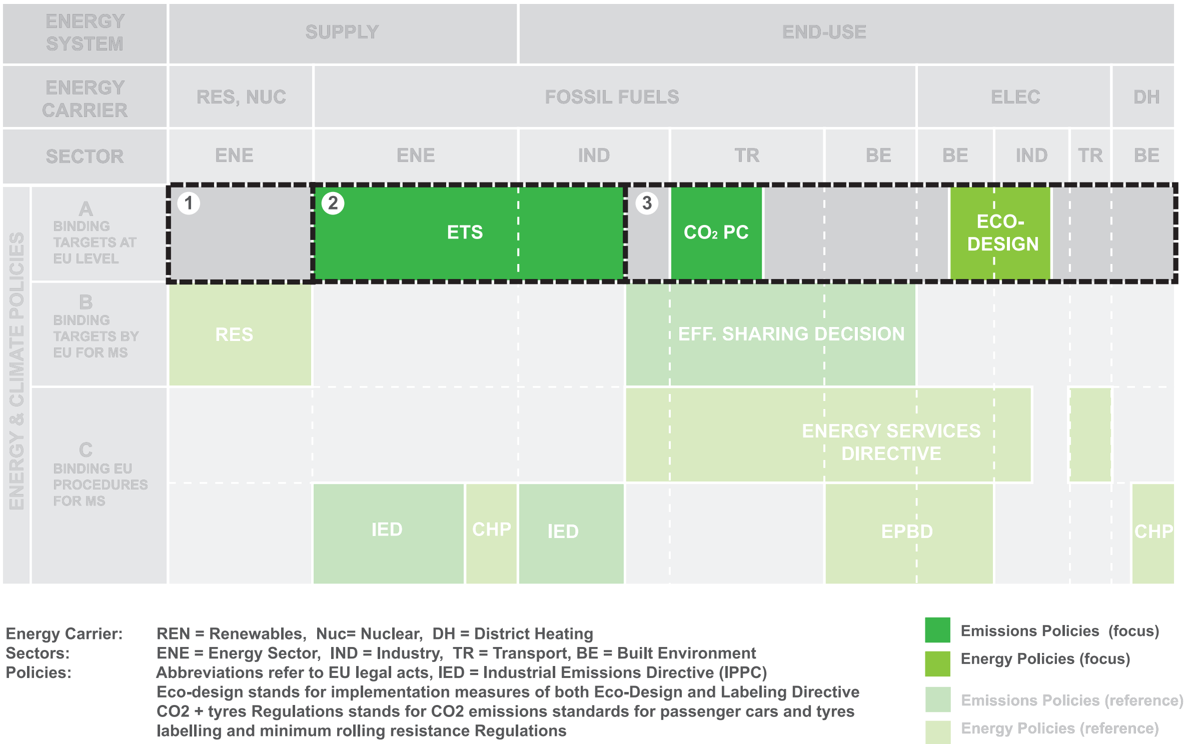



Figure 7 - 47 Illustrative summary overview of the scope of current EU policies, in relation the different definitions of the energy system (supply, end-use) (upper row), energy carriers (second row) and sectors (third row). Rows 4-7 illustrate the hierarchy of policy that set binding targets at EU level (row 4), or national level (row 5) to legal acts that set more procedural obligations (row 6 and 7). Dotted lines around row 4 illustrate the option of 3 types of sub-target(s) set at the EU-level.

Here, an energy saving target for the renewable energy supply sector would be a somewhat strange policy element. Although efficient use of renewable energy should be encouraged, an absolute energy savings target for renewable energy supply as such would hamper accelerated deployment of renewable energy. Moreover, savings on energy 'end-uses' are recognised as the most cost-effective way of increasing the share of renewables.

A binding energy savings target for ETS-sectors would create a new incentive in combination with the greenhouse gas cap. This implies that a future ETS cap and allocation procedure should be designed in such a way that it integrates both energy and GHG constraints[48].

Figure 7 - 47 illustrates that an energy savings target for 'end-users', excluding the energy use covered by ETS, would create a new incentive for EU legislation that already sets targets or standards at the EU level, like the emissions performance of passenger cars and the Eco-design implementation measures. Also it would encourage introduction of new policies like $CO_2$ standards for trucks. Note that we showed in the previous chapter that end-use electricity and district heat savings support the objectives of the EU-ETS.

On the other hand such an EU-target would still be rather disconnected from framework Directives like the Energy Performance of Buildings Directive (EPBD) and the Energy Services Directive (ESD) where compliance is largely delegated to the Member State level.

48. Scanning the feasibility of such integration was outside the scope of our study.

## 7.2 BINDING ENERGY SAVINGS TARGET(S) AT THE MEMBER STATE LEVEL

**One binding energy savings target for each Member State**

A single economy-wide target, set for each EU Member State, would mean that the current 20% EU target is burden shared over the 27 Member States[49]. Several examples support such an approach, like the 20% EU-renewables target and the GHG target under the Effort Sharing Decision. Related examples from other policy areas are the emissions ceilings for air pollutants under the NEC Directive, the EU milk quota and the Total Allowable Catches in EU fisheries policies.

A single national target would provide Member States with flexibility on how to implement the target. It would create a positive incentive for ambitious implementation of framework Directives like the EPBD, the IED, the CHP Directive and Energy

### Evaluation Framework for Binding Target Designs: Member State Level Economy-Wide Target

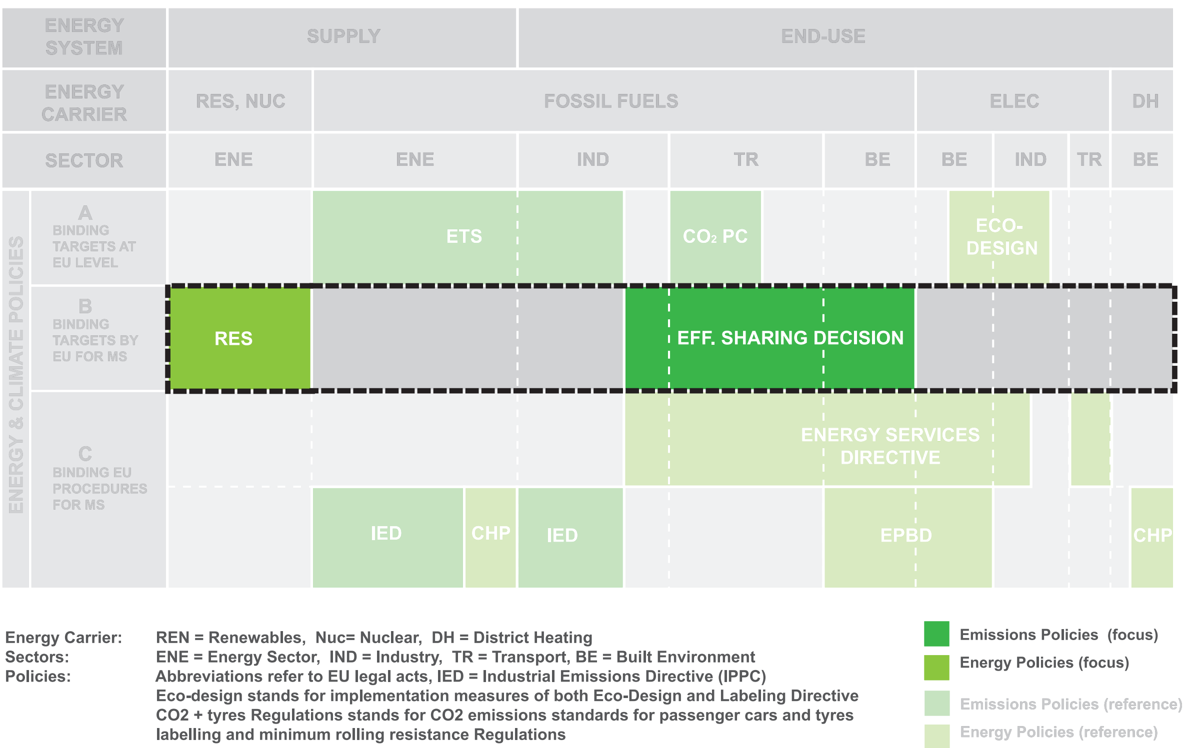



Figure 7 - 48 Illustrative summary overview of the scope of current EU policies, in relation to the different definitions of the energy system (supply, end-use) (upper row), energy carriers (second row) and sectors (third row). Rows 4-7 illustrate the hierarchy of policies that set binding targets at EU level (row 4), or national level (row 5) to legislation that sets more procedural obligations (row 6 and 7). Dotted lines around row 5 illustrate the option of one single economy-wide energy savings target for each EU Member State.

49. The HPI potentials of Member States in Appendix 2 provide a first indication of a possible burden sharing mechanism.

Services Directive and it would strengthen the rather weak incentives on energy savings that we expect from the Effort Sharing Decision.

As a result of a national binding energy savings target, Member States would be expected to take an ambitious position at the EU-level with respect to setting new standards in Eco-design implementation measures and transport regulations. However, when these standards are not set at top ambition, incoherence may arise between national and EU-wide energy savings targets.

Also, Member States may perceive incoherence between national economy-wide energy savings targets and EU-ETS policies. This is because the ETS sector in a Member State is allowed to increase $CO_2$ emissions (and thus its primary energy use) as long as this is compensated EU-wide, elsewhere in the Trading Scheme. In such a case, the increased primary energy use would require an additional effort from the Member State to meet its energy savings target.

**Binding target(s) set at Member State level for section(s) of the economy**

An alternative design option is to introduce one or more binding national targets, that each cover a part of the economy. Here, as discussed earlier, the renewable energy supply sector may be excluded. For the power sector under EU-ETS we provided evidence of substantial efficiency improvement in the baseline. To avoid the incoherence with EU-ETS mentioned earlier, a partial national target could exclude the fuel use of ETS. A national sub-target would then focus on 'end-users' *excluding fuel use for ETS industry* (see Figure 7 - 49). Such a target would still cover 79% of the economy-wide HPI primary energy savings potential identified in this study. If the electricity use from installations that participate in EU-ETS was also excluded, the target would cover 72% of the HPI potential. This last target definition resembles the current scope of the Energy Services Directive's non-binding target.

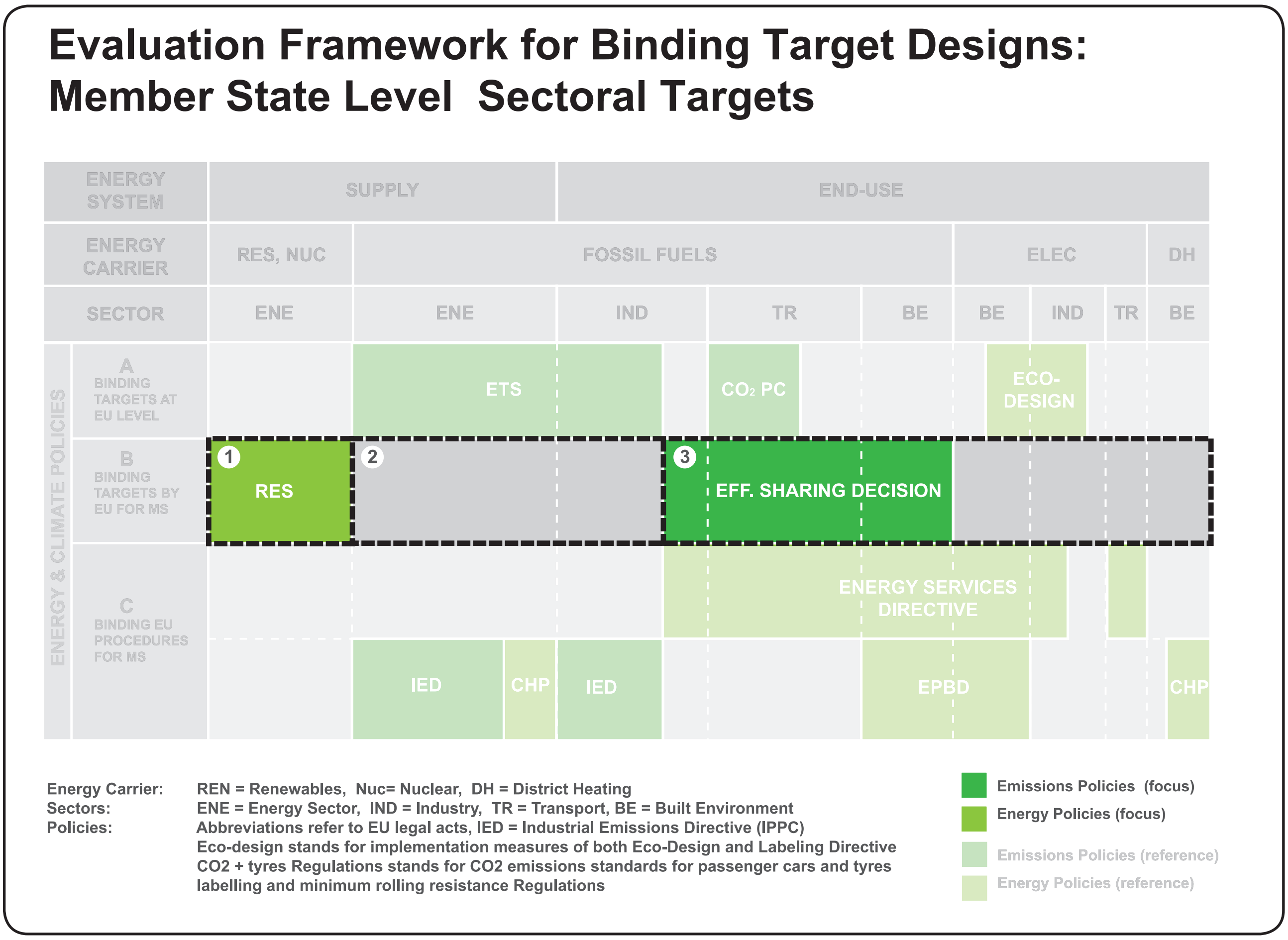



Figure 7 - 49 Illustrative summary overview of the scope of current EU policies, in relation the different definitions of the energy system (supply, end-use) (upper row), energy carriers (second row) and sectors (third row). Rows 4-7 illustrate the hierarchy of policy that set binding targets at EU level (row 4), or national level (row 5) to legal acts that set more procedural obligations (row 6 and 7). Dotted lines around row 5 illustrate the option of 3 types of sub-target(s) set at the Member State level.

A binding target at Member State level ensures political accountability and commitment to deliver results while providing the required flexibility to choose and apply the most suitable tools to achieve the target. It presents a framework to guide the implementation of existing EU energy efficiency policies, e.g., the EPBD, the IED, the CHP Directive and the Energy Services Directive. Adopting a binding savings target for Member states in conjunction with these existing policies reduces the risk of fragmented or weak national implementation activities.

Additional EU policies to further reduce these risks could be considered, such as a requirement for EU energy distributors (e.g., electricity, heat and transport fuels, see textbox) to demonstrate energy savings in parallel with the binding target at the Member State level. The trade-off is that such an approach would reduce national flexibility in developing and applying target attainment measures. Clearly, however, careful further assessment and investigation of such an EU legislative instrument would be required.

**EU requirement on energy distributers**

The EU-ETS provides an example of EU-policies in which the common rules and targets for industrial and power facilities are set at the EU-level. Building on this example, an EU energy savings obligation put on energy distributors or retailers (electricity, heat, transport fuels) in all Member States could be envisaged[50]. Such an instrument could encourage distributors and retailers to change their business model and realise energy savings with their clients (e.g. efficient light bulbs, or insulation of houses). Such an instrument could function as a lever for ambitious implementation of the framework directives like the Energy Services Directive and the EPBD that work on the Member State level[51].

Though this option builds on the EU-ETS example, it is also different. Distributors and retailers are made responsible for the energy savings of their clients, which may not be fully compatible with their business model to promote energy sales. We are therefore not aware of an example EU-policy that exactly resembles the idea of an energy savings obligation for distributors or retailers. Also, national or regional obligations for energy distributors or retailers that have already been introduced in e.g. the UK (see textbox in section 3.3.2), France, Italy and Belgium, would need to be aligned with an EU-wide introduction. Moreover, to the extent that national delivery systems are being expanded to include additional (or alternate) entities, such as local governments in the UK, an EU-wide energy savings obligation that focuses on suppliers may inhibit the partnership approach being considered in those regions/countries.

EU energy saving targets on particular retailers could be challenged as incompatible with the principles of subsidiarity and proportionality. However, this could be argued against by using the example of EU-ETS that imposes certain obligations directly on particular installations or by showing how the lack of the common EU rules could cause a distortion of competition in the EU.

We conclude therefore, that direct establishment by the EU of an energy savings obligation for energy distributors is theoretically possible from a legal point of view. Clearly, however, this option would require further reflections as to its design and feasibility.

50. The reason for mentioning this particular EU-measure is, that it falls in the category of 'binding targets'.
51. Note that when EU-wide rules and targets for such a new instrument would be formulated under the Environment chapter of the Lisbon Treaty, formally the obligation would still be on Member States.

*No 'silver bullet'*

Whether a binding target is set at the Member State level for the economy as a whole, or for selected section(s) of that economy, success in achieving that target relies on effective implementation. Experience suggests that there is no single 'silver bullet' for achieving deep and large-scale energy savings through efficiency, but rather a mix of delivery strategies and national policies will be needed, tailored to local circumstances (ECF, 2010b).

## 7.3 DESIGN CONCLUSIONS

In chapters 6 and 7 we reviewed four design features and four theoretical design options for binding energy savings targets, ranging from a single economy-wide EU target to national targets for a subset of sectors. In particular, we considered two basic options for a binding energy savings target at the Member State level: (1) one binding target covering all sectors of the national economy (which would apply to primary energy use), or (2) binding target(s) for a sub-set of sectors or facilities within the national economy, focusing on 'end-users' in the built environment and transport sectors.

Though in theory all design options may be open, this analysis suggests that the most feasible design option is to introduce binding energy savings targets for 'end-users' at the Member State level. Key findings on this and related design issues are summarised below.

**Binding targets at Member State level are the most feasible**

A binding target at Member State level would ensure political accountability and commitment to deliver results while providing flexibility to choose and apply the most suitable tools to achieve the target. It could provide a framework to guide ambitious and coherent implementation of the existing EU energy efficiency policies, like the Energy Performance in Buildings Directive (EPBD), as well as the strengthening of national policies. Such a policy package should reduce the risk of fragmented or weak national implementation activities. Furthermore, binding targets at Member State level will make Member States take an ambitious position at the EU-level when new standards for e.g. appliances are set.

**A Member State binding target applied to 'end-users' is a design option that covers the vast majority of energy savings potential**

An economy-wide binding target clearly provides Member States with the most flexibility and highest savings potentials captured by the target. However, it should also form the most effective and coherent combination with EU-ETS and RES policies:

- EU-ETS participants may argue that a binding energy savings target that includes their facilities would reduce their EU-wide trade flexibility. Our calculations suggest that the additional fuel savings, compared to the baseline assumptions, expected from EU-ETS covered facilities is comparatively small.

- Our analysis of design options shows that applying the target to 'end-users' would work most effectively in tandem with RES policies. This is because end-use energy savings are the most cost-effective way of increasing the percentage share of renewables in final energy consumption, such as is already recognised in the RES Directive.

Overall, this analysis shows that adopting a binding national target that focuses on energy use that is outside the scope of EU-ETS would still realise 79% of the savings potential that is required to reach the 20% energy savings target by 2020.

**A savings target is best expressed in absolute energy use terms**

A savings target should be transparent and easy to monitor and measure. By far the most straightforward way to comply with these criteria is to define the target as absolute energy use in a target year and monitor the absolute development of energy use over time. This means that the energy use which remains is measured, rather than estimating the savings. Under this approach, the volume of energy savings, as compared to the baseline is only estimated once, and upfront, when setting the target. Subsequently, existing energy statistics, already implemented in all EU Member States through statistical offices, provide a straightforward way to monitor progress towards achievement of the target. Such an approach would also best safeguard the substantial energy savings that are required to achieve the EUs ambition of deep GHG emissions reductions by 2050.

**For targets applied to 'end-users', expressing the savings as 'adjusted final energy' will be the most transparent and measureable approach**
Our study suggests that a target for 'end-users' would preferably be expressed as 'adjusted final energy use'. Here, the electricity and district heat components of final energy use data, readily available from energy statistics, are weighted with a factor of 2.5 and 1.2 respectively. This is to ensure that electricity and district heat savings are weighted in a similar way as fuel savings. We recommend weighing factors that are constant over time and across Member States. This method is similar to the primary energy use definition but may address the tendency to use Member State specific conversion factors. A constant factor over time would provide the most transparent view on end-use energy savings achieved. A constant factor across Member States would ensure that fuel, district heat and electricity savings are weighted in the same way across Member States, which would provide an EU-wide level playing field for end-use energy savings.

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# ANNEX 1: GLOSSARY

| | |
|---|---|
| **BAT** | Best Available Technology |
| **CCS** | Carbon Capture and Storage |
| **CDM** | Clean Development Mechanism |
| **CHP** | Combined Heat-Power production |
| **EPBD** | Energy Performance of Buildings Directive |
| **ECF** | The European Climate Foundation |
| **EU-ETS** | European Union Emissions Trading Scheme |
| **FTRL** | Frozen Technology Reference |
| **GHG** | Greenhouse Gas |
| **HPI** | High Policy Intensity scenario |
| **LPI** | Low Policy Intensity scenario |
| **MACC** | Marginal Abatement Cost Curve |
| **MS** | Member State |
| **RAP** | Regulatory Assistance Project |
| **RES** | Renewable Energy Supply |
| **SERPEC** | Sectoral Emissions Reduction Potentials and Economic Costs for Climate Change |
| **TFEU** | Treaty on the Functioning of the European Union |

## UNITS

| | |
|---|---|
| **Ktoe** | Kiloton oil equivalent |
| **Mtoe** | Megaton oil equivalent |
| **Mt-$CO_2$** | Megaton $CO_2$ |
| **TWh** | Terawatt Hour |

# ANNEX 2: ILLUSTRATION OF POSSIBLE OBLIGED PARTIES

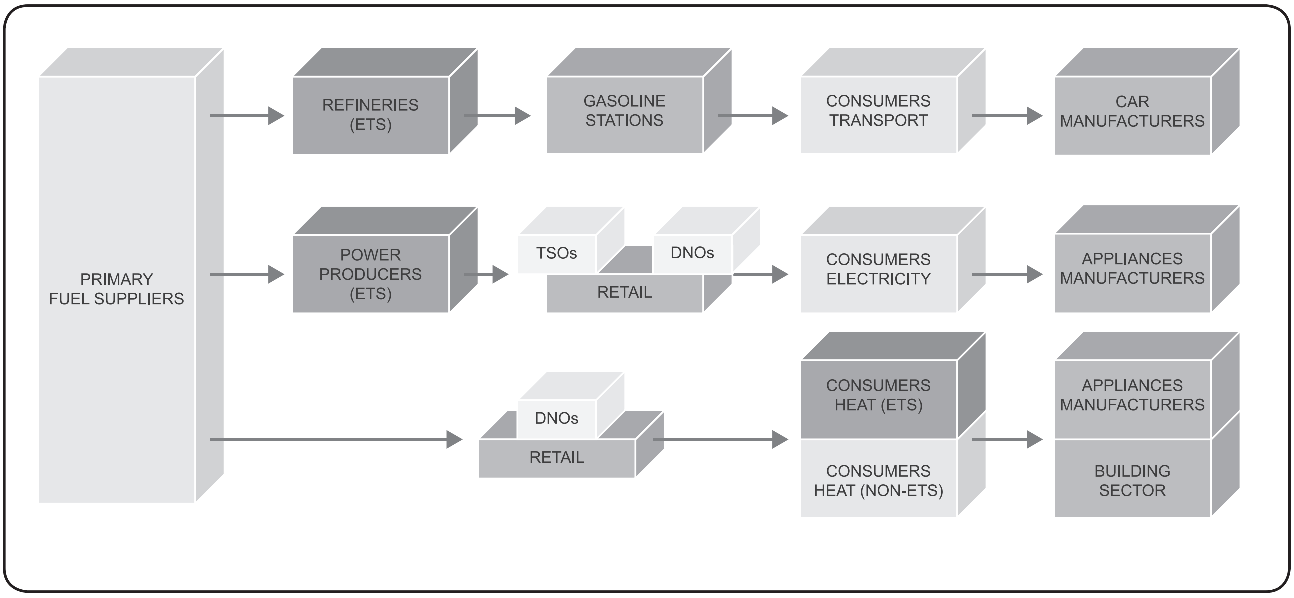


Figure 1 Illustrative representation of possible 'obliged parties' that should realise –supported by tailored policies- the achievements of national or cross sectoral binding energy savings targets (TSO = Transmission System Operator; DNO = Distribution Network Operator).

# ANNEX 3: END-USE ENERGY SAVINGS POTENTIALS FOR EU MEMBER STATES

Hereafter a summary overview of savings potentials in end-use sectors on the country and sector level is provided. Data are expressed in final energy terms. This dataset was used in chapter 4 of this study. Latest insights have been included in these data, which may therefore occasionally differ from the energy savings database that is available on the internet. However, data are fully consistent with the potentials presented in the final report of the Fraunhofer et al. (2009) study.

Table 1 HPI energy savings potential of end-use sectors and baseline development (final energy).

| Economic (HPI) - Total saving potential all sectors | | | |
|---|---|---|---|
| | Unit | 2020 | 2030 |
| EU27 | ktoe | 254699 | 418885 |
| EU15 | ktoe | 216161 | 348819 |
| EU12 | ktoe | 38534 | 70073 |
| Austria | ktoe | 5444 | 8457 |
| Belgium | ktoe | 7718 | 13376 |
| Bulgaria | ktoe | 2067 | 4479 |
| Cyprus | ktoe | 255 | 426 |
| Czech Repul | ktoe | 6883 | 14664 |
| Denmark | ktoe | 3343 | 5141 |
| Estonia | ktoe | 546 | 1098 |
| Finland | ktoe | 4221 | 6531 |
| France | ktoe | 35457 | 57260 |
| Germany | ktoe | 51378 | 85578 |
| Greece | ktoe | 5295 | 9246 |
| Hungary | ktoe | 3272 | 5894 |
| Ireland | ktoe | 2391 | 3742 |
| Italy | ktoe | 26081 | 40142 |
| Latvia | ktoe | 756 | 1457 |
| Lithuania | ktoe | 1044 | 1879 |
| Luxembour( | ktoe | 492 | 841 |
| Malta | ktoe | 80 | 140 |
| Netherlands | ktoe | 8780 | 15250 |
| Poland | ktoe | 14660 | 23955 |
| Portugal | ktoe | 3930 | 5947 |
| Romania | ktoe | 5693 | 10037 |
| Slovak Repu | ktoe | 2073 | 3993 |
| Slovenia | ktoe | 1240 | 2178 |
| Spain | ktoe | 26223 | 39885 |
| Sweden | ktoe | 7353 | 11179 |
| United King | ktoe | 28296 | 47388 |

| Economic (HPI) - Total saving potential all sectors | | | |
|---|---|---|---|
| | Unit | 2020 | 2030 |
| EU27 | % | 18.9% | 29.8% |
| EU15 | % | 19.1% | 30.0% |
| EU12 | % | 17.8% | 29.0% |
| Austria | % | 17.3% | 26.2% |
| Belgium | % | 19.4% | 33.4% |
| Bulgaria | % | 16.1% | 29.7% |
| Cyprus | % | 11.9% | 18.7% |
| Czech Repul | % | 22.0% | 43.6% |
| Denmark | % | 20.3% | 31.0% |
| Estonia | % | 14.2% | 26.4% |
| Finland | % | 15.8% | 24.1% |
| France | % | 20.3% | 31.8% |
| Germany | % | 22.1% | 36.3% |
| Greece | % | 20.4% | 34.5% |
| Hungary | % | 14.9% | 25.5% |
| Ireland | % | 15.8% | 23.7% |
| Italy | % | 16.0% | 23.2% |
| Latvia | % | 12.3% | 21.1% |
| Lithuania | % | 16.6% | 26.0% |
| Luxembour( | % | 9.3% | 15.4% |
| Malta | % | 11.1% | 18.4% |
| Netherlands | % | 15.2% | 25.6% |
| Poland | % | 19.3% | 28.5% |
| Portugal | % | 16.9% | 23.6% |
| Romania | % | 15.9% | 23.3% |
| Slovak Repu | % | 15.5% | 27.2% |
| Slovenia | % | 20.2% | 33.5% |
| Spain | % | 21.5% | 31.8% |
| Sweden | % | 20.1% | 29.6% |
| United King | % | 17.9% | 29.3% |

| Baseline - Total final consumption | | | | |
|---|---|---|---|---|
| | Unit | 2005 | 2020 | 2030 |
| EU27 | ktoe | 1162329 | 1345948 | 1404363 |
| EU15 | ktoe | 999234 | 1129355 | 1162735 |
| EU12 | ktoe | 163095 | 216593 | 241628 |
| Austria | ktoe | 26907 | 31426 | 32264 |
| Belgium | ktoe | 36321 | 39771 | 40049 |
| Bulgaria | ktoe | 9569 | 12824 | 15071 |
| Cyprus | ktoe | 1691 | 2143 | 2276 |
| Czech Repul | ktoe | 25375 | 31306 | 33643 |
| Denmark | ktoe | 15179 | 16486 | 16585 |
| Estonia | ktoe | 2843 | 3852 | 4163 |
| Finland | ktoe | 24175 | 26749 | 27045 |
| France | ktoe | 156187 | 174839 | 180331 |
| Germany | ktoe | 218719 | 232738 | 235628 |
| Greece | ktoe | 20731 | 25917 | 26804 |
| Hungary | ktoe | 18067 | 21950 | 23106 |
| Ireland | ktoe | 12353 | 15147 | 15797 |
| Italy | ktoe | 133716 | 163347 | 172742 |
| Latvia | ktoe | 4046 | 6151 | 6910 |
| Lithuania | ktoe | 4451 | 6297 | 7215 |
| Luxembour( | ktoe | 4424 | 5299 | 5456 |
| Malta | ktoe | 528 | 718 | 760 |
| Netherlands | ktoe | 51493 | 57596 | 59639 |
| Poland | ktoe | 56688 | 75983 | 84126 |
| Portugal | ktoe | 18627 | 23206 | 25252 |
| Romania | ktoe | 24605 | 35897 | 43150 |
| Slovak Repu | ktoe | 10387 | 13343 | 14702 |
| Slovenia | ktoe | 4846 | 6130 | 6505 |
| Spain | ktoe | 96508 | 121992 | 125443 |
| Sweden | ktoe | 32364 | 36632 | 37729 |
| United King | ktoe | 150758 | 158210 | 161971 |

Table 2 HPI fuel savings potential of end-use sectors and baseline development.

| Economic (HPI) - Fuel saving potential all sectors | | | |
|---|---|---|---|
| | Unit | 2020 | 2030 |
| EU27 | ktoe | 216814 | 359657 |
| EU15 | ktoe | 183688 | 299020 |
| EU12 | ktoe | 33125 | 60645 |
| Austria | ktoe | 4801 | 7406 |
| Belgium | ktoe | 6406 | 11737 |
| Bulgaria | ktoe | 1693 | 3651 |
| Cyprus | ktoe | 169 | 299 |
| Czech Repul | ktoe | 6114 | 13434 |
| Denmark | ktoe | 2939 | 4475 |
| Estonia | ktoe | 409 | 806 |
| Finland | ktoe | 2808 | 4320 |
| France | ktoe | 30733 | 50159 |
| Germany | ktoe | 44983 | 75800 |
| Greece | ktoe | 4553 | 7942 |
| Hungary | ktoe | 2778 | 5111 |
| Ireland | ktoe | 1965 | 3078 |
| Italy | ktoe | 21775 | 33430 |
| Latvia | ktoe | 644 | 1233 |
| Lithuania | ktoe | 891 | 1566 |
| Luxembour( | ktoe | 395 | 681 |
| Malta | ktoe | 45 | 72 |
| Netherlands | ktoe | 7437 | 13093 |
| Poland | ktoe | 12654 | 20636 |
| Portugal | ktoe | 3074 | 4532 |
| Romania | ktoe | 4969 | 8570 |
| Slovak Repu | ktoe | 1738 | 3491 |
| Slovenia | ktoe | 1055 | 1904 |
| Spain | ktoe | 22365 | 34225 |
| Sweden | ktoe | 5152 | 7726 |
| United King | ktoe | 24549 | 41556 |

| Economic (HPI) - Fuel saving potential all sectors | | | |
|---|---|---|---|
| | Unit | 2020 | 2030 |
| EU27 | % | 20.7% | 33.2% |
| EU15 | % | 21.0% | 33.5% |
| EU12 | % | 18.9% | 31.5% |
| Austria | % | 18.7% | 28.5% |
| Belgium | % | 20.6% | 38.0% |
| Bulgaria | % | 17.9% | 33.0% |
| Cyprus | % | 10.4% | 18.0% |
| Czech Repul | % | 24.5% | 51.2% |
| Denmark | % | 22.2% | 33.8% |
| Estonia | % | 13.9% | 25.9% |
| Finland | % | 15.3% | 23.8% |
| France | % | 23.2% | 36.8% |
| Germany | % | 24.6% | 41.3% |
| Greece | % | 22.7% | 38.9% |
| Hungary | % | 15.4% | 27.3% |
| Ireland | % | 16.0% | 24.1% |
| Italy | % | 17.1% | 25.2% |
| Latvia | % | 12.3% | 21.3% |
| Lithuania | % | 17.4% | 27.1% |
| Luxembour( | % | 8.5% | 14.4% |
| Malta | % | 8.8% | 14.0% |
| Netherlands | % | 16.3% | 28.1% |
| Poland | % | 20.2% | 30.1% |
| Portugal | % | 17.7% | 24.8% |
| Romania | % | 16.5% | 24.2% |
| Slovak Repu | % | 17.0% | 32.1% |
| Slovenia | % | 22.8% | 39.4% |
| Spain | % | 23.9% | 35.8% |
| Sweden | % | 21.4% | 30.9% |
| United King | % | 19.7% | 32.7% |

| Baseline - Total thermal consumption | | | | |
|---|---|---|---|---|
| | Unit | 2004 | 2020 | 2030 |
| EU27 | ktoe | 930884 | 1048928 | 1083835 |
| EU15 | ktoe | 794584 | 873408 | 891306 |
| EU12 | ktoe | 136300 | 175520 | 192529 |
| Austria | ktoe | 22289 | 25610 | 25986 |
| Belgium | ktoe | 29571 | 31154 | 30924 |
| Bulgaria | ktoe | 7221 | 9451 | 11056 |
| Cyprus | ktoe | 1350 | 1624 | 1658 |
| Czech Repul | ktoe | 20808 | 24919 | 26249 |
| Denmark | ktoe | 12330 | 13267 | 13254 |
| Estonia | ktoe | 2267 | 2931 | 3109 |
| Finland | ktoe | 17272 | 18330 | 18178 |
| France | ktoe | 120906 | 132228 | 136192 |
| Germany | ktoe | 175615 | 182591 | 183658 |
| Greece | ktoe | 16371 | 20073 | 20408 |
| Hungary | ktoe | 15338 | 18068 | 18704 |
| Ireland | ktoe | 10264 | 12313 | 12778 |
| Italy | ktoe | 108697 | 127386 | 132453 |
| Latvia | ktoe | 3519 | 5223 | 5799 |
| Lithuania | ktoe | 3707 | 5118 | 5783 |
| Luxembour( | ktoe | 3903 | 4641 | 4745 |
| Malta | ktoe | 373 | 505 | 519 |
| Netherlands | ktoe | 42645 | 45697 | 46591 |
| Poland | ktoe | 48219 | 62776 | 68572 |
| Portugal | ktoe | 14685 | 17358 | 18277 |
| Romania | ktoe | 21257 | 30065 | 35373 |
| Slovak Repu | ktoe | 8471 | 10212 | 10869 |
| Slovenia | ktoe | 3768 | 4629 | 4839 |
| Spain | ktoe | 76141 | 93730 | 95666 |
| Sweden | ktoe | 21310 | 24106 | 24983 |
| United King | ktoe | 121813 | 124926 | 127214 |

Table 3 HPI electricity savings potential of end-use sectors and baseline development.

Economic (HPI) - Electricity saving potential all sectors

| | Unit | 2020 | 2030 |
|---|---|---|---|
| EU27 | ktoe | 37885 | 59228 |
| EU15 | ktoe | 32473 | 49800 |
| EU12 | ktoe | 5410 | 9428 |
| Austria | ktoe | 644 | 1051 |
| Belgium | ktoe | 1312 | 1639 |
| Bulgaria | ktoe | 374 | 828 |
| Cyprus | ktoe | 86 | 127 |
| Czech Repul | ktoe | 769 | 1230 |
| Denmark | ktoe | 404 | 666 |
| Estonia | ktoe | 137 | 292 |
| Finland | ktoe | 1413 | 2211 |
| France | ktoe | 4724 | 7101 |
| Germany | ktoe | 6395 | 9778 |
| Greece | ktoe | 742 | 1304 |
| Hungary | ktoe | 493 | 783 |
| Ireland | ktoe | 426 | 664 |
| Italy | ktoe | 4306 | 6711 |
| Latvia | ktoe | 112 | 224 |
| Lithuania | ktoe | 154 | 313 |
| Luxembour( | ktoe | 97 | 160 |
| Malta | ktoe | 35 | 67 |
| Netherlands | ktoe | 1343 | 2158 |
| Poland | ktoe | 2006 | 3320 |
| Portugal | ktoe | 856 | 1416 |
| Romania | ktoe | 724 | 1467 |
| Slovak Repu | ktoe | 335 | 502 |
| Slovenia | ktoe | 185 | 274 |
| Spain | ktoe | 3859 | 5661 |
| Sweden | ktoe | 2201 | 3453 |
| United King( | ktoe | 3747 | 5831 |

Economic (HPI) - Electricity saving potential all sectors

| | Unit | 2020 | 2030 |
|---|---|---|---|
| EU27 | % | 12.8% | 18.5% |
| EU15 | % | 12.7% | 18.3% |
| EU12 | % | 13.2% | 19.2% |
| Austria | % | 11.1% | 16.7% |
| Belgium | % | 15.2% | 18.0% |
| Bulgaria | % | 11.1% | 20.6% |
| Cyprus | % | 16.5% | 20.6% |
| Czech Repul | % | 12.0% | 16.6% |
| Denmark | % | 12.5% | 20.0% |
| Estonia | % | 14.9% | 27.7% |
| Finland | % | 16.8% | 24.9% |
| France | % | 11.1% | 16.1% |
| Germany | % | 12.8% | 18.8% |
| Greece | % | 12.7% | 20.4% |
| Hungary | % | 12.7% | 17.8% |
| Ireland | % | 15.0% | 22.0% |
| Italy | % | 12.0% | 16.7% |
| Latvia | % | 12.1% | 20.2% |
| Lithuania | % | 13.0% | 21.9% |
| Luxembour( | % | 14.7% | 22.5% |
| Malta | % | 16.5% | 27.9% |
| Netherlands | % | 11.3% | 16.5% |
| Poland | % | 15.2% | 21.3% |
| Portugal | % | 14.6% | 20.3% |
| Romania | % | 12.4% | 18.9% |
| Slovak Repu | % | 10.7% | 13.1% |
| Slovenia | % | 12.3% | 16.4% |
| Spain | % | 13.7% | 19.0% |
| Sweden | % | 17.6% | 27.1% |
| United King( | % | 11.3% | 16.8% |

Baseline - Total electricity consumption

| | Unit | 2004 | 2020 | 2030 |
|---|---|---|---|---|
| EU27 | ktoe | 231445 | 297020 | 320527 |
| EU15 | ktoe | 204650 | 255947 | 271429 |
| EU12 | ktoe | 26795 | 41073 | 49099 |
| Austria | ktoe | 4618 | 5816 | 6278 |
| Belgium | ktoe | 6750 | 8618 | 9125 |
| Bulgaria | ktoe | 2348 | 3373 | 4015 |
| Cyprus | ktoe | 340 | 519 | 618 |
| Czech Repul | ktoe | 4567 | 6387 | 7394 |
| Denmark | ktoe | 2849 | 3219 | 3330 |
| Estonia | ktoe | 575 | 921 | 1055 |
| Finland | ktoe | 6903 | 8419 | 8867 |
| France | ktoe | 35280 | 42612 | 44138 |
| Germany | ktoe | 43104 | 50147 | 51970 |
| Greece | ktoe | 4360 | 5845 | 6396 |
| Hungary | ktoe | 2729 | 3883 | 4402 |
| Ireland | ktoe | 2089 | 2834 | 3020 |
| Italy | ktoe | 25018 | 35961 | 40289 |
| Latvia | ktoe | 526 | 928 | 1111 |
| Lithuania | ktoe | 744 | 1179 | 1432 |
| Luxembour( | ktoe | 521 | 658 | 711 |
| Malta | ktoe | 155 | 213 | 241 |
| Netherlands | ktoe | 8848 | 11899 | 13048 |
| Poland | ktoe | 8469 | 13207 | 15554 |
| Portugal | ktoe | 3942 | 5847 | 6975 |
| Romania | ktoe | 3347 | 5833 | 7777 |
| Slovak Repu | ktoe | 1916 | 3132 | 3834 |
| Slovenia | ktoe | 1079 | 1500 | 1666 |
| Spain | ktoe | 20366 | 28262 | 29777 |
| Sweden | ktoe | 11054 | 12526 | 12746 |
| United King( | ktoe | 28945 | 33284 | 34757 |

Table 4 HPI energy savings potential of industry (final energy).

Economic (HPI) - Total saving potential in industry

| | Unit | 2010 | 2012 | 2015 | 2016 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|---|
| EU27 | ktoe | 15172 | 21429 | 30816 | 33941 | 46442 | 60361 | 73964 |
| EU15 | ktoe | 12840 | 17910 | 25500 | 27842 | 37191 | 46859 | 55109 |
| EU12 | ktoe | 2332 | 3519 | 5317 | 6100 | 9250 | 13503 | 18858 |
| Austria | ktoe | 422 | 592 | 846 | 930 | 1267 | 1620 | 1979 |
| Belgium | ktoe | 459 | 625 | 873 | 948 | 1239 | 1556 | 1839 |
| Bulgaria | ktoe | 148 | 230 | 353 | 417 | 672 | 1144 | 1822 |
| Cyprus | ktoe | 11 | 14 | 20 | 23 | 34 | 43 | 54 |
| Czech Republic | ktoe | 471 | 853 | 1446 | 1758 | 3025 | 4832 | 7404 |
| Denmark | ktoe | 145 | 228 | 352 | 385 | 513 | 645 | 765 |
| Estonia | ktoe | 17 | 27 | 41 | 46 | 66 | 104 | 142 |
| Finland | ktoe | 514 | 789 | 1203 | 1336 | 1868 | 2433 | 2834 |
| France | ktoe | 1431 | 2106 | 3125 | 3435 | 4676 | 5995 | 7023 |
| Germany | ktoe | 2791 | 3815 | 5347 | 5783 | 7522 | 9334 | 10892 |
| Greece | ktoe | 133 | 182 | 254 | 275 | 362 | 438 | 497 |
| Hungary | ktoe | 130 | 183 | 261 | 285 | 381 | 478 | 570 |
| Ireland | ktoe | 101 | 143 | 205 | 226 | 306 | 400 | 483 |
| Italy | ktoe | 1571 | 2203 | 3153 | 3449 | 4632 | 5862 | 7008 |
| Latvia | ktoe | 40 | 59 | 86 | 97 | 141 | 197 | 247 |
| Lithuania | ktoe | 114 | 140 | 175 | 187 | 238 | 297 | 358 |
| Luxembourg | ktoe | 46 | 64 | 91 | 99 | 139 | 187 | 234 |
| Malta | ktoe | 3 | 5 | 7 | 8 | 11 | 14 | 17 |
| Netherlands | ktoe | 841 | 1114 | 1521 | 1642 | 2121 | 2625 | 3045 |
| Poland | ktoe | 962 | 1318 | 1847 | 2038 | 2798 | 3757 | 4732 |
| Portugal | ktoe | 304 | 417 | 585 | 645 | 885 | 1162 | 1458 |
| Romania | ktoe | 286 | 419 | 614 | 692 | 1004 | 1436 | 1951 |
| Slovak Republic | ktoe | 63 | 94 | 140 | 155 | 245 | 330 | 437 |
| Slovenia | ktoe | 176 | 265 | 399 | 445 | 631 | 871 | 1125 |
| Spain | ktoe | 1625 | 2243 | 3167 | 3479 | 4726 | 5895 | 6915 |
| Sweden | ktoe | 984 | 1398 | 2016 | 2222 | 3047 | 3827 | 4412 |
| United Kingdom | ktoe | 1472 | 1990 | 2761 | 2986 | 3887 | 4877 | 5730 |

Table 5 HPI fuel savings potential of industry.

| Economic (HPI) - Fuels saving potential in industry | Unit | 2010 | 2012 | 2015 | 2016 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|---|
| **EU27** | ktoe | 9172 | 12745 | 18106 | 19957 | 27362 | 36188 | 46042 |
| **EU15** | ktoe | 7633 | 10412 | 14565 | 15847 | 20956 | 26506 | 31850 |
| **EU12** | ktoe | 1539 | 2334 | 3543 | 4112 | 6406 | 9684 | 14195 |
| **Austria** | ktoe | 290 | 400 | 564 | 621 | 852 | 1101 | 1390 |
| **Belgium** | ktoe | 245 | 326 | 446 | 484 | 627 | 802 | 978 |
| **Bulgaria** | ktoe | 90 | 141 | 217 | 261 | 435 | 791 | 1341 |
| **Cyprus** | ktoe | 8 | 10 | 15 | 17 | 26 | 33 | 43 |
| **Czech Republic** | ktoe | 333 | 656 | 1160 | 1440 | 2580 | 4252 | 6721 |
| **Denmark** | ktoe | 92 | 153 | 244 | 267 | 357 | 455 | 550 |
| **Estonia** | ktoe | 0 | 0 | 0 | 0 | 0 | 15 | 36 |
| **Finland** | ktoe | 248 | 369 | 552 | 607 | 826 | 1077 | 1287 |
| **France** | ktoe | 777 | 1166 | 1756 | 1932 | 2638 | 3434 | 4083 |
| **Germany** | ktoe | 1547 | 2079 | 2872 | 3096 | 3986 | 5008 | 6023 |
| **Greece** | ktoe | 63 | 88 | 124 | 134 | 175 | 211 | 243 |
| **Hungary** | ktoe | 80 | 112 | 158 | 172 | 227 | 283 | 345 |
| **Ireland** | ktoe | 57 | 77 | 107 | 117 | 154 | 204 | 255 |
| **Italy** | ktoe | 782 | 1097 | 1571 | 1724 | 2336 | 2993 | 3697 |
| **Latvia** | ktoe | 27 | 39 | 55 | 62 | 89 | 125 | 160 |
| **Lithuania** | ktoe | 94 | 108 | 126 | 131 | 156 | 182 | 212 |
| **Luxembourg** | ktoe | 27 | 37 | 51 | 55 | 78 | 101 | 133 |
| **Malta** | ktoe | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Netherlands** | ktoe | 632 | 821 | 1101 | 1186 | 1523 | 1896 | 2226 |
| **Poland** | ktoe | 724 | 954 | 1295 | 1417 | 1901 | 2564 | 3308 |
| **Portugal** | ktoe | 215 | 279 | 373 | 407 | 543 | 697 | 881 |
| **Romania** | ktoe | 133 | 188 | 267 | 301 | 439 | 648 | 937 |
| **Slovak Republic** | ktoe | 0 | 0 | 0 | 0 | 30 | 55 | 122 |
| **Slovenia** | ktoe | 139 | 212 | 322 | 361 | 519 | 734 | 971 |
| **Spain** | ktoe | 1101 | 1478 | 2040 | 2233 | 3006 | 3735 | 4457 |
| **Sweden** | ktoe | 634 | 826 | 1110 | 1203 | 1574 | 1896 | 2154 |
| **United Kingdom** | ktoe | 923 | 1217 | 1653 | 1779 | 2282 | 2892 | 3497 |

Table 6 HPI electricity savings potential of industry.

| Economic (HPI) - Fuels saving potential in industry | Unit | 2010 | 2012 | 2015 | 2016 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|---|
| **EU27** | ktoe | 9172 | 12745 | 18106 | 19957 | 27362 | 36188 | 46042 |
| **EU15** | ktoe | 7633 | 10412 | 14565 | 15847 | 20956 | 26506 | 31850 |
| **EU12** | ktoe | 1539 | 2334 | 3543 | 4112 | 6406 | 9684 | 14195 |
| **Austria** | ktoe | 290 | 400 | 564 | 621 | 852 | 1101 | 1390 |
| **Belgium** | ktoe | 245 | 326 | 446 | 484 | 627 | 802 | 978 |
| **Bulgaria** | ktoe | 90 | 141 | 217 | 261 | 435 | 791 | 1341 |
| **Cyprus** | ktoe | 8 | 10 | 15 | 17 | 26 | 33 | 43 |
| **Czech Republic** | ktoe | 333 | 656 | 1160 | 1440 | 2580 | 4252 | 6721 |
| **Denmark** | ktoe | 92 | 153 | 244 | 267 | 357 | 455 | 550 |
| **Estonia** | ktoe | 0 | 0 | 0 | 0 | 0 | 15 | 36 |
| **Finland** | ktoe | 248 | 369 | 552 | 607 | 826 | 1077 | 1287 |
| **France** | ktoe | 777 | 1166 | 1756 | 1932 | 2638 | 3434 | 4083 |
| **Germany** | ktoe | 1547 | 2079 | 2872 | 3096 | 3986 | 5008 | 6023 |
| **Greece** | ktoe | 63 | 88 | 124 | 134 | 175 | 211 | 243 |
| **Hungary** | ktoe | 80 | 112 | 158 | 172 | 227 | 283 | 345 |
| **Ireland** | ktoe | 57 | 77 | 107 | 117 | 154 | 204 | 255 |
| **Italy** | ktoe | 782 | 1097 | 1571 | 1724 | 2336 | 2993 | 3697 |
| **Latvia** | ktoe | 27 | 39 | 55 | 62 | 89 | 125 | 160 |
| **Lithuania** | ktoe | 94 | 108 | 126 | 131 | 156 | 182 | 212 |
| **Luxembourg** | ktoe | 27 | 37 | 51 | 55 | 78 | 101 | 133 |
| **Malta** | ktoe | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Netherlands** | ktoe | 632 | 821 | 1101 | 1186 | 1523 | 1896 | 2226 |
| **Poland** | ktoe | 724 | 954 | 1295 | 1417 | 1901 | 2564 | 3308 |
| **Portugal** | ktoe | 215 | 279 | 373 | 407 | 543 | 697 | 881 |
| **Romania** | ktoe | 133 | 188 | 267 | 301 | 439 | 648 | 937 |
| **Slovak Republic** | ktoe | 0 | 0 | 0 | 0 | 30 | 55 | 122 |
| **Slovenia** | ktoe | 139 | 212 | 322 | 361 | 519 | 734 | 971 |
| **Spain** | ktoe | 1101 | 1478 | 2040 | 2233 | 3006 | 3735 | 4457 |
| **Sweden** | ktoe | 634 | 826 | 1110 | 1203 | 1574 | 1896 | 2154 |
| **United Kingdom** | ktoe | 923 | 1217 | 1653 | 1779 | 2282 | 2892 | 3497 |

Table 7 HPI energy savings potential of households (final energy).

| Economic (HPI) - Total saving potential for households | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Unit | 2010 | 2012 | 2015 | 2016 | 2020 | 2025 | 2030 |
| **EU27** | ktoe | 26254 | 35861 | 50289 | 56073 | 79239 | 111508 | 150595 |
| **EU15** | ktoe | 22869 | 31102 | 43465 | 48240 | 67392 | 94499 | 128073 |
| **EU12** | ktoe | 3384 | 4760 | 6824 | 7834 | 11848 | 17005 | 22525 |
| **Austria** | ktoe | 846 | 1109 | 1507 | 1636 | 2164 | 2751 | 3442 |
| **Belgium** | ktoe | 1315 | 1689 | 2251 | 2472 | 3369 | 4855 | 6567 |
| **Bulgaria** | ktoe | 126 | 228 | 381 | 439 | 676 | 962 | 1306 |
| **Cyprus** | ktoe | 68 | 74 | 84 | 88 | 104 | 127 | 160 |
| **Czech Republic** | ktoe | 297 | 547 | 924 | 1015 | 1382 | 2198 | 3016 |
| **Denmark** | ktoe | 454 | 582 | 774 | 845 | 1131 | 1478 | 1949 |
| **Estonia** | ktoe | 35 | 51 | 75 | 95 | 176 | 277 | 431 |
| **Finland** | ktoe | 412 | 512 | 668 | 731 | 993 | 1346 | 1762 |
| **France** | ktoe | 4509 | 6090 | 8463 | 9275 | 12539 | 16461 | 22051 |
| **Germany** | ktoe | 6440 | 9020 | 12882 | 14341 | 20192 | 29729 | 39953 |
| **Greece** | ktoe | 967 | 1112 | 1335 | 1441 | 1877 | 2356 | 2879 |
| **Hungary** | ktoe | 362 | 504 | 720 | 855 | 1394 | 2065 | 2862 |
| **Ireland** | ktoe | 565 | 653 | 785 | 818 | 962 | 1159 | 1590 |
| **Italy** | ktoe | 1999 | 2786 | 3968 | 4506 | 6656 | 9739 | 13143 |
| **Latvia** | ktoe | 103 | 144 | 203 | 218 | 281 | 361 | 468 |
| **Lithuania** | ktoe | 60 | 94 | 144 | 170 | 275 | 397 | 574 |
| **Luxembourg** | ktoe | 67 | 87 | 119 | 129 | 169 | 211 | 275 |
| **Malta** | ktoe | 15 | 18 | 25 | 27 | 36 | 48 | 69 |
| **Netherlands** | ktoe | 528 | 699 | 961 | 1152 | 1903 | 2821 | 3960 |
| **Poland** | ktoe | 1617 | 2138 | 2928 | 3314 | 4857 | 6724 | 8278 |
| **Portugal** | ktoe | 583 | 665 | 791 | 850 | 1092 | 1357 | 1689 |
| **Romania** | ktoe | 478 | 638 | 881 | 1055 | 1750 | 2469 | 3373 |
| **Slovak Republic** | ktoe | 134 | 195 | 285 | 351 | 610 | 970 | 1425 |
| **Slovenia** | ktoe | 91 | 121 | 166 | 192 | 300 | 403 | 559 |
| **Spain** | ktoe | 2329 | 2898 | 3762 | 4079 | 5362 | 6952 | 9141 |
| **Sweden** | ktoe | 332 | 504 | 764 | 883 | 1364 | 1804 | 2464 |
| **United Kingdom** | ktoe | 1522 | 2684 | 4423 | 5065 | 7618 | 11485 | 17209 |

Table 8 HPI fuel savings potential of households.

| Economic (HPI) - Fuel saving potential for households | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Unit | 2010 | 2012 | 2015 | 2016 | 2020 | 2025 | 2030 |
| **EU27** | ktoe | 23048 | 31993 | 45429 | 50834 | 72486 | 101755 | 140037 |
| **EU15** | ktoe | 20112 | 27749 | 39217 | 43704 | 61704 | 85880 | 119233 |
| **EU12** | ktoe | 2935 | 4246 | 6212 | 7131 | 10783 | 15871 | 20807 |
| **Austria** | ktoe | 777 | 1051 | 1466 | 1603 | 2161 | 2730 | 3363 |
| **Belgium** | ktoe | 986 | 1332 | 1852 | 2056 | 2883 | 4329 | 6152 |
| **Bulgaria** | ktoe | 133 | 233 | 384 | 441 | 674 | 951 | 1278 |
| **Cyprus** | ktoe | 43 | 44 | 47 | 49 | 57 | 72 | 102 |
| **Czech Republic** | ktoe | 272 | 514 | 878 | 962 | 1299 | 2020 | 2918 |
| **Denmark** | ktoe | 402 | 522 | 703 | 773 | 1054 | 1355 | 1786 |
| **Estonia** | ktoe | 32 | 46 | 66 | 82 | 146 | 223 | 323 |
| **Finland** | ktoe | 367 | 453 | 588 | 636 | 838 | 1122 | 1472 |
| **France** | ktoe | 4242 | 5754 | 8024 | 8772 | 11780 | 15515 | 21234 |
| **Germany** | ktoe | 5511 | 7983 | 11684 | 13180 | 19180 | 27408 | 38096 |
| **Greece** | ktoe | 907 | 1032 | 1225 | 1311 | 1666 | 2034 | 2404 |
| **Hungary** | ktoe | 334 | 466 | 668 | 779 | 1221 | 1827 | 2619 |
| **Ireland** | ktoe | 509 | 590 | 711 | 730 | 816 | 963 | 1393 |
| **Italy** | ktoe | 1748 | 2461 | 3533 | 4031 | 6020 | 8921 | 11908 |
| **Latvia** | ktoe | 100 | 140 | 198 | 212 | 270 | 341 | 432 |
| **Lithuania** | ktoe | 56 | 89 | 137 | 161 | 260 | 369 | 523 |
| **Luxembourg** | ktoe | 61 | 78 | 106 | 115 | 153 | 182 | 254 |
| **Malta** | ktoe | 10 | 11 | 16 | 17 | 22 | 27 | 37 |
| **Netherlands** | ktoe | 495 | 642 | 868 | 1033 | 1682 | 2456 | 3515 |
| **Poland** | ktoe | 1281 | 1774 | 2523 | 2871 | 4261 | 6338 | 7429 |
| **Portugal** | ktoe | 451 | 505 | 588 | 632 | 813 | 1005 | 1265 |
| **Romania** | ktoe | 471 | 625 | 859 | 1028 | 1702 | 2374 | 3177 |
| **Slovak Republic** | ktoe | 124 | 185 | 275 | 341 | 602 | 972 | 1463 |
| **Slovenia** | ktoe | 83 | 111 | 152 | 173 | 263 | 356 | 504 |
| **Spain** | ktoe | 2026 | 2473 | 3154 | 3434 | 4569 | 5894 | 8045 |
| **Sweden** | ktoe | 266 | 399 | 601 | 689 | 1045 | 1385 | 1989 |
| **United Kingdom** | ktoe | 1364 | 2460 | 4100 | 4692 | 7044 | 10586 | 16356 |

Table 9  HPI electricity savings potential of households.

| Economic (HPI) - Electricity saving potential for households | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Unit** | **2010** | **2012** | **2015** | **2016** | **2020** | **2025** | **2030** |
| **EU27** | ktoe | 3206 | 3868 | 4860 | 5239 | 6753 | 9753 | 10558 |
| **EU15** | ktoe | 2757 | 3353 | 4248 | 4536 | 5688 | 8619 | 8840 |
| **EU12** | ktoe | 449 | 514 | 612 | 703 | 1065 | 1134 | 1718 |
| **Austria** | ktoe | 69 | 58 | 41 | 33 | 3 | 21 | 79 |
| **Belgium** | ktoe | 329 | 357 | 399 | 416 | 486 | 526 | 415 |
| **Bulgaria** | ktoe | -7 | -5 | -3 | -2 | 2 | 11 | 28 |
| **Cyprus** | ktoe | 25 | 30 | 37 | 39 | 47 | 55 | 58 |
| **Czech Republic** | ktoe | 25 | 33 | 46 | 53 | 83 | 178 | 98 |
| **Denmark** | ktoe | 52 | 60 | 71 | 72 | 77 | 123 | 163 |
| **Estonia** | ktoe | 3 | 5 | 9 | 13 | 30 | 54 | 108 |
| **Finland** | ktoe | 45 | 59 | 80 | 95 | 155 | 224 | 290 |
| **France** | ktoe | 267 | 336 | 439 | 503 | 759 | 946 | 817 |
| **Germany** | ktoe | 929 | 1037 | 1198 | 1161 | 1012 | 2321 | 1857 |
| **Greece** | ktoe | 60 | 80 | 110 | 130 | 211 | 322 | 475 |
| **Hungary** | ktoe | 28 | 38 | 52 | 76 | 173 | 238 | 243 |
| **Ireland** | ktoe | 56 | 63 | 74 | 88 | 146 | 196 | 197 |
| **Italy** | ktoe | 251 | 325 | 435 | 475 | 636 | 818 | 1235 |
| **Latvia** | ktoe | 3 | 4 | 5 | 6 | 11 | 20 | 36 |
| **Lithuania** | ktoe | 4 | 5 | 7 | 9 | 15 | 28 | 51 |
| **Luxembourg** | ktoe | 6 | 9 | 13 | 14 | 16 | 29 | 21 |
| **Malta** | ktoe | 5 | 7 | 9 | 10 | 14 | 21 | 32 |
| **Netherlands** | ktoe | 33 | 57 | 93 | 119 | 221 | 365 | 445 |
| **Poland** | ktoe | 336 | 364 | 405 | 443 | 596 | 386 | 849 |
| **Portugal** | ktoe | 132 | 160 | 203 | 218 | 279 | 352 | 424 |
| **Romania** | ktoe | 7 | 13 | 22 | 27 | 48 | 95 | 196 |
| **Slovak Republic** | ktoe | 10 | 10 | 10 | 10 | 8 | -2 | -38 |
| **Slovenia** | ktoe | 8 | 10 | 14 | 19 | 37 | 47 | 55 |
| **Spain** | ktoe | 303 | 425 | 608 | 645 | 793 | 1058 | 1096 |
| **Sweden** | ktoe | 66 | 105 | 163 | 194 | 319 | 419 | 475 |
| **United Kingdom** | ktoe | 158 | 224 | 323 | 373 | 574 | 899 | 853 |

Table 10  HPI energy savings potential of tertiary sector (final energy).

| Economic (HPI) - | Total saving potential for tertiary | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Unit** | **2010** | **2012** | **2015** | **2016** | **2020** | **2025** | **2030** |
| **EU27** | ktoe | 9072 | 14175 | 21828 | 24431 | 34844 | 47873 | 62205 |
| **EU15** | ktoe | 7334 | 11516 | 17786 | 19929 | 28499 | 38920 | 49658 |
| **EU12** | ktoe | 1740 | 2660 | 4041 | 4502 | 6341 | 8955 | 12549 |
| **Austria** | ktoe | 202 | 310 | 469 | 523 | 741 | 1008 | 1281 |
| **Belgium** | ktoe | 213 | 321 | 488 | 541 | 761 | 1033 | 1326 |
| **Bulgaria** | ktoe | 71 | 118 | 189 | 216 | 323 | 478 | 673 |
| **Cyprus** | ktoe | 7 | 13 | 22 | 25 | 43 | 61 | 84 |
| **Czech Republic** | ktoe | 238 | 365 | 551 | 617 | 874 | 1216 | 1626 |
| **Denmark** | ktoe | 180 | 272 | 408 | 453 | 634 | 856 | 1079 |
| **Estonia** | ktoe | 10 | 20 | 35 | 41 | 65 | 95 | 137 |
| **Finland** | ktoe | 84 | 148 | 246 | 278 | 412 | 579 | 763 |
| **France** | ktoe | 1137 | 1833 | 2880 | 3239 | 4682 | 6449 | 8227 |
| **Germany** | ktoe | 2007 | 2997 | 4483 | 4982 | 6985 | 9398 | 11808 |
| **Greece** | ktoe | 185 | 300 | 472 | 533 | 775 | 1070 | 1434 |
| **Hungary** | ktoe | 176 | 267 | 406 | 449 | 637 | 888 | 1193 |
| **Ireland** | ktoe | 87 | 140 | 219 | 246 | 354 | 505 | 689 |
| **Italy** | ktoe | 922 | 1438 | 2212 | 2474 | 3525 | 4745 | 5833 |
| **Latvia** | ktoe | 16 | 29 | 49 | 55 | 88 | 139 | 217 |
| **Lithuania** | ktoe | 34 | 56 | 89 | 100 | 146 | 215 | 312 |
| **Luxembourg** | ktoe | 12 | 19 | 30 | 34 | 49 | 71 | 99 |
| **Malta** | ktoe | 3 | 4 | 7 | 8 | 15 | 21 | 27 |
| **Netherlands** | ktoe | 325 | 524 | 821 | 923 | 1323 | 1810 | 2294 |
| **Poland** | ktoe | 680 | 1040 | 1579 | 1753 | 2452 | 3469 | 4942 |
| **Portugal** | ktoe | 107 | 180 | 288 | 326 | 482 | 674 | 902 |
| **Romania** | ktoe | 348 | 503 | 738 | 813 | 1112 | 1545 | 2177 |
| **Slovak Republic** | ktoe | 130 | 200 | 306 | 340 | 479 | 677 | 960 |
| **Slovenia** | ktoe | 28 | 45 | 69 | 77 | 110 | 152 | 198 |
| **Spain** | ktoe | 578 | 960 | 1531 | 1728 | 2529 | 3469 | 4392 |
| **Sweden** | ktoe | 121 | 226 | 385 | 441 | 669 | 948 | 1267 |
| **United Kingdom** | ktoe | 1176 | 1849 | 2857 | 3200 | 4574 | 6306 | 8260 |

Table 11 HPI fuel savings potential of tertiary sector.

| Economic (HPI) - | Fuel saving potential for tertiary | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Unit** | **2010** | **2012** | **2015** | **2016** | **2020** | **2025** | **2030** |
| **EU27** | ktoe | 8240 | 11420 | 16188 | 17682 | 23660 | 31728 | 42567 |
| **EU15** | ktoe | 6582 | 9070 | 12800 | 13987 | 18733 | 24976 | 32938 |
| **EU12** | ktoe | 1660 | 2350 | 3386 | 3695 | 4924 | 6754 | 9631 |
| **Austria** | ktoe | 187 | 258 | 361 | 394 | 528 | 704 | 914 |
| **Belgium** | ktoe | 200 | 274 | 391 | 425 | 569 | 760 | 993 |
| **Bulgaria** | ktoe | 64 | 91 | 132 | 144 | 192 | 261 | 360 |
| **Cyprus** | ktoe | 5 | 6 | 8 | 8 | 13 | 16 | 27 |
| **Czech Republic** | ktoe | 224 | 314 | 444 | 486 | 647 | 877 | 1197 |
| **Denmark** | ktoe | 169 | 233 | 326 | 355 | 473 | 628 | 802 |
| **Estonia** | ktoe | 8 | 11 | 16 | 18 | 26 | 36 | 62 |
| **Finland** | ktoe | 69 | 97 | 140 | 152 | 204 | 280 | 398 |
| **France** | ktoe | 1006 | 1390 | 1970 | 2150 | 2875 | 3842 | 5041 |
| **Germany** | ktoe | 1887 | 2582 | 3625 | 3960 | 5306 | 7032 | 8963 |
| **Greece** | ktoe | 156 | 215 | 304 | 334 | 453 | 608 | 898 |
| **Hungary** | ktoe | 166 | 230 | 329 | 356 | 478 | 650 | 889 |
| **Ireland** | ktoe | 79 | 112 | 161 | 175 | 233 | 322 | 458 |
| **Italy** | ktoe | 805 | 1098 | 1538 | 1682 | 2259 | 2976 | 3796 |
| **Latvia** | ktoe | 13 | 19 | 28 | 29 | 41 | 64 | 120 |
| **Lithuania** | ktoe | 31 | 45 | 65 | 70 | 93 | 132 | 201 |
| **Luxembourg** | ktoe | 11 | 15 | 21 | 23 | 30 | 43 | 63 |
| **Malta** | ktoe | 2 | 2 | 3 | 3 | 5 | 7 | 9 |
| **Netherlands** | ktoe | 290 | 402 | 568 | 621 | 827 | 1105 | 1437 |
| **Poland** | ktoe | 655 | 936 | 1356 | 1478 | 1969 | 2716 | 3942 |
| **Portugal** | ktoe | 90 | 125 | 177 | 193 | 261 | 350 | 505 |
| **Romania** | ktoe | 343 | 483 | 695 | 759 | 1013 | 1380 | 1940 |
| **Slovak Republic** | ktoe | 124 | 177 | 257 | 280 | 374 | 514 | 745 |
| **Slovenia** | ktoe | 26 | 37 | 52 | 57 | 76 | 102 | 136 |
| **Spain** | ktoe | 460 | 632 | 889 | 971 | 1311 | 1743 | 2442 |
| **Sweden** | ktoe | 95 | 133 | 192 | 209 | 281 | 387 | 573 |
| **United Kingdom** | ktoe | 1080 | 1505 | 2140 | 2336 | 3121 | 4196 | 5651 |

Table 12 HPI electricity savings potential of tertiary sector.

| Economic (HPI) - | Electricity saving potential for tertiary | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Unit** | **2010** | **2012** | **2015** | **2016** | **2020** | **2025** | **2030** |
| **EU27** | ktoe | 832 | 2755 | 5640 | 6749 | 11184 | 16145 | 19638 |
| **EU15** | ktoe | 752 | 2446 | 4986 | 5942 | 9766 | 13944 | 16720 |
| **EU12** | ktoe | 80 | 310 | 655 | 807 | 1417 | 2201 | 2918 |
| **Austria** | ktoe | 15 | 52 | 108 | 129 | 213 | 304 | 367 |
| **Belgium** | ktoe | 13 | 47 | 97 | 116 | 192 | 273 | 333 |
| **Bulgaria** | ktoe | 7 | 27 | 57 | 72 | 131 | 217 | 313 |
| **Cyprus** | ktoe | 2 | 7 | 14 | 17 | 30 | 45 | 57 |
| **Czech Republic** | ktoe | 14 | 51 | 107 | 131 | 227 | 339 | 429 |
| **Denmark** | ktoe | 11 | 39 | 82 | 98 | 161 | 228 | 277 |
| **Estonia** | ktoe | 2 | 9 | 19 | 23 | 39 | 59 | 75 |
| **Finland** | ktoe | 15 | 51 | 106 | 126 | 208 | 299 | 365 |
| **France** | ktoe | 131 | 443 | 910 | 1089 | 1807 | 2607 | 3186 |
| **Germany** | ktoe | 120 | 415 | 858 | 1022 | 1679 | 2366 | 2845 |
| **Greece** | ktoe | 29 | 85 | 168 | 199 | 322 | 462 | 536 |
| **Hungary** | ktoe | 10 | 37 | 77 | 93 | 159 | 238 | 304 |
| **Ireland** | ktoe | 8 | 28 | 58 | 71 | 121 | 183 | 231 |
| **Italy** | ktoe | 117 | 340 | 674 | 792 | 1266 | 1769 | 2037 |
| **Latvia** | ktoe | 3 | 10 | 21 | 26 | 47 | 75 | 97 |
| **Lithuania** | ktoe | 3 | 11 | 24 | 30 | 53 | 83 | 111 |
| **Luxembourg** | ktoe | 1 | 4 | 9 | 11 | 19 | 28 | 36 |
| **Malta** | ktoe | 1 | 2 | 4 | 5 | 10 | 14 | 18 |
| **Netherlands** | ktoe | 35 | 122 | 253 | 302 | 496 | 705 | 857 |
| **Poland** | ktoe | 25 | 104 | 223 | 275 | 483 | 753 | 1000 |
| **Portugal** | ktoe | 17 | 55 | 111 | 133 | 221 | 324 | 397 |
| **Romania** | ktoe | 5 | 20 | 43 | 54 | 99 | 165 | 237 |
| **Slovak Republic** | ktoe | 6 | 23 | 49 | 60 | 105 | 163 | 215 |
| **Slovenia** | ktoe | 2 | 8 | 17 | 20 | 34 | 50 | 62 |
| **Spain** | ktoe | 118 | 328 | 642 | 757 | 1218 | 1726 | 1950 |
| **Sweden** | ktoe | 26 | 93 | 193 | 232 | 388 | 561 | 694 |
| **United Kingdom** | ktoe | 96 | 344 | 717 | 864 | 1453 | 2110 | 2609 |

Includes: street lighting, office lighting, computers and monitors, copying and printing, servers, commercial refrigeration and freezing, fans, air conditioning (central), other motor appliances)

Table 13 HPI energy savings potential of transport (final energy).

| Economic (HPI) - | Total saving potential for transport | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Unit** | **2010** | **2012** | **2015** | **2016** | **2020** | **2025** | **2030** |
| **EU27** | ktoe | 41119 | 57960 | 70511 | 75058 | 94174 | 115397 | 132120 |
| **EU15** | ktoe | 36404 | 51259 | 61631 | 65785 | 83078 | 101811 | 115980 |
| **EU12** | ktoe | 4714 | 6701 | 8879 | 9271 | 11096 | 13588 | 16142 |
| **Austria** | ktoe | 592 | 814 | 927 | 992 | 1273 | 1549 | 1755 |
| **Belgium** | ktoe | 781 | 1257 | 1668 | 1803 | 2348 | 3038 | 3644 |
| **Bulgaria** | ktoe | 215 | 266 | 315 | 329 | 396 | 541 | 678 |
| **Cyprus** | ktoe | 22 | 34 | 47 | 52 | 73 | 99 | 128 |
| **Czech Republic** | ktoe | 875 | 992 | 1082 | 1178 | 1602 | 2120 | 2618 |
| **Denmark** | ktoe | 535 | 768 | 878 | 912 | 1065 | 1236 | 1348 |
| **Estonia** | ktoe | 119 | 152 | 189 | 197 | 238 | 303 | 388 |
| **Finland** | ktoe | 560 | 725 | 796 | 828 | 949 | 1070 | 1172 |
| **France** | ktoe | 5009 | 7520 | 9877 | 10585 | 13559 | 16882 | 19958 |
| **Germany** | ktoe | 6820 | 9951 | 12050 | 12943 | 16679 | 20548 | 22925 |
| **Greece** | ktoe | 796 | 1171 | 1476 | 1630 | 2281 | 3298 | 4435 |
| **Hungary** | ktoe | 448 | 561 | 657 | 695 | 859 | 1073 | 1269 |
| **Ireland** | ktoe | 302 | 454 | 561 | 600 | 769 | 906 | 981 |
| **Italy** | ktoe | 5221 | 7318 | 8608 | 9122 | 11269 | 13246 | 14158 |
| **Latvia** | ktoe | 185 | 200 | 218 | 223 | 246 | 381 | 525 |
| **Lithuania** | ktoe | 236 | 278 | 320 | 331 | 386 | 508 | 635 |
| **Luxembourg** | ktoe | 60 | 81 | 101 | 106 | 135 | 234 | 232 |
| **Malta** | ktoe | 5 | 9 | 11 | 13 | 17 | 22 | 26 |
| **Netherlands** | ktoe | 1734 | 2150 | 2279 | 2510 | 3433 | 4701 | 5952 |
| **Poland** | ktoe | 1642 | 2695 | 3914 | 4019 | 4553 | 5263 | 6003 |
| **Portugal** | ktoe | 710 | 971 | 1109 | 1177 | 1471 | 1756 | 1898 |
| **Romania** | ktoe | 530 | 954 | 1465 | 1528 | 1827 | 2203 | 2535 |
| **Slovak Republic** | ktoe | 306 | 421 | 539 | 576 | 738 | 955 | 1171 |
| **Slovenia** | ktoe | 125 | 145 | 153 | 161 | 199 | 246 | 297 |
| **Spain** | ktoe | 6099 | 8414 | 10021 | 10713 | 13607 | 16541 | 19437 |
| **Sweden** | ktoe | 1832 | 2007 | 1856 | 1939 | 2272 | 2725 | 3035 |
| **United Kingdom** | ktoe | 5557 | 7857 | 9615 | 10123 | 12216 | 14731 | 16190 |

## ENERGY SAVINGS 2020

Energy Savings 2020 is a contributing study to Roadmap 2050: a practical guide to a prosperous, low-carbon Europe. The role of this report is to assess the impact of current EU energy and climate policies and to make recommendations on the design of an overarching energy saving policy framework to achieve Europe's 20% energy savings target by 2020 as a vital step to meet its 2050 GHG commitment.

The analysis was conducted by Ecofys and Fraunhofer ISI in the period of December 2009 to April 2010. The report was commissioned by the European Climate Foundation (ECF) and the Regulatory Assistance Project (RAP).

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In conducting the analysis and writing the report, Ecofys and Fraunhofer ISI have benefited from the advice and feedback from the ECF, the RAP and a broad group of stakeholders including NGOs, Trade Associations and Industry.

## CONTRIBUTING STUDIES TO ROADMAP 2050

The Contributing Studies to Roadmap 2050 is a set of publications strategically addressing some of the main challenges and short-term priorities as indentified by the Roadmap 2050 analysis in the move towards a low-carbon economy in Europe.

## ROADMAP 2050

The mission of Roadmap 2050 is to provide a practical, independent and objective analysis of pathways to achieve a low-carbon economy in Europe, in line with the energy security, environmental and economic goals of the European Union.

The Roadmap 2050 project is an initiative of the European Climate Foundation (ECF), and has been developed by a consortium of experts funded by the ECF.

The core of the Roadmap 2050 analysis is contained in the following 3 volumes:
- Volume I: Technical and Economic Analysis
- Volume II: Policy Report
- Volume III: Graphic Narrative

For more information on Roadmap 2050:
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# ENERGY SAVINGS 2020

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ECOFYS

Fraunhofer ISI