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IMPACT ASSESSMENT

Accompanying the document

Communication from the Commission to the European Parliament and the Council

Energy Efficiency and its contribution to energy security and the 2030 Framework for climate and energy policy

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Contents

1. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

1.1. Organization and timing

The preparation of the Impact Assessment (IA) for the Energy Efficiency Review started in 2012 following the adoption of the Energy Efficiency Directive (Directive 2012/27/EC, 'EED') which requires it. Its scope was broadened by the Communication "A policy framework for climate and energy in the period from 2020 to 2030" (2030 Communication), and the IA builds on the preparatory work and impact assessment done for that Communication[1].

Interservice meetings at Director level were held on 22 March and 9 April 2014. The energy efficiency interservice group (ISG) discussed the IA 4 times, on 13 March, 28 March, 30 April and 13 May 2014. The lead DG is Energy. The services invited to the ISG were Agriculture and Rural Development; Budget; Communications Networks, Content and Technology; Climate Action; Competition; Economic and Financial Affairs; Employment, Social Affairs and Inclusion; Enterprise and Industry; Environment; Eurostat; Health and Consumers; Infrastructure and Logistics in Brussels; Internal Market and Services; Joint Research Centre; Mobility and Transport; Regional and Urban Policy; Research and Innovation; Secretariat-General; Taxation and Customs Union; Legal Service; and the Executive Agency for Small and Medium-sized Enterprises.

1.2. Consultation and expertise

1.2.1. Consultation

Public consultation was conducted between 3 February and 28 April 2014. Stakeholder views were sought on (i) the right approach for addressing the shortfall in progress towards the 2020 target; (ii) the design of a possible future energy efficiency target; (iii) possible additional measures to address the economic saving potentials in different sectors. 733 responses were submitted representing a broad spectrum of stakeholders.[2] The Commission's minimum consultation standards were met. The report of the public consultation is in Annex I.

The review was discussed with Member States in the Energy Efficiency Directive Committee on 14 March 2014. A high-level stakeholder conference was held on 22 May 2014. It provided useful first-hand accounts on the major issues addressed by the consultation and complemented the formal public consultation.

Those Member States that took part in the public consultation (8 Member States), have stated diverging views with two calling for a binding target and 5 being against energy

[1] http://ec.europa.eu/energy/2030_en.htm
[2] 720 replies were submitted through the IPM tool, which were taken into account statistically. Out of 720 - 37% respondents were citizens, 34% organisations, 25% companies, 3% public authorities – including 8 Member States - and 2% others.

efficiency targets, some of them suggested waiting for clearer results of the impact of the existing measures, and/or pleading for the reinforced implementation of the existing measures.
In addition to the views received to the public consultation, five additional Member states called for a binding energy efficiency target in an open letter to the Commission in view of the EED Review (dated 17 June 2014).

Box 1: Main findings of the public consultation

Many respondents argued that energy efficiency is a sound response to the prevailing energy security issue in Europe and also an effective tool for climate mitigation. It triggers innovation and creates new jobs. A number of replies indicated in particular that there is still untapped potential in manufacturing industry and that more needs to be done in buildings.

Most respondents considered that the shortfall in achieving the EU energy efficiency objective for 2020 should be addressed through targets or new policy measures. 108 respondents suggested other means of tightening the gap.

Among 312 respondents favouring targets for 2020 and/or 2030, 43% considered that these should be expressed in terms of absolute energy savings; 20% in terms of energy intensity; and 30% as a combination of the two. Respondents favouring targets argued for them at EU (218), national (205) or sectoral (110) level. 221 respondents (70%) favoured legally binding targets while 70 (22%) would prefer indicative targets.

534 respondents saw the need for additional financing instruments and mechanisms at EU level. For many, this should go hand in hand with reducing the market and non-economic barriers and raising awareness of the underlying benefits of energy efficiency.

One group of stakeholders stressed the need for the development and uptake of new technologies, while a second emphasised that the necessary solutions are already available and should be promoted through demand side policies and exchange of best practice, awareness raising and information campaigns.

1.2.2. External expertise

The IA is supported by:

- Analysis of **security of supply** through energy system modelling using the PRIMES partial equilibrium model, developed and used by the National Technical University of Athens (NTUA). The model provided projections of energy consumption and import dependency. A number of energy efficiency scenarios were modelled to analyse their impacts on import dependency;

- Analysis of **European competitiveness** on the basis of the Communication and assessment of energy prices and costs in Europe[3] and accompanying ECFIN report[4]; macroeconomic modelling using GEM-E3, a general equilibrium model, maintained and used by NTUA; and macroeconomic modelling using E3MG, a macro-econometric model run by Cambridge Econometrics. GEM-E3 and E3MG were used to assess GDP, employment and related impacts of the energy efficiency scenarios;
- Analysis of **sustainability** aspects through the PRIMES model;
- Analysis of impact on energy prices through the POLES model;
- Analysis of **potentials and progress** through:
  - Bottom-up analysis of the impact of current EU and Member State energy efficiency measures; decomposition analysis of factors contributing to changes in energy consumption in the EU; and bottom-up analysis of sectoral energy-saving potentials by Fraunhofer ISI;
  - Analysis of Member States' energy efficiency obligation schemes and alternatives under the Energy Efficiency Directive (EED)[5] by CE Delft.

1.3. Opinion of the Impact Assessment Board

The draft IA was submitted to the Impact Assessment Board (IAB) on 14 May and was discussed at the IAB hearing on 4 June 2014, following which the IAB asked for a revised submission. The board asked for clarifying the context of the initiative and the logic behind the impact assessment. This was done by including a clearer description of the link and complementarity of the Energy Efficiency Review with the relevant initiatives, notably the "2030" Communication (section 2.1).

Regarding the analysis of progress towards the 2020 target the board requested more evidence on the basis of which certain assertions are made, in particular the expected size of the gap to the target. The revised impact assessment includes up-to-date and more extensive information .

The board also requested to include an analysis, based on experience with the current framework, of the interactions between different sets of targets (EE, RES, GHG) and, more broadly, pricing/market-based instruments and other types of policies. A dedicated section has been added in section 2.

In line with the request from the board section 2 has been restructured to provide clear information on the baseline should be clarified.

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[3] COM(2014) 21 /2 and SWD(2014) 20 final/2.

[4] Energy Economic Developments in Europe, European Economy, 1/2014.

[5] Art. 7 of the EED requires Member States to establish an energy efficiency obligation scheme or alternative to achieve new savings every year from 2014–2020 of up to 1.5% of the annual final energy consumption averaged over the years 2010-2012.

The analysis of options for bridging the gap to 2020 (section 5.2) includes more details on the underlying assumptions and expected impacts.

Regarding the analysis of options for the optimal level of energy efficiency policy for 2030 the board asked to justify the logic behind modelling different levels of ambition rather than different options for achieving 25% savings by 2030, mentioned in the 2030 Communication. This is addressed in section 4 (4.2) and 5 (5.1).

Section 3 (objectives) has been restructured to make clearer links with section 2 (problem definition) and 4 (policy options) and correspond to the IA guidelines.

The board also indicated that the impact analysis of the different levels of ambition for 2030 needs to be strengthened, in particular regarding possible interactions with the EU Emission Trading Scheme (ETS). Additional information in this respect was added in section 2.2.4, 3.1 and Annex V.

Finally the board asked to explain how the option of a binding target would be translated into concrete actions and legislative acts (e.g. for the building sector, CO_2 reduction targets for cars, and on eco-design), and assess the related according costs and benefits. The scope of the review was clarified in section 4.2.

2. PROBLEM DEFINITION

2.1. Policy context

In 2007 the European Council set the target of saving 20% primary energy by 2020 (compared to 2007 projections). The Energy Efficiency Directive (EED) establishes a common framework of measures for the promotion of energy efficiency to ensure the achievement of the target. It requires the Commission to assess by June 2014 whether the EU is likely to reach the target and to propose further measures if necessary[6].

Amid concerns over current events in the Ukraine on the one hand, and growing energy costs for EU consumers and businesses on the other, the European Council of 21 March 2014 invited the Commission to consider the role energy efficiency should play in:

- increasing the security of energy supply to the EU market; and
- hedging against energy price increases.

The Council highlighted the timely review of the EED and the development of an energy efficiency framework as elements to reach an early agreement on a new policy framework for energy and climate in the period 2020 to 2030.

The recent European Energy Security Strategy (EESS)[7] highlights moderating energy demand as *"one of the most effective tools to reduce the EU's external energy*

[6] EED Arts. 3(2), 3(3), 24(7).

[7] COM(2014) 330

dependency and exposure to price hikes". The strategy primary focus is on short-term measures that can increase the EU energy security and so it does not analyse in a detailed and quantified way the long-term relationship between increased energy efficiency and greater security of supply.

The "2030" communication lays down the broad modalities of the EU climate and energy framework for the period between 2020 and 2030, including proposals for binding targets of 40% greenhouse gas reduction and 27% share of renewable energy in final energy demand by 2030[8]. While the communication states that *"A greenhouse gas emissions reduction target of 40% would require an increased level of energy savings of approximately 25% in 2030"* it indicates that the exact ambition of future energy savings policy and measures necessary to deliver it are to be established in the review of the EED building on the analysis underpinning the 2030 framework and the targets and objectives for greenhouse gas reductions and renewable energy. It also requires the review to consider whether *"energy intensity improvements of the economy and economic sectors, or absolute energy savings or a hybrid of the two represents a better benchmark upon which to frame a 2030 objective"*. The logic behind this is two-fold:

- A decision on the modalities of the energy efficiency framework beyond 2020 needs to build on the lessons learned from the current framework, including which policies had worked and what were the drivers of energy efficiency developments in recent years. The review under the EED can provide such an ex-post analysis, notably because it benefits from up-to-date information submitted by the Member States as part of reporting obligations under that directive.
- While the impact assessment accompanying the "2030" communication established that a 40% decrease of greenhouse gas emissions matched by 27% renewables and 25% energy savings represent the lowest energy system costs for achieving the 40% GHG reduction, it also indicated that savings going beyond that threshold result, for relatively limited cost (up to a point), in substantial benefits in terms of increased security of supply, health, employment and, under relevant assumptions, economic growth, while remaining consistent with the other targets. The decision on the optimal level of policy ambition in 2030 needs to find the right balance between these elements and would benefit from an analysis of a broader set of scenarios focusing on energy efficiency in the context of this broad set of impacts and taking into account current EU policy priorities..

2.2. Progress achieved and lessons learned

[8] The underlying model is the "GHG40" model analysed in the 2030 Impact Assessment. This model has total system costs (average annual 2011-2030) of 2069 bn €'10, the investment expenditures (average annual 2011-2030) are 854 bn €'10 and 1188 bn €'10 (average annual 2031-2050).

2.2.1. Trends in energy consumption and energy efficiency

The European Union's energy efficiency target for 2020, adopted in 2007, equates to primary energy consumption of no more than 1483 Mtoe.

Having increased from 1618 Mtoe in 2000 to 1721 Mtoe in 2006, primary energy consumption has since decreased to 1584 Mtoe in 2012. As Figure 1 shows 2006 marked a turning in decoupling economic growth from energy consumption. This was a result of increased energy efficiency. Since then this decoupling has accelerated driven both through price signals and a comprehensive set of energy efficiency policies.

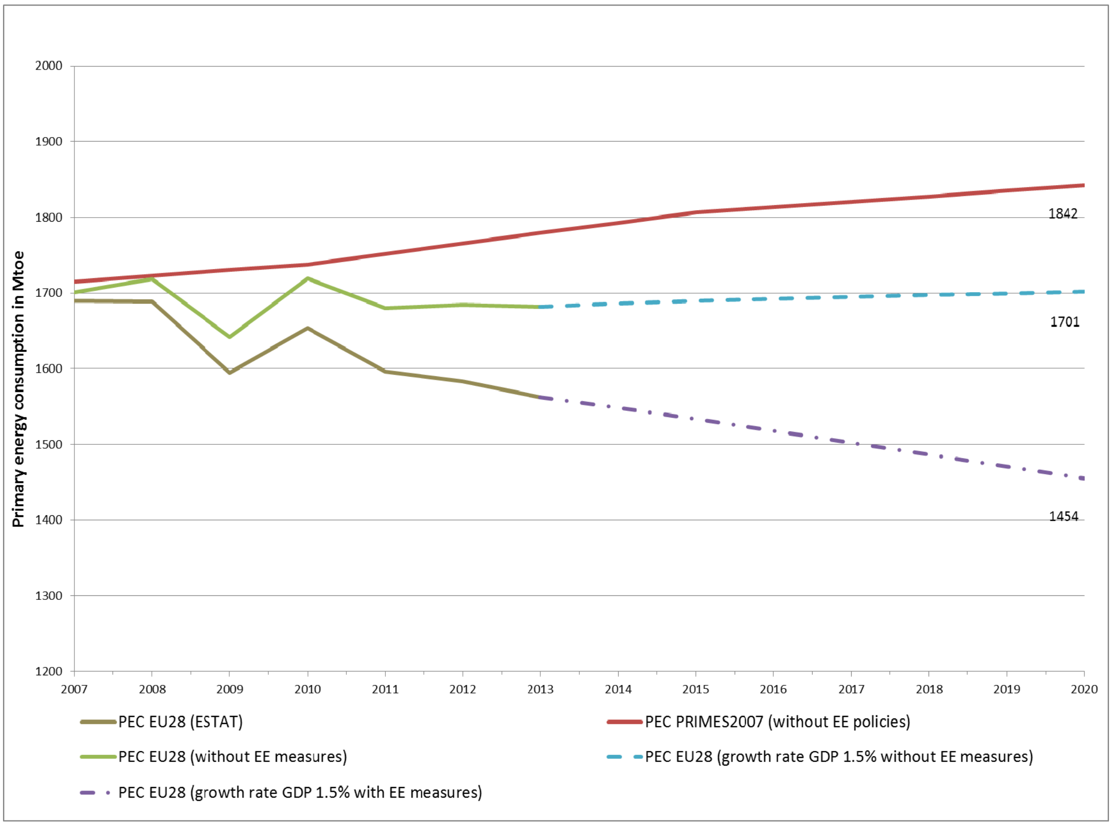
Figure 1. Evolution of energy consumption and GDP in the EU 1995-2013

Source: European Commission

While the economic crisis that began in 2008 had a significant impact on energy demand, the effect of efficiency gains (driven by prices and policies) was greater. This can be observed on Figure 2 which compares the developments in primary energy consumption under 2007 Reference projections on which the 2020 target is based (red line) with real developments projected so far, where the impact of energy efficiency (brown line) and economic drivers (green line) has been stripped out[9]. As the graph shows if current trends continue by 2020 roughly 1/3 of reduction in energy consumption compared to the 2007 Reference will stem from lower growth than anticipated, and about 2/3 from increasing energy efficiency improvements.

[9] Based on « Study evaluating the current energy efficiency policy framework in the EU and providing orientation on policy options for realising the cost-effective energy efficiency/saving potential until 2020 and beyond, Fraunhofer ISI, draft study commissioned by the Commission services

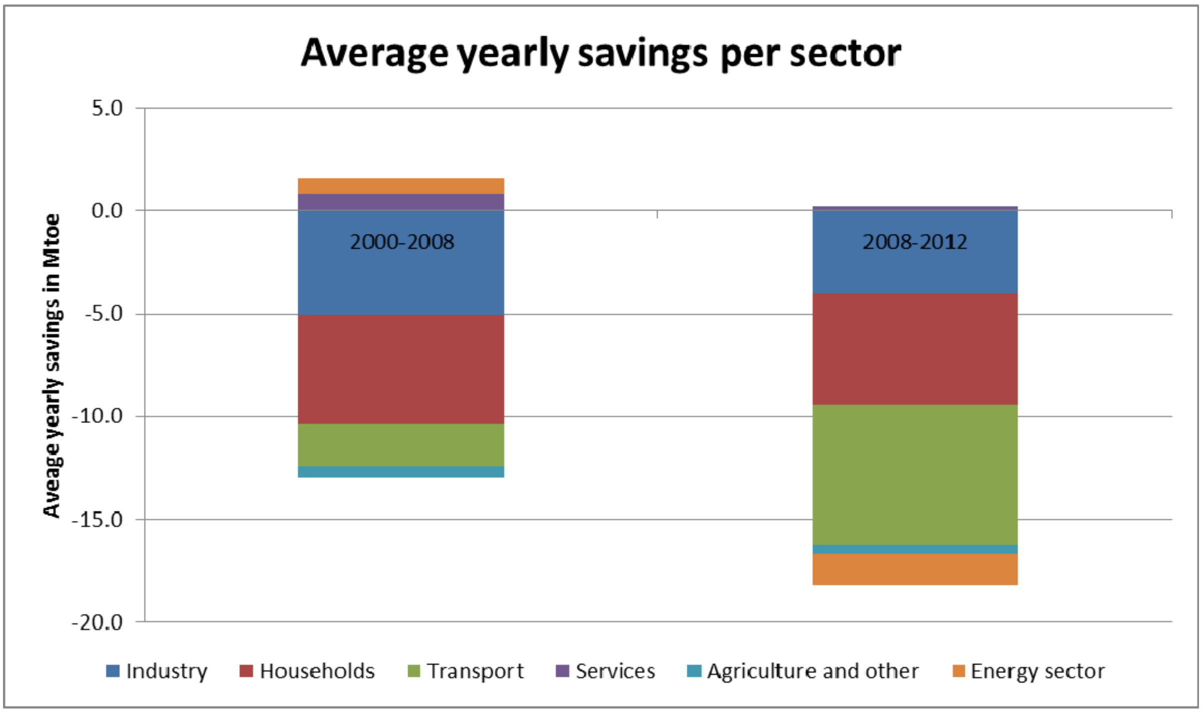
Figure 2. Comparison of primary energy evolution under 2007 Reference with registered and projected developments (including the impact of energy efficiency and economic/activity factors)



Source: European Commission, PRIMES 2014

At sectoral level as can be seen in Figure 3, the efficiency gains had the biggest impact on reducing energy demand in absolute terms in transport, followed by households and industry. The pace of energy efficiency improvements has also increased, especially in transport. Whereas the efficiency of the power and services sector deteriorated between 2000 and 2008, this trend was reversed in subsequent years.

Figure 3. Absolute reductions in primary energy consumption at sectoral level attributable to increased energy efficiency (2000-2008 and 2008-2012).



Source: European Commission, Fraunhofer (based on the decomposition analysis included in Annex III)

Progress in energy efficiency within the different sectors can be exemplified by the following elements[10]:

- Between 1995 and 2010 the average specific consumption of new cars in the EU was more than 2 litres less than in 1995 (reduction from 7.7 l/100 km to 5.6 l/100 km);
- New dwellings built today consume on average 40% less than dwellings built 20 years ago;
- The share of refrigerators meeting the highest energy efficiency labelling classes (A and above) increased from less than 5% in 1995 to more than 90% 15 years later;
- EU industry improved its energy intensity by almost 19% between 2001 and 2011, compared with 9% in the US[11].

Although it is in general difficult to single out the effect of policies from prices and other factors influencing energy efficiency, the figures and examples above allow concluding that policies work and there is a clear correlation between the roll-out of certain policies in the EU over the last years and energy efficiency trends. For example the increased savings in the transport sector as of 2008 can be to a large extent attributed to the effect of fuel-efficiency standards for passenger cars.

[10] Energy efficiency trends in the EU, Odyssee-Mure, 2013
[11] European Commission, « Energy Economic Developments in Europe », European Economy(1) 2014

At the same time without lower economic growth than expected the target would probably not be met. The 85 policy measures included in the 2006 Energy Efficiency Action Plan[12] when the target was proposed were expected to bring 14% savings by 2020. In 2011 the Commission estimated that the EU was on track to reach only 11% of savings and hence proposed the Energy Efficiency Directive which was supposed to bridge the gap to the 2020 target. The directive as adopted by the European Parliament and the Council was however weakened by about 25% compared to the original Commission proposal. Hence it can be concluded that the EU and Member States equipped themselves with the policy tools matching the 2020 target, but only with the lower economic growth taken into account.

2.2.2. Policy developments

The EU policy framework (including an indicative EU target and concrete measures in the fields of buildings, appliances, power generation, transport and industry) seems to have served as an effective framework to support this progress in energy efficiency, while needing to be accompanied by appropriate action in the fields of financing and of policy implementation.

The energy efficiency policy framework has been developed significantly in the last years. The EU target has been clearly defined, providing political momentum, guidance for investors and a benchmark to measure progress. In the areas of buildings and products, including cars, progressive rules have been established although their implementation and enforcement remains an issue in some cases. Despite the economic crisis investment in energy efficiency is growing although it remains below the thresholds necessary to realise the cost-effective efficiency potential of the EU economy (see section 2.2.5). Experience from funding energy efficiency indicates that what is needed is a robust framework enabling better understanding, knowledge, transparency, performance measurement and de-risking at the EU level, accompanied by tailored Financial Instruments at the appropriate level, which will often be closer to final beneficiaries.

At European level, the most effective policy so far have been product efficient standards including ecodesign and energy labelling of products and the cars and CO_2 legislation. The Energy Performance of Buildings Directive and the Energy Efficiency Directive of 2012 have the potential to drive energy efficiency in the EU provided they are properly implemented by Member States. The long-term potential of the EED is however limited as some of the key provisions stop applying in 2020.

Between 2008 and 2012, primary energy consumption fell in all Member States except Austria, Estonia, Latvia, Lithuania, Luxembourg and Poland. Changes in the level of economic activity played a big part in this, as did changes in the electricity generation mix and changes in industrial structure. In certain countries – especially in Bulgaria,

12 COM(2006)545.

Croatia, Latvia, Lithuania and Romania – the effect of these factors was countered by changes in the level of consumption (e.g. increasing average size of dwellings). When the effects of these factors and of climatic variation are stripped out, the Member States that made the greatest improvements in final energy consumption per unit of energy service were Bulgaria, Denmark, Greece, Hungary and Slovakia. Details are in Annex III.

At national level, Member States report success with different policy measures. Examples include taxation (e.g. Sweden), voluntary agreements with industry (e.g. Netherlands, Finland), credit for building owners (e.g. Estonia, Germany). Energy efficiency obligations for utilities have been an effective tool in the five Member States – UK, Denmark, Italy, France and Belgium - that have had them in place for some time. The up-to-date information submitted by Member States in their 2014 National Energy Efficiency Action Plans indicates further strengthening of national policies, including new measures to implement the Energy Efficiency Directive, in many Member States. Energy efficiency obligations for utilities to implement energy-saving measures among their customers, involving actors that have the most direct link to energy consumers and who previously had little or no incentive to limit energy demand, have changed the business model of energy providers and created a stable source of financing for energy efficiency. Following the adoption of the Energy Efficiency Directive the number of Member States applying such schemes is expected to go from five to sixteen. Other countries will strengthen existing schemes: for example in France savings required the ambition level of the current utility obligations scheme will be doubled from 2015. Several Member States' new national building renovation strategies indicate that they are linking a better knowledge of their building stocks with policies to stimulate cost-effective deep renovation of buildings and with suitable financial support[13]. The draft Operational Programmes beginning to be submitted under the European Structural and Investment Funds indicate an increase in sums allocated for the low–carbon economy (in some cases significantly above the minimum requirements for this objective). Financing mechanisms are being diversified, with less focus on grants and greater use of financial instruments (leveraging private capital), such as soft loans or guarantees.

While the overall trend both in terms of energy consumption and efficiency and in terms of the policy framework that aims to foster it is positive, implementation of EU rules is often incomplete and delayed (details are provided in section 2.4).

More details on EU and national policy developments are given in Annex II.

2.2.3. Projections of progress towards the 2020 target

The latest projections using PRIMES are for primary energy consumption of 1539 Mtoe in 2020 - savings of 16.8%. These projections serve as the baseline for this impact

[13] This includes support from the European Structural and Investment Funds 2014-2020, Horizon 2020, energy efficiency obligation schemes and funds coming from ETS revenues.

assessment. These projections are based on the PRIMES Reference Scenario 2013 "EU Energy, Transport and GHG Emissions – Trends to 2050"[14] ("Reference 2013"), which was also used in the Impact Assessment of the 2030 framework. A reference scenario follows the logic of including only policy measures which have been adopted until a certain cut-off date, without including new policies not yet officially adopted. In the Reference 2013 scenario, the cut-off date was spring 2012 (the EED was therefore included, with strongly conservative assumptions as to its implementation).

In order to have as accurate as possible a review of the effects of possible new energy efficiency measures and their overall level of ambition, it was necessary to update this Reference Scenario 2013 with regard to recently adopted and proposed policies especially with regard to legislation influencing energy consumption. The update of the Reference Scenario 2013 is called the Reference Plus Scenario ("Reference+") and features the policies that were adopted between spring 2012 and January 2014. A detailed description of both scenarios is included in Annex V. The Reference+ scenario projects energy savings in 2020 at 17.0%.

However, the energy consumption estimates referred to in the previous paragraphs are likely to be too high for two reasons:

1. Member States' latest reports on their national targets and planned measures under the EED suggest that these will deliver significantly more savings in 2020 than assumed in PRIMES[15]. While the national targets notified in 2013 summed up to 17% savings, the latest notifications (submitted at the end of April 2014 therefore already after the cut-off date of new measures included even in the updated baseline) give a more positive picture: 6 Member States are expecting that savings resulting from the measures included in the latest National Energy Efficiency Action Plans will lead to lower energy consumption than the respective national targets. In the case of 3 among them this difference exceeds 10%. If these elements are taken into account the latest notified national targets and accompanying national measures sum up to 18%. PRIMES also made certain conservative assumptions regarding the implementation of relevant legislative provisions. In PRIMES it is assumed that Article 7 obligations will not be fully achieved in any Member State to take into account uncertainties regarding the implementation of this article. In fact it is assumed that the whole EED will lead to a reduction in annual final energy consumption of 39 Mtoe in 2020. By contrast, the targets notified by Member States for the implementation of Article 7 of the Directive alone sum, if fully achieved, to savings of 59 Mtoe in 2020.

2. The EU economy has recently on aggregate performed less well than assumed in PRIMES Reference scenario – so that at the end of 2013, GDP was 3% lower

[14] http://ec.europa.eu/energy/observatory/trends_2030/doc/trends_to_2050_update_2013.pdf

[15] National Energy Efficiency Action Plans submitted in accordance with Article 24(2) of the EED (deadline 30 April 2014): http://ec.europa.eu/energy/efficiency/eed/neep_en.htm.

than assumed. Unless growth accelerates rapidly to make up this shortfall, this will translate into additional energy savings in 2020. Sensitivities accounting for high and low economic growth performed on the PRIMES Reference showed the following impacts:

Table 1. Sensitivies on GDP growth rate for the PRIMES 2013 Reference scenario and according impact on energy consumption.

Growth rate (av. annual 2010-2030)	Savings achieved in 2020 (compared with 2007 Reference)
1.2% (low)	18%
1.5% (normal)	17%
1.9% (high)	15.5%

Source: PRIMES

According to the latest economic forecasts[16], average GDP growth between 2010 and 2015 will be 1%. If the shortfall in economic growth up to 2014 is not made up later in the decade, energy consumption will probably be lowered by 0.5-1%.

It is therefore expected that on current trends, the EU will achieve primary energy savings in 2020 in the range of **18-19%**, corresponding to a gap of 20-40 Mtoe relative to the 20% target. This conclusion rests on the assumption that (a) current economic trends will not significantly change in the coming years; and, more importantly, that (b) the energy efficiency plans recently notified by Member States will be realised with reasonable effectiveness. It is important to note that taking into account these notifications does not imply an assumption of full implementation of the current policy framework as important delays and gaps in this implementation as described in Section 2.4 remain and, if not rectified, will lower the chance of meeting the 2020 energy efficiency target.

2.2.4. Interactions with other elements of the present energy and climate framework

In line with the Impact Assessment accompanying the "2030" communication the following interactions between policies aimed at increasing energy efficiency, fostering the development of renewables and abating GHG emissions can be identified:

- As indicated in the Impact Assessment accompanying the 2030 communication the 2020 energy efficiency target has been instrumental in ensuring progress in improving energy efficiency of the EU economy as well as in progressing towards meeting the GHG target. A quantified target has provided a political

[16] European Economic Forecast spring 2014 DG ECFIN, European Commission.

momentum and guidance for investors. The energy efficiency targets gave a clear mandate for the Commission to come up with specific efficiency measures, which are necessary to correct certain market failures. This was the case for example in 2011 when the Commission proposed the EED because the EU was not on track to meet the target.

- Specific measures promoting energy efficiency and renewables can in some cases lead to higher costs of GHG abatement than the marginal cost of abatement required to reach the cap in the ETS sector. At the same time such measures produce additional benefits, in terms of spurring innovation or synergies with resource efficiency. Energy efficiency measures are often complementary to the ETS since they address non-price barriers such as imperfect information. In addition, energy efficiency targets have most of their effect in the non-ETS sector, where Member States have national targets under the Effort Sharing Decision[17]. EU action to support energy efficiency targets brings down the cost of national action to achieve these targets – for example through harmonised product efficiency standards (ecodesign) and common approaches to the certification of buildings' efficiency.

- By reducing electricity consumption in buildings and products, EE targets have an indirect effect on the demand for electricity, which is part of the ETS sector. Because EE targets reduce the demand for electricity, the ETS has to do "less work". As a result, the price of allowances is lower than it would otherwise be. It should however be pointed out that so far Commission assessments, including the impact assessment of the "2030" communication, have not found evidence of this in the current framework as the decrease in the prices of allowances was primarily driven by lower economic activity and other factors. In the future this might change, although the proposed Market Stability Reserve, by reducing the surplus, would counteract this effect and stabilise the level of emission allowance prices.

- The current low price of allowances is primarily due to low economic activity, and not to spill-over effects of specific energy efficiency measures.

- Policies based on price signals, such as the ETS, are less effective in certain sectors, such as residential due to the fact that consumers are not very price sensitive[18] and the potential of energy efficiency is not realised to a large extent due to barriers that cannot be addressed by price signals alone, such as split incentives between landlords and tenants.

[17] Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emission to meet the Community's greenhouse gas emission reduction commitments up to 2030.

[18] For energy consumption in the residential sector elasticities of -0.2 are typically reported (e.g. Lavin, F., L. Dale, et al. (2011)) which means that for every 10% increase in price consumers typically reduce their consumption by 2%.

- Energy savings help to ensure progress towards higher shares of renewables, as lower energy consumption means a lower denominator in the ratio between consumption of renewables and gross final energy consumption. Reversely, non-thermal renewable energy typically has much lower transformation losses than conventional energy sources, lowering the primary energy consumption for any given final energy consumption. Higher shares of renewable energy can therefore help to make progress towards the energy savings target, as the target relates to primary energy consumption.

2.2.5. Current energy efficiency trends compared to the identified cost-effective energy-saving potentials and the EU decarbonisation goals

Looking at long-term trends, analyses have shown that current improvements in energy efficiency in the EU are below the cost-effective energy-saving potential and are not sufficient to fully contribute to the EU decarbonisation goals. A study by Fraunhofer ISI[19] concluded that significant cost-effective potentials remain in all sectors at the EU level, notably in buildings. The findings of this study are broadly in line with the analysis of the IEA[20]. According to the IEA, efficiency gains compared to current trends could increase EU GDP by 1.1% in 2035; additional investments required in end-use efficiency are $2.2 trillion over 2012-2035 compared with reduced energy expenditures of $4.9 trillion during that period.

The Impact Assessment accompanying the “2030” communication established that under current trends (the Reference 2013 Scenario) only 21% savings compared to projections would be achieved; whereas 25% savings would be needed to meet the 2030 GHG reduction objectives, with improvements above 25% having positive impacts on employment and the security of supply. The Impact Assessment also made it clear that these savings could not be driven by the EU Emission Trading Scheme alone and more policies will be needed in the non-ETS sectors post 2020[21]. The Reference 2013 Scenario shows that under the current policy setting, the energy efficiency improvements will slow down after 2020.

2.3. What is the problem?

2.3.1. General problem

The general problem is that despite policies which foster energy efficiency being already in place, certain persistent barriers to energy savings still remain and the cost-effective energy-saving potential (both short- and long-term) is not fully realised.

[19] Draft study commissioned by DG ENER for supporting the Energy Efficiency Review.
[20] World Energy Outlook 2012.
[21] These were modelled in the Scenario GHG40 through ‘carbon values’.

The scale of the problem is smaller within the 2020 perspective as it is now expected that the 2020 target, identified as the cost-effective saving potential, will be missed by 1-2 percentage points only. For 2030 the mismatch between the expected efficiency trends and the underpinning policies, on the one hand, and the efforts required to reach the climate objectives or realise the cost-effective potential mentioned in section 2.2.5 is greater.

Therefore, energy efficiency does not presently and, to a greater extent, is not expected in the future to sufficiently contribute to the EU's energy policy objectives. This has the following consequences:

- In terms of **security of supply**, high energy demand increases the dependence of the EU on energy imports, notably of gas. (In 2011, energy dependency was already 54% and gas imports were at 394[22] Mtoe.) While international trade, including in commodities, is one of the foundations of the global economy and relatively small indigenous fossil fuel resources in the EU are a geological fact, the overexposure of several Member States to fossil fuel imports from single providers and dependency on single import routes create several risks, including price volatility and sudden disruptions of supply. Reliance on single providers has also negatively affected the EU internal energy market by fragmenting it. The potential savings to be made on fuel import bills could instead be invested in other areas of the EU economy – leading to economic growth and job creation.

- In terms of **affordability (for households)** and **competitiveness (for the EU economy),** the unused energy efficiency potential hampers the economy in several ways: it limits productivity and economic output; it negatively affects the trade balance of the EU; it limits employment especially in the current economic environment with significant spare capacity; it creates uncertainty on markets given their exposure to the volatility of energy prices; and it leads to a loss of budget revenue.

- High energy demand for fossil fuels makes the transition to a **low-carbon economy** more difficult and costly. Insufficient energy efficiency means that the EU will not be on track to reach its long-term climate objectives (and will also be confronted with higher costs linked to health problems). Energy efficiency measures are among the cheapest options for GHG abatement.

2.3.2. Specific problems

This general problem is underpinned by the following specific problems:

[22] Source : Eurostat

1) Despite existing policies the EU energy savings target for 2020 will not be fully met

   Significant progress has been made since the analysis carried out in 2010 that showed that the EU was far from reaching its target and needed to double its efforts on energy efficiency. Now the gap is projected to be much smaller also thanks to new policies such as the Energy Efficiency Directive, but still remains at 1-2%. In addition, as shown in section 2.2.1 it is expected that about 1/3 of the progress by 2020 will be attributable to lower growth than expected at the time of setting the target. Consequently, some of the short-term energy efficiency potential of the EU economy remains untapped and will remain so under current trends.

2) The 2020 time horizon is not sufficient to create investment security

   In the absence of a clear objective post-2020 there is no signal orienting the market to the outcomes that public policy aims to achieve. This is a particular problem given the long timeframe of investments in some sectors, especially energy generation and buildings. The viability of such investments needs to be weighed against long-term projected energy demand which can be heavily affected by energy efficiency policies. The period up to 2020 is also insufficient for the establishment of business solutions and of markets for energy efficiency and services. A long-term and coherent policy framework is needed to reduce the perceived risk amongst investors and consumers alike.

   From a policy perspective in the absence of these long-term determinants, the choice of present policy instruments risks to be driven by short term analysis.

3) Ensuring coherence of different targets and policies

   Given the key role of energy efficiency for energy security, competitiveness and GHG reductions, as well as the interactions between GHG, renewables and energy efficiency targets and policies, the future energy efficiency framework needs to be defined in a coherent way with the general 2030 framework. Otherwise there is a risk that different policy instruments within the energy and climate framework will be set up and applied in an incoherent way driving down their effectiveness, undermining the internal market and increasing the overall cost.

2.4. What are the drivers for the problem?

There is a broad body of evidence and theoretical analysis of barriers preventing consumers and investors from adopting cost-effective energy efficiency measures.

These have been categorised into economic, behavioural and organisational barriers[23] or alternatively into market and non-market failures[24].

The current policy framework addresses market, regulatory and behavioural failures in several ways. There is however evidence that this framework does not address existing barriers sufficiently. The following elements with respect to this framework can be singled out:

- **Incomplete implementation**: the principal reason why the 2020 target is expected to be missed is insufficient Member State level implementation of the existing legislative framework. Regarding the EPBD the following main issues arise: (i) there is not enough national supervision and technical capacity for checking at local and/or regional level the compliance of energy performance requirements in building energy codes; (ii) the reliability of Energy Performance Certificates is undermined by a lack of transparency of how they are established for establishing them use underlying calculations which are often not sufficiently transparent for the outcomes to be directly comparable. Regarding Ecodesign the main problem driver is insufficient market surveillance. Only 5 Member States are estimated to have an active policy in that regard and the total amount spent on it is estimated to represent some 0.05% of the value of lost energy savings[25].

- **Short-term perspective**: some of the key policy tools were designed within a 2020 timeframe and therefore do not provide long-term incentives for investing in energy efficiency. Examples include the fact that Article 7 of the EED, ceases to apply after 2020 and there is no post-2020 overall target.

- **Inadequacy:** certain existing policy tools need to be revised to address existing barriers more effectively. As an example under the Energy label the A+, A++ and A+++ labelling scales that were introduced during the previous revision of the Directive have been shown to affect consumers' motivation to buy more energy efficient products less effectively than the previous scale. This change has weakened the market transformation impact of the label.

- **Incompleteness:** Regarding financing, important barriers that hamper further uptake of energy efficiency investments in buildings continue to be in place, including a lack of awareness and expertise regarding energy efficiency financing on the part of all actors; high initial costs, relatively long pay-back

[23] Energy efficiency policy and carbon pricing, International Energy Agency, August 2011 after O'Malley et al., 2003.
[24] Ibid after Jaffe and Stavins, 1994.
[25] Evaluation of the Energy Labelling Directive and specific aspects of the Ecodesign Directive, Ecofys, 2014.

periods and (perceived) credit risk associated with energy efficiency investments; and competing priorities for final beneficiaries[26].

An overview of the current status of implementation of the relevant EU provisions is included in Annex IX.

2.5. The Union's right to act, subsidiarity and proportionality

The EU's competence in the area of energy in general and energy efficiency in particular is enshrined in the Treaty on the Functioning of the European Union, Article 194(1). In acting, the EU needs to respect the principles of subsidiarity and proportionality. Member States are at the centre of the realization of energy efficiency policy and EU intervention should be well targeted and supportive to their actions. The EU's role is in:

- Establishing a common framework which creates the basis for coherent and mutually reinforcing mechanisms while leaving in being the responsibility of Member States to set, in a transparent and comparable way, the concrete means and modalities to achieve the agreed objectives;
- Creating a platform for exchanging best practice and stimulating capacity building;
- Setting minimum requirements in areas where there is a risk of internal market distortions if Member States take individual measures;
- Using EU instruments to promote energy efficiency, e.g. through financing, and to mainstream it in other policy areas.

3. SCOPE AND OBJECTIVES

3.1. Context and scope

EU leaders have set the objective of saving 20% of the EU's energy consumption compared to projections for 2020. This target is recognised as an integral element and essential part of the EU energy policy, with its triple objectives of competitiveness, sustainability and security of supply. In March 2014 EU leaders have reiterated that the 20% energy efficiency target has to be met. As established in section 2 of this Impact Assessment this will not happen under current trends. Specific short-term options for bridging the gap to the target need therefore to be identified and analysed.

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[26] 2013 financial support for energy efficiency in buildings report (http://ec.europa.eu/energy/efficiency/buildings/doc/report_financing_ee_buildings_com_2013_225_en.pdf).

The “2030” communication has set the broad framework for the energy and climate policy after 2020. It indicated that the specific level of energy savings aimed at in 2030 needs to be established, while ensuring full coherence with the GHG and RES targets. The GHG target is (40% domestic reduction wrt. 1990 levels, of which the sectors covered by the EU Emissions Trading System (ETS) would have to deliver a reduction of 43% in GHG in 2030 compared to 2005, by means of a strengthening of the EU ETS cap and an ETS market stability reserve, for which a legal proposal has been made, which makes the system more robust. Ensured by binding national targets, the non-ETS sector is expected to deliver a reduction of 30% both compared to 2005) and renewable energy target (at least 27% share of renewables in the final energy consumption). Similarly as in the case of the impact assessment underpinning the “2030” communication the aim here within the mid and long-term perspective (i.e. beyond 2020) is to: (i) focus the analysis on the desired level of a possible energy efficiency target from the perspective of the general aims of the EU energy policy and of the interaction of this target with the other elements of the energy and climate policy framework; and (ii) to propose the general direction of policy development in the energy efficiency area, without entering into the details of specific policy options, which will be underpinned by appropriate impact assessments in the future.

3.2. Objectives

In this context the objectives of the initiative are:

3.2.1. General objective

To ensure that energy efficiency contributes to the development of a competitive, sustainable and secure EU energy system.

3.2.2. Specific objectives

- To agree on the measures necessary to achieve the 20% energy efficiency target providing thus the relevant actors with information on the actions that need to be undertaken in the short term;
- To agree on the level and general direction of energy efficiency policy in the long term providing thus Member States and investors with more predictability and certainty.

3.2.3. Operational objectives

Theses general and specific objectives are to be achieved by:

- Proposing actions to bridge the gap to the 2020 target;

- Setting a level of energy efficiency policy ambition for 2030 consistent with the goals of the EU energy policy and coherent with the other headline targets of this policy framework;
- Proposing a long-term energy efficiency policy architecture, including the formulation of a possible target.

3.3. Consistency with other policies

The above objectives are in line with other EU policies. They:

- Promote economic recovery and enhance the competitiveness of EU industries in line with the Europe 2020 Strategy, contributing to the Resource Efficiency flagship initiative and the sustainability layer of Europe 2020;
- Increase security of energy supply as called for in the European Energy Security Strategy create jobs and reduce energy poverty in support of the EU's social agenda.
- Enable further reductions of GHG emissions up to 2020 and thus contribute to reaching the EU's climate objectives.
- Facilitate further commitments on GHG emission reduction after 2020.

4. Policy Options

4.1. Options for closing the gap towards the 2020 target

The following options are considered:

1. No action.
2. New primary legislation laying down binding national targets or additional binding measures.
3. Strengthened implementation of current policies.

Option 1 is discarded from further detailed analysis as the 2020 target would not be fully achieved and the benefits associated with meeting it would not be realised.

4.2. Analysis of the optimal level of savings for 2030

Building on the 2030 Communication and its accompanying IA, six scenarios with a stepwise increase in the ambition of energy efficiency efforts (in all sectors targeted by current policy measures) were modelled and the impacts that these efforts would have on security of supply, competitiveness and sustainability were assessed both in 2030 and in 2050 perspective.

The 2030 IA also itself investigated a range of scenarios with energy efficiency policies reaching higher levels of energy savings than the Reference scenario. While the Reference scenario achieves 21% energy savings (in comparison to 2007 PRIMES baseline for 2030[27]), the scenarios presented in the 2030 IA achieve between 23 and 34% savings. The 2030 Communication states that achieving the proposed 2030 GHG (40% reduction) and RES (at least 27% share) targets cost-effectively would require 25% energy savings (which corresponds to GHG40 scenario). At the same time, the 2030 IA indicated that a higher ambition in energy efficiency would have additional benefits in terms of energy security, growth and jobs and lowered imports bill as well as on health – while incurring higher costs within the energy system.

The scenarios included in the IA underpinning the 2030 Communication modelled EE with different approaches (with reference settings or in the context of enabling conditions, with carbon values (in GHG40 scenario) or with concrete (and ambitious) EE policies (in GHG40/EE and GHG40/EE/RES30 scenarios) and the very ambitious EE policies (in GHG40/EE/RES35) scenario).

In the GHG40 scenario, the 25% cost-efficient energy savings were reached without modelling additional energy efficiency policies compared to the References scenario 2013 by 2030. However, more stringent CO2 standards for passenger cars are assumed in the GHG40 scenario after 2030, going down from 95gCO2/km to 25gCO2/km in 2050 (and also for vans – see table below). The level of 25% energy savings in 2030 is achieved in the GHG40 scenario with a) the existing EE legislation in place plus tighter CO2 standards for passenger cars after 2030 and b) with a 40% GHG target triggering energy efficiency mainly through carbon values in the non-ETS sector[28] and c) in the context of the assumption of enabling settings[29]. The GHG40 scenario does not model specific EE policies beyond the ones indicated above. In contrast, this IA proposes scenarios which achieve higher levels of energy savings with concrete EE policies. It should be noted that *by construction*, the GHG40 scenario, working with carbon values in the non-ETS sector, depicts the lowest possible cost of achieving 40% GHG savings in 2030.

In this IA, a broader range for EE ambition is explored aiming for up to 40% energy savings in 2030 with the aim of analysing energy system cost impact and broader impact in terms of security of supply, job creation and economic growth.

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[27] Here and subsequently, energy savings in 2030 are calculated relative to the energy consumption projected, in PRIMES in 2007, for that year (1874 Mtoe).
[28] See Annex V.
[29] See Impact Assessment in energy and climate policy up to 2030, SWD(2014) 16, p. 43 and 160.

In the present IA, the analysis from 2030 IA is continued in a coherent way, taking into account not only the modelling results but also the progress that Member States are making towards their national targets under the EED and taking into account studies on energy-saving potentials and responses to the public consultation. . Six energy efficiency scenarios were modelled with primary energy reductions in 2030 relative to PRIMES 2007 projection of around 27 %, 28%, 29%, 30%, 35% and 40%. Chapter 5 analyses the energy system impacts of these scenarios, their macro-economic impacts and, in addition, Annex VII shows the results of specific EE policies in their specific fields (e.g. improvement in performance of appliances, rate of renovations, energy savings in industry etc.). The scenarios are based on common assumptions regarding GDP and population growth, imported fossil fuel prices and technology costs as all of them are built on and later on compared to the Reference Scenario 2013 ("Reference") – the same as used in the 2030 IA.

The mix of energy efficiency policies assumed for the scenarios follows the logic of the current set of EE legislation including the EED, EPBD, regulations adopted under ecodesign/energy labelling . Only the overall level of ambition is intensified. In this sense, the IA is conservative – it does not analyse measures or propose new mechanisms (e.g. in EED). For transport, the policy measures put forward in the 2011 White Paper on Transport are assumed to be implemented. For industry the Best Available Technology (BAT) uptake is modelled. At this stage, it is however clear that the main effort will be concentrated on buildings/products reflecting lower GHG abatement potential in the transport sector and the fact that EE in industry is chiefly driven by costs of energy and competitiveness aspects. Different policy mixes and specific policy instruments might be necessary or desired in the future but entering into such considerations goes beyond the scope of the Energy Efficiency Review and could pre-empt future policy choices. Future policy choices will translate - into specific policy or legal proposals which will be accompanied by dedicated IA assessing costs and benefits for specific sectors or economic actors.

In the context of all energy efficiency scenarios analysed here, it is assumed that the EE legislation continues after 2020 and further intensifies in terms of saving obligations. The following policies are assumed to intensify until 2030 and then intensify only moderately beyond 2030:

- EED with annual savings obligation beyond 2020 and intensifying;
- CO2 standards for cars and light commercial vehicles (LCVs) becoming more stringent beyond 2020 and other transport policies leading to energy efficiency savings;
- EPBD with stronger requirements leading to higher and deeper (in terms of EE) renovation rates;
- Eco-design requirements excluding less performing technologies currently still present on the market and stretching to new categories of products leading to a more accelerated uptake of efficient technologies in the demand sectors enabled by lowering perceived cost parameters;
- Measures promoting increased use of CHP and district heating and cooling;

- Measures aimed at higher uptake of BAT in the industry;
- Measures limiting grid losses.

Other transport policy measures, in addition to CO2 standards for light duty vehicles, are in line with the 2011 White Paper on transport and are assumed to be included in all scenarios but their intensity is not varied between scenarios (i.e. measures leading to 1.1% improvements per year in the fuel efficiency of heavy duty vehicles (HDVs), development of infrastructure for alternative power-trains, internalisation of external costs, introduction of a CO2-related element in vehicle taxation, wide deployment of intelligent transport systems and other soft measures like fuel labelling and eco-driving).

The energy efficiency assumptions imply reduced demand for energy by end-users and also reduced demand for electricity. For each scenario the model simulates a new equilibrium in the energy market. This means that the lowered energy demand in each scenario affects, to a different extent, the electricity prices, the fuel mix, the need for new generation capacities, electricity/gas networks or other energy system components. Also the ETS is affected by the reduced demand.

The table below shows the assumptions on energy efficiency measures in the scenarios that have been modelled and for comparability reasons the assumptions of the GHG40.

Table 2. Assumptions of the GHG40 scenario and the policy scenarios assessed in this impact assessment[30 31]

GHG 40	Primary energy savings: 25.1% GHG reduction in 2030 (wrt. to 1990): 40.6% RES share in 2030: 26.5% Energy efficiency policies: ⅄ Adopted energy efficiency regulations until spring 2012 as in the Reference Scenario 2013; ⅄ no strengthening of policies before or after 2020 (except for CO2 standards for cars and vans – see below); ⅄ Carbon values drive some additional energy efficiency in comparison to the Reference. Measures reducing energy consumption in transport and driving the electrification in the long-run: CO2 standards for passenger cars of 95 gCO2/km in 2030 (25 gCO2/km in 2050) and CO2 standards for LCVs of 147

[30] See Annex V for further details on assumptions.

[31] Other transport policy measures, in addition to CO2 standards for light duty vehicles, are included in all scenarios in line with the 2011 White Paper on Transport but their intensity does not change among scenarios.

	gCO2/km in 2030 (60 gCO2/km in 2050). The scenario is set in enabling conditions.
EE28	Primary energy savings: 28.3% GHG reduction in 2030 (wrt. to 1990): 40.2% RES share in 2030: 27.7% Energy efficiency policies: - Increasing energy efficiency of houses and buildings leading to renovation rates of 1.48% in 2015-2020, 1.84% in 2021-2030 and 1.15% in 2031-3050 which will bring average energy savings after renovation of 21.93% in 2015-2020, 44.55% in 2021-2030 and 45.79% in 2031-3050; - Elimination of market failures and imperfections reflected in the reduction of discount rates from 12% in 2020 progressively to 10.2% (by 2050) in the residential sector and from 10% to 9% (by 2050) in the tertiary sector; - Increased uptake of advanced technologies (Ecodesign); - Increased uptake of BAT in industry; - Higher penetration of district heating; assuming that 11% of households will be connected to district heating networks in 2030; - Measures limiting grid losses; - Measures reducing energy consumption in transport and driving the electrification in the long-run (e.g. CO2 standard of 75 gCO2/km in 2030 (26 gCO2/km in 2050) for passenger cars and 110 gCO2/km in 2030 (60 gCO2/km in 2050) for LCVs). The scenario is set in enabling conditions.
EE29	Primary energy savings: 29.3% GHG reduction in 2030 (wrt. to 1990): 40.1% RES share in 2030: 27.7% Energy efficiency policies: - Increasing energy efficiency of houses and buildings leading to renovation rates of 1.53% in 2015-2020, 2.11% in 2021-2030 and 1.22% in 2031-3050 which will bring average energy savings after renovation of 22.04% in 2015-2020, 45.04% in 2021-2030 and 47.55% in 2031-3050; - Elimination of market failures and imperfections reflected in the reduction of discount rates from 12% in 2020 progressively to 10.2% (by 2050) in the residential sector and from 10% to 9% (by 2050) in the tertiary sector; - Increased uptake of advanced technologies (Ecodesign);

	- Increased uptake of BAT in industry; - Higher penetration of district heating; assuming that 11% of households will be connected to district heating networks in 2030; - Measures limiting grid losses; - Measures reducing energy consumption in transport and driving the electrification in the long-run (e.g. CO2 standard of 74 gCO2/km in 2030 (26 gCO2/km in 2050) for passenger cars and 110 gCO2/km in 2030 (60 gCO2/km in 2050) for LCVs). The scenario is set in enabling conditions.
EE30	Primary energy savings: 30.7% GHG reduction in 2030 (wrt. to 1990): 40.1% RES share in 2030: 27.7% Energy efficiency policies: - Increasing energy efficiency of houses and buildings leading to renovation rates of 1.61% in 2015-2020, 2.21% in 2021-2030 and 1.26% in 2031-3050 which will bring average energy savings after renovation of 22.08% in 2015-2020, 45.82% in 2021-2030 and 48.48% in 2031-3050; - Elimination of market failures and imperfections reflected in the reduction of discount rates from 12% in 2020 progressively to 9% (by 2050) in the residential sector and from 10% to 8.5% (by 2050) in the tertiary sector; - Increased uptake of advanced technologies (Ecodesign); - Increased uptake of BAT in industry; - Higher penetration of district heating; assuming that 12% of households will be connected to district heating networks in 2030; - Measures limiting grid losses; - Measures reducing energy consumption in transport and driving the electrification in the long-run (e.g. CO2 standard of 72 gCO2/km in 2030 (25 gCO2/km in 2050) for passenger cars and 110 gCO2/km in 2030 (60 gCO2/km in 2050) for LCVs). The scenario is set in enabling conditions.
EE35	Primary energy savings: 35.0% GHG reduction in 2030 (wrt. to 1990): 41.1% RES share in 2030: 27.4% Energy efficiency policies: - Increasing energy efficiency of houses and buildings leading to renovation rates of 1.64% in 2015-2020, 2.39% in 2021-2030 and 1.32% in 2031-3050 which will bring average energy savings after renovation of 22.10% in 2015-2020, 46.19% in 2021-2030 and 48.84%

	in 2031-3050; - Elimination of market failures and imperfections reflected in the reduction of discount rates from 12% in 2020 progressively to 9% (by 2050) in the residential sector and from 10% to 8.5% (by 2050) in the tertiary sector; - Increased uptake of advanced technologies (Ecodesign); - Increased uptake of BAT in industry; - Higher penetration of district heating; assuming that 14% of households will be connected to district heating networks in 2030; - Measures limiting grid losses; - Measures reducing energy consumption in transport and driving the electrification in the long-run (e.g. CO2 standard of 70 gCO2/km in 2030 (17 gCO2/km in 2050) for passenger cars and 110 gCO2/km in 2030 (60 gCO2/km in 2050) for LCVs). The scenario is set in enabling conditions.
EE40	Primary energy savings: 39.8% GHG reduction in 2030 (wrt. to 1990): 43.9 % RES share in 2030: 27.4 % Energy efficiency policies: - Increasing energy efficiency of houses and buildings leading to renovation rates of 1.65% in 2015-2020, 2.42% in 2021-2030 and 1.33% in 2031-3050 which will bring average energy savings after renovation of 22.11% in 2015-2020, 46.18% in 2021-2030 and 48.85% in 2031-3050; - Elimination of market failures and imperfections reflected in the reduction of discount rates from 12% in 2020 progressively to 9% (by 2050) in the residential sector and from 10% to 8.5% (by 2050) in the tertiary sector; - Increased uptake of advanced technologies (Ecodesign); - Increased uptake of BAT in industry; - Higher penetration of district heating; assuming that 14% of households will be connected to district heating networks in 2030; - Measures limiting grid losses; - Measures reducing energy consumption in transport and driving the electrification in the long-run (e.g. CO2 standard of 70 gCO2/km in 2030 (17 gCO2/km in 2050) for passenger cars and 110 gCO2/km in 2030 (60 gCO2/km in 2050) for LCVs). The scenario is set in enabling conditions.

Source: European Commission, PRIMES2014

This IA does not aim at assessing in detail specific policy measures within a 2030 perspective. Neither does it compare the impact of typical policy alternatives (regulation, voluntary agreements, financing, training and awareness) as it is likely that they would all play a role within the long timeframe considered. Rather, the IA aims at identifying the optimum strategic direction, to be complemented by specific IAs in the future.

4.3. Options for the architecture of the energy efficiency framework post-2020

The current, **2020** framework is based on:

- an indicative EU target underpinned by indicative national targets;
- EU legislation for products traded in the internal market;
- EU legislation coupled with administrative support in other areas, such as buildings and combined heat and power, providing general overall provisions while leaving flexibility for the national and local level to implement them in an appropriate way;
- national and local provisions not linked to common EU rules
- financing through European, national and local sources.

This design provides a mutually-reinforcing set of instruments. At the same time it is the result of an 'organic' evolution of policies and has not so far been thoroughly compared with alternatives. This analysis with its long-term perspective allows such a comparison.

The following options for the architecture of the framework for **2030** are identified:

I. No action. This implies that post 2020, any EU target would be abandoned and efforts at European level would be based solely on specific instruments.

II. Indicative EU target, coupled with specific EU measures. This would be a continuation of the current framework.

III. Binding EU target, coupled with specific EU measures. This would replicate the approach proposed by the Commission in the 2030 Communication for RES.

IV. Binding MS targets, coupled with EU polices solely in areas linked to the internal market.

In addition, irrespective of the character and level of a possible target, it needs to be considered how it could be formulated. The following options for target formulation are identified:

- Consumption target
- Intensity target
- Hybrid approach

5. ANALYSIS OF IMPACTS

5.1. Methodology

This IA follows and is fully consistent with the 2030 Communication and its accompanying IA.

The 2030 Communication proposes two binding targets for 2030: 40% GHG emissions reductions and at least 27% share of renewable energy in final energy consumption. These targets were taken as constraints[32] in modelling of policy scenarios presented in this IA.

The policy scenarios of the 2030 Communication build upon the Reference scenario 2013 which takes into account climate and energy policies adopted up to June 2012. For comparability reasons, the policy scenarios of this IA build on the same Reference 2013.

Given the requirement for the EED review to assess whether or not the EU is on track for its 2020 energy saving objective, it was necessary to update the Reference scenario with recently adopted policies. This is why so–called "Reference+" scenario was also developed taking into account policies adopted (and some important polices proposed by the Commission) up to January 2014. The Reference+ scenario is described in Annex V and assessment of achievement of 2020 target is presented in chapter 2.2.3.It should be noted that this exercise has shown that the differences of the policy scenario including recently adopted policies are minimal to the one without these policies. This is due to the fact that the additional measures (e.g. eco-design measures which were adopted in the last 2 years) are part of the EE policy mix of the policy scenarios in any case which are intensified between the different scenarios to achieve a higher EE level.

The internal logic of scenarios and the key assumptions have not been changed from 2030 modelling exercise (see Table 3 below). The starting point of the present analysis is the GHG40 scenario, whose results are shown in all summary tables for more convenient reference. The policy scenarios presented in this IA are, however, not fully comparable with the GHG40 scenario as they use concrete energy efficiency policies rather than carbon values in the non-ETS sector. All policy scenarios analysed in this IA are in fact similar in structure to the GHG40/EE scenario in the 2030 IA, which featured

[32] In modelling it is difficult to achieve precisely a set constraint of GHG emissions and RES because of various complex constraints and interactions For example the GHG40 scenario used for the 2030 communication itself achieves GHG savings of 40.6%. The modelling exercise underpinning this IA clearly illustrated that greenhouse gas emissions fall as energy efficiency policy are intensified. This is why the EE40 scenario overshoots in 2030 the 40% GHG reduction target proposed by the Commission. As an EE target of 40% in 2030 was proposed by the European Parliament, this scenario is nonetheless presented in this IA even if the GHG constraint is not fulfilled to analyse the full range of EE levels proposed in the current political discussion.

concrete EE policies. Finally, while the overall energy savings in 2030 amounted to 25% (for GHG40) and 29% (for GHG40/EE), the range of ambition is broader in the policy options analysed here.

Six scenarios were thus quantified, assuming a stepwise increase in the intensity of energy efficiency efforts after 2020 in sectors targeted by current policy measures. The energy saving (calculated against the 2007 PRIMES baseline projections for 2030) achieved by the scenarios is the key metric, which, because of its importance, is used for labelling of scenarios. The scenarios achieve respectively energy savings in 2030 of around 27%, 28%, 29%, 30%, 35% and 40%. Later on they are referred to as EE27, EE28, EE29, EE30, EE35 and EE40 scenarios. As explained in chapter 4, the mix of energy efficiency policies is not altered among the scenarios (it always follows the logic of current legislation) and only the overall level of ambition intensifies. The specific policies are defined in a general manner and the precise assessment of their impacts would have to be done on case-by-case basis and will likely be done alongside specific legislative or other initiatives of the Commission that will follow this proposal.

Table 3: Methodological approach for modelling– consistency with 2030 communication

	2030 Communication	**2014 EED review**	**Notes**
Reference scenario	Climate and energy policies adopted up to June 2012	As "2030" For the purpose of assessment of achieving the 2020 target, Reference+ scenario was elaborated (as "2030", plus policies adopted up to January 2014)[33]	For the Reference+ modelling results suggest that the 13 ecodesign/ energy labelling regulations adopted since June 2012 have no impact.[34]
GDP growth	2010-20: 1.5% p.a. 2020-30: 1.6% p.a.	As "2030"	
Fossil fuel prices (€'10/boe, 2020/30)	Oil 89/93; gas 62/65; coal 23/24	As "2030"	
Energy technology progress	Decreasing costs and increasing performances for specific technologies	As "2030"	
Structure of EU28 economy	Increasing share of services in the gross value added of the economy	As "2030"	
Population growth	2010-20: 0.3% p.a; 2020-30: 0.2% p.a.	As "2030"	
Degree days	Kept constant at 2005 level	As "2030"	
Policy scenarios: GHG emissions	-40%	As "2030"	Most high-saving scenario: overshooting allowed
Policy scenarios: share	at least 27%	As "2030"	

[33] F-Gas regulation; new transport measures (alternative fuels infrastructure, better quality and more choice in railway services, improvements in fuel efficiency of lorries, speeding up the reform of Europe's air traffic control system); new ecodesign and energy labelling regulations; updated depiction of 2012 Energy Efficiency Directive, reflecting reporting by Member States.

[34] In PRIMES efficiency and technology improvements are driven not only from specific policies but also from economic drivers and market forces. Ecodesign and energy labelling policies were already modelled in the Reference 2013 scenario. This means that in the technology menu more advanced technologies which can be selected in a scenario were included. In this case, the uptake of efficient technologies - if economically justified - is occurring de facto, even in absence of a specific policy and even if not prescribed by specific policy such as eco-design. In this respect, the Reference 2013 scenario projected already significant changes in regard to energy efficiency, technology progress (in the menu of available technologies for choice) and in effective choice of technologies. Therefore, the inclusion of recently adopted ecodesign and labelling policies in the policy scenarios did not show any significant changes in energy consumption.

of renewable energy			
Representation of active public policy in energy efficiency and other sectors	"Carbon values"[35], and, post-2030, "enabling settings"[36]. In addition, tighter CO2 standards for cars after 2030. The 2030 IA also included some scenarios with modelling of additional energy efficiency measures[37].	As "2030"	Carbon values and enabling settings in the case of energy efficiency, replaced by energy efficiency measures[38] .
Discount rates used to depict decision-making by economic actors	8-17.5%; some energy efficiency measures can lower discount rates	As "2030"[39]	
System costs	Calculated using standard (un-lowered) private discount rates[40]	As "2030"	

[35] Mirroring ETS prices in the non-ETS sector – representing still undefined policies that will drive GHG reduction.
[36] Assumption of perfect market coordination and consumer confidence driven by firm commitment to decarbonisation, leading to lower system costs and faster uptake of EE, RES and emission reduction technologies.
[37] Savings obligations for utilities; energy management systems; ESCOs; energy labelling; CHP and district heating/cooling; efficiency in grids; ecodesign; take-up in industry of best available techniques; internalisation of local externalities in transport; CO_2-related element in vehicle registration and circulation taxes; revised Energy Taxation Directive; ITS for road and waterborne transport; ecodriving; tighter CO_2 standards for cars and vans; efficiency improvements for heavy duty vehicles.
[38] As described in the footnote above.
[39] In the 2030 impact assessment, the scenarios with ambitious energy efficiency policies made the assumption of a wide deployment of energy performance contracting and strong penetration of ESCOs, which is mirrored by a further reduction of discount rates for households from Reference scenario conditions – see assumptions on discount rates in Annex V.
[40] Households, private cars 17.5%; industry, tertiary, trucks, inland navigation 12%; power generation 9%; public transport 8%.

5.2. Policy options for 2020

On present trends, EU primary energy savings are likely to achieve 18-19% in 2020, a shortfall compared to the target of approximately **20-40 Mtoe** (Chapter 2). Chapter 4 identified two options to address the gap:

- New primary legislation laying down binding national targets or additional binding measures
- Strengthened implementation of existing legislation

Based on the precedents of the EED and the Energy Performance of Buildings Directive (EPBD), **new primary legislation –** whether binding measures or binding targets **–** would be unlikely, even on an optimistic timetable, to enter into force before 2018.[41] The EU would then need to reduce energy consumption, compared to what it would otherwise have been, by an additional 12 Mtoe in each of the next three years, nearly doubling the rate projected in the modelling. It is unlikely that this could be achieved at such short notice.

The PRIMES modelling in question assumes a level of **implementation** of the requirements of the EED, EPBD and regulations adopted under ecodesign/energy labelling that falls well short of full compliance.

Regarding the EED, PRIMES assumes that it will lead to a reduction in annual final energy consumption of 39 Mtoe in 2020. By contrast, the targets notified by Member States for the implementation of Article 7 of the EED alone sum, if fully achieved, to savings of 59 Mtoe in 2020, whereas the potential impact of the EED - if fully implemented - calculated at the time when it was adopted was estimated to be above 100 Mtoe. In this impact assessment under a conservative approach, it is concluded on the basis of these numbers that another 20 Mtoe could be saved through proper implementation.

Regarding the EPBD, the impact assessment[42] of that directive estimated its impact to be in the range of 60 Mtoe savings by 2030. A study by Fraunhofer ISI[43] concluded that this potential will not be fully realised, unless it is properly implemented, and that proper implementation which could bring an additional 15 Mtoe savings. The key elements that need to be strengthened are the reliability of energy performance certificates, the effectiveness of certification frameworks in all Member States, and better checks of the compliance of new and renovated buildings with the relevant provisions in building codes.

[41] Proposal by Commission: January 2015. Adoption by co-legislators: July 2016. Transposition: January 2018.
[42] SEC/2008/2865.
[43] Draft study commissioned by DG ENER for supporting the Energy Efficiency Review.

Regarding Ecodesign and Energy Labelling the combined impact of the 40 or so measures adopted so far, based on engineering-type calculations, is 80 Mtoe. When overlaps and rebound are taken into account it can be conservatively estimated that at least half of these savings will materialise in practice. It is estimated that approximately 10% of the savings could be lost due to poor compliance[44]. This corresponds to additional 4 Mtoe could be saved through stronger enforcement.

This analysis suggests that the approach with the best potential to close the remaining gap to 2020 is strengthened implementation of existing legislation. This conclusion is corroborated by the study by Fraunhofer ISI which collated the expected impact of more than 500 national energy efficiency measures: according to that study assuming that these measures will be implemented as planned and correcting for double-counting the 2020 target could be fully reached[45]. The list of the analysed national measures and their expected impact is included in Annex VIII.

Strengthened implementation could be achieved through:

- Full implementation of EU legislation at national level, with effective monitoring;
- Reinforced resourcing of market surveillance and better cooperation among national market surveillance authorities;
- Strengthening energy performance certificates under the EPBD through benchmarking of the effectiveness of certification frameworks in all Member States, assisting Member States in compliance checks and linking national schemes to reliable EN standards;
- Making wider use of innovative financing in the form of standardised investment products to support energy efficiency financing products;
- Databases on product and building energy performance and indicators for measuring progress.

Accelerating secondary legislation in the products sector could play a supporting role providing additional savings over and above those stemming from improved implementation. Preparatory work is under way for seven new product groups, including windows, servers and data centres, steam boilers and water-related products. Accelerated implementation (in collaboration with stakeholders, Member States and the European Parliament) could bring this legislation into force a year earlier – with adoption dates in 2015/16 rather than 2016/17. It is estimated that this acceleration would increase primary energy savings by a further 5 Mtoe.

Accelerating secondary legislation in the products sector would help achieving the target but is not a condition for achieving it since strengthened implementation of existing rules would be sufficient for that purpose. In order to bridge the gap Member States would not be expected to implement requirements over and above those

[44] Monitoring, Verification and Enforcement Capabilities and Practices for the Implementation of the Ecodesign and Labelling Directives in EU Member States, CLASP, 2011.
[45] Draft study commissioned by DG ENER for supporting the Energy Efficiency Review, section 2.

stemming from existing EU legislation, the cost of which has been already assessed when this legislation was proposed. For example in the case of the EPBD the impact assessments of the proposal estimated that the abolishing the 1000 m^2 threshold at which buildings had to meet minimum efficiency standards when undergoing major renovation would lead to €8 billion/year additional capital costs but would trigger €25 billion/year energy cost savings by 2020 and therefore create negative CO_2 abatement costs. Key conclusions from the impact assessments of the EPBD and of the EED are included in Annex X.

5.3. Ambition level 2030

5.3.1. Energy system impacts

The main results of PRIMES modelling estimate the impacts of EE on the energy system. All results for the different policy scenarios are compared with the Reference 2013 scenario (later "Reference"). If it were assumed that the European 2020 target on energy efficiency would be fully met (in the light of discussion in chapters above), the baseline scenario would need to be adjusted, also beyond 2020 and the comparisons would be different. As in this IA a conservative approach is taken, the Reference was not adjusted in this manner.

These impacts vary for different levels of ambition of EE as portrayed by the scenarios analysed in this IA. The energy saving (calculated against the 2007 PRIMES baseline projections for 2030) achieved by the scenarios is the key metric, which, because of its importance, is used for labelling of scenarios. The scenarios achieve respectively energy savings in 2030 of 27.4%, 28.3%, 29.3%, 30.7%, 35.0% and 39.8%. Later they are referred to as EE27, EE28, EE29, EE30, EE35 and EE40 scenarios.

For all scenarios presented in this IA, GHG40 scenario from the 2030 IA is the starting point. With an overall increasing energy efficiency ambition, the scenarios become more costly. Still they present additional benefits (notably in security of supply – see below) which should be weighed against the incremental cost increase.

Measured as an absolute value, **primary energy consumption**[46] is clearly reduced in all scenarios analysed (8 to 24% in 2030 and 13 to 32% in 2050 in comparison to the Reference scenario) despite the steady growth of the EU GDP that is assumed[47]. The reductions are higher for all new scenarios than for the GHG40 scenario as the concrete EE policies have more impact than the carbon values assumed in the GHG40. It should be also noted that some reduction in primary energy consumption is due to the RES target of (at least) 27% present in all new scenarios - thanks to high statistical efficiency of RES in electricity production. This was also the case in GHG40.

[46] Gross Inland Consumption minus non-energy uses.

[47] The GDP growth projections are established by DG ECFIN and they are on avg. 1.6% p.a. over the period 2015-2030 and avg. 1.4% p.a. over the period 2030-2050).

As a result of reduced gross inland energy consumption, the **energy intensity of the EU economy** is reduced under all scenarios. The higher the energy savings, the lower the energy intensity of the EU economy gets. Among the sectors, lowering of the energy intensity is most visible in the residential and tertiary sectors reflecting the fact that the policies proposed for the policy mix in all scenarios affect mostly these two sectors.

The policy scenarios demonstrate also significant differences in terms of **the consumption of various primary energy sources**. **Table 4** below shows both the changes in the relative shares of fuels, as well as the changes in absolute consumption compared to Reference. It has to be borne in mind that all the scenarios achieve decreases in total energy consumption impacting the relative fuel shares.

- As regards **solid fuels** (notably coal), already in 2030 their consumption in absolute terms declines substantially under all scenarios except EE35 scenario (between 16 and 8% in comparison to the Reference). The EE35 has a high ambition of EE measures and consequently a rather low ETS prices are necessary to achieve the 40% GHG reduction allowing maintaining the same consumption of solids as in the Reference scenario (only 0.7% reduction compared to the Reference). In longer term, only EE30, EE35 and EE40 achieve a reduction of solids consumption (in comparison to Reference).

  The share of solids in the fuel mix in 2030 remains largely stable (in comparison to Reference) for EE27, EE28 and EE29 while it grows slightly for all other scenarios.

- For **oil**, the reduction of consumption in absolute terms is higher the more the energy savings and becomes more substantial with time (in 2030 between 7 to 14% and in 2050 between 59-63% in comparison to the Reference) – closely linked with CO_2 standards for light duty vehicles becoming more stringent.

  The share of oil in the fuel mix 2030 remains very stable (in comparison to Reference) in EE27, EE28, EE29 and EE30 scenarios at 32-33%, while it grows slightly in EE35 and EE40 scenarios.

- For **natural gas,** the reduction of consumption in absolute terms is the most pronounced among all the fuels. The reduction is higher the more the energy savings and becomes more substantial with time (in 2030 between 16 to 42% and in 2050 between 30-50% in comparison to the Reference) – closely linked to policies improving the thermal integrity of buildings.

  The shares of natural gas decline slightly as the scenarios get more ambitious. In 2030, they go from 25% for Reference to 23% for EE27 and to 19% for EE40.

- The consumption of **nuclear** in absolute terms decreases in 2030 in all scenarios in comparison to the Reference but in 2050 perspective it grows strongly for EE27, EE28 and EE29 scenarios, slightly for EE30 scenario and declines in

EE35 and EE40. The strong EE makes the nuclear less necessary for the achievement of decarbonisation.

The shares of nuclear in 2030 remain very stable (in comparison to Reference) in all scenarios at between 11-13%.

- Finally, the absolute consumption of **renewables** grows in 2030 for EE27, EE28 and EE29 scenarios (in comparison to Reference) but declines in the scenarios with more energy savings, where by the sheer reduction of energy consumption there is less need for the development of RES in absolute consumption. The main driver of renewables is the RES target which is around 27% for all scenarios. In longer perspective, the consumption of RES grows very strong for all scenarios driven by the decarbonisation and facilitated by enabling conditions. It should be noted that increased share of RES strengthens the effects of EE through increased statistical efficiency in power generation.

  The shares of renewables in 2030 are slightly higher (than in Reference) in all scenarios at: between 22-23%.

The changes described above will have some effects on the power generation capacity (growing for RES and declining for other fuels) as well as the necessary investments.

The **share of renewables in final energy consumption** as specified by the RES target present in all scenarios can be translated into specific shares in electricity, heating & cooling and transport. The scenarios analysed in this IA show very little variation for the shares in these specific sectors.

Table 4. Impacts on gross inland energy consumption in 2030 and 2050

Indicator *(figures are presented in a 2030/2050 format)*	**Ref**	**GHG40**	**Decarbonisation Scenarios**					
			EE27	**EE28**	**EE29**	**EE30**	**EE35**	**EE40**
Gross Inland Energy Consumption (Mtoe)	1611 / 1630	1534 / 1393	1488 / 1423	1470 / 1380	1450 / 1338	1422 / 1286	1337 / 1196	1243 / 1129
Primary Energy Consumption (Mtoe)[48]	1490 / 1510	1413 / 1294	1369 / 1319	1352 / 1281	1333 / 1239	1307 / 1188	1227 / 1098	1135 / 1031
Energy Savings % in 2030[49]	21.0	25.1	27.4	28.3	29.3	30.7	35.0	39.8
Energy Intensity (2010 = 100) *(primary energy to GDP)*	67 / 52	64 / 44	62 / 45	61 / 44	61 / 42	59 / 41	56 / 38	52 / 36
- Industry[50]	81 / 68	78 / 55	74 / 50	74 / 48	73 / 48	72 / 48	68 / 48	68 / 48
- Residential[51]	72 / 54	67 / 40	65 / 44	63 / 41	61 / 38	58 / 35	52 / 29	43 / 24

[48] Refers to Gross Inland Energy Consumption excluding non energy uses.
[49] Evaluated against the 2007 Baseline projections for Primary Energy Consumption
[50] Energy on Value added.

- Tertiary[52]	65 / 49	59 / 34	58 / 42	55 / 40	52 / 37	50 / 34	43 / 29	33 / 24
- Transport[53]	71 / 56	70 / 44	68 / 44	68 / 44	68 / 44	68 / 44	68 / 43	68 / 43
Gross Inland Energy Consumption in Reference and % change compared to Reference	1611 / 1630	-4.8 / -14.5	-7.7 / -12.7	-8.8 / -15.3	-10 / -17.9	-11.8 / -21.1	-17 / -26.6	-22.8 / -30.8
- Solid fuels	174 / 124	-10.8 / 7.2	-15.7 / 8.4	-12.1 / 5	-9.5 / 1.3	-7.5 / -3.7	-0.7 / -13.1	-11.6 / -16.5
- Oil	520 / 498	-3.3 / -62.1	-7.3 / -59.4	-8 / -59.9	-8.8 / -60.2	-9.7 / -60.4	-12 / -62.5	-13.6 / -62.8
- Natural gas	397 / 397	-13.2 / -36.9	-15.6 / -30.1	-18.9 / -33.8	-21.7 / -37.1	-24.9 / -40.6	-35.3 / -44.9	-42.2 / -49.9
- Nuclear	201 / 216	-0.2 / 17.1	-6.2 / 13.1	-6.6 / 11.2	-8.1 / 7.8	-11.7 / 2	-21.7 / -8.4	-31.5 / -17.2
- Renewables	320 / 398	3.5 / 43.6	5 / 42.6	2.9 / 38.2	1.1 / 34.3	-1.1 / 29.8	-8.3 / 22.7	-14.4 / 16.8
Gross Inland Energy Inland Consumption Share of :								
- Solid fuels	10.8 / 7.6	10.1 / 9.5	9.9 / 9.5	10.4 / 9.4	10.8 / 9.4	11.3 / 9.3	12.9 / 9	12.4 / 9.2
- Oil	32.3 / 30.5	32.8 / 13.5	32.4 / 14.2	32.6 / 14.5	32.7 / 14.8	33 / 15.3	34.2 / 15.6	36.2 / 16.4
- Natural gas	24.6 / 24.3	22.5 / 17.9	22.5 / 19.5	21.9 / 19	21.5 / 18.6	21 / 18.3	19.2 / 18.3	18.5 / 17.6
- Nuclear	12.5 / 13.2	13.1 / 18.1	12.7 / 17.2	12.8 / 17.4	12.7 / 17.4	12.5 / 17.1	11.8 / 16.5	11.1 / 15.8
- Renewables	19.9 / 24.4	21.6 / 41	22.6 / 39.9	22.4 / 39.8	22.3 / 39.9	22.3 / 40.1	22 / 40.8	22.1 / 41.2
Renewables Share - Overall	24.4 / 28.7	26.5 / 51.4	27.8 / 49.9	27.7 / 50.1	27.7 / 50.4	27.7 / 50.56	27.4 / 51.8	27.4 / 52.3
- Share in electricity, heating & cooling	31 / 36.8	34.2 / 51.4	36.2 / 50.4	36.2 / 50.7	36.4 / 51.3	36.5 / 51.5	36.9 / 53	37.8 / 53.9
- Share in heating & cooling	23.8 / 26.6	25.9 / 49	27.4 / 46.4	27.4 / 46.6	27.5 / 46.9	27.5 / 45.9	27.4 / 46.1	27 / 46.3
- Share in electricity	42.7 / 50.1	47.3 / 53.2	49.7 / 53.8	49.4 / 54.1	49.3 / 54.6	49.6 / 55.8	50.3 / 58.1	52.7 / 59.3
- Share in transport	12 / 13.9	12.8 / 67.9	13.7 / 65	13.7 / 65.2	13.9 / 65.5	14 / 966	14.2 / 68.5	14.4 / 68.9

Source: PRIMES 2014

The impacts of EE on overall energy consumption and on the fuel mix have important effects on **energy imports**. Clearly, the energy efficiency policy can contribute to reducing the demand for imported fuels and thus increasing the security of supply, which is currently a high political priority in the context of events in Ukraine.

[51] Energy on Private Income.
[52] Energy on Value added.
[53] Energy on GDP.

In the **Table 5** below it is visible that **net energy imports** decrease significantly for all scenarios already in 2030. While the reduction of net energy imports in 2030 (in comparison the year 2010) is 4% for the Reference, the scenarios achieve between 14 and 26% reductions - the reductions are getting higher, the more is the energy savings. All scenarios achieve higher reduction than the GHG40 scenario presented in the 2030 IA. The trend is even more pronounced in 2050 (where for all scenarios the imports practically halve in comparison to the year 2010). In this longer term perspective, the drivers are both EE policies and higher share of (domestically produced) renewables in the context of decarbonisation.

Looking at specific imported fuels in 2030:

- the **imports of solids** decrease for all scenarios and up to 41% for EE40 scenario (in comparison to 2010) whereas the Reference achieves only 23% reduction;
- the **imports of oil** decrease for all scenarios and up to 19% for EE40 (in comparison to 2010) whereas the Reference achieves only 7% reduction;
- the **imports of gas** decrease for all scenarios and up to 40% for EE 40 scenario (in comparison to 2010) whereas in Reference imports grow by 5%.

Import dependency – if defined as the ratio between fuel imports and total energy consumption - is in the short term only to some extent affected by policy choices and there are little differences between scenarios in 2030 with respect to the Reference and even present levels. In 2050, however, the Reference still has 57% import dependency whereas all other scenarios decrease it to below 40%, due to reduced demand for imported fossil fuels – brought about by the EE policies. In general, the import dependency indicator should be interpreted with caution. As shown in the **Table 5**, the import dependency values slightly increase from the EE29 to the EE40 scenario. At first glance, this seems to be contrary to the reduced absolute imported fuels. But it has to be also borne in mind that EE reduces global energy consumption in total, which decreases the denominator of the indicator *import dependency* (imported fuels divided by energy consumption). As both values of this indicator - the imported fuels and the energy consumptions - change with increased EE, it is better to use the absolute numbers for comparability reasons to assess the increase of **security of supply**.

The key role of EE in increasing security of supply was already acknowledged in the impact assessment underpinning the 2030 Communication and again in the European Energy Security Strategy. In the current context, it is more relevant to look at the impact that EE has on gas imports than overall energy dependency. As well as a risk of severance of energy provision, insecurity in the natural gas market can significantly contribute to increasing prices for industries and households. Approximately 65% of the EU's gas use is for heating buildings, and energy efficiency measures are well attuned to cutting this. Already with 27% energy savings, gas imports would already be 17% lower in 2030 than in the Reference. Every additional 1% in energy savings leads to a further reduction of about 2.6% in gas imports, reaching, for example, a 36% cut in gas imports in EE35(116 bcm) compared with Reference. Above 35% energy savings, the rate of reduction of gas imports from additional energy savings falls off sharply.

Decreasing import dependency under all EE scenarios demonstrates that EE policy reduced energy consumption of imported fuels to a greater extent than consumption of those produced domestically.

Another manner of illustrating the impact of EE on imports is calculation of **fossil fuel net imports in monetary value** which already in 2030 decreases for all scenarios and most markedly for EE30, EE35 and EE40. In2050 perspective, the value of imports under the Reference would increase taking into account growing fossil fuel prices but it decreases even further in all scenarios analysed reflecting their strong impact on curbing the demand, which even outweighs the effect of growing prices.

Net energy import decreases translate into **savings in the energy fossil fuels imports bill** (calculated here as a cumulative value over a 20 year period). For the period 2011-2030 cumulative savings range from €285 billion to €549 billion and for the period 2031-2050 from €3349 billion to €4360 billion. These savings indicate that rather than paying for imports, the EU economy can have these resources invested either in technology development and/or new assets and/or education, all of which contribute to job creation and economic growth.

Energy efficiency cannot, of course, constitute an entire energy security strategy on its own. It needs to be part of a broader set of measures, including the diversification of suppliers and supply points, ensuring proper fuel stocks and building interconnectors. With reduced energy demand but without these additional elements countries would be still exposed to sudden disruptions and price shocks. Neither this analysis nor the analysis underpinning the European Energy Security Strategy attempts to quantify the respective role that these different measures can play. It can be however concluded on the basis of this analysis that energy efficiency has the effect of:

- Reducing the scale of impacts that sudden supply disruptions or price hikes can have on the economy thanks to lower absolute consumption of energy, and of imported fuels in particular;

- Changing the relative weight of certain fuels in the energy mix, with a reduced share of gas where the exposure to these risk factors is particularly high and increased share of other fuels where this risk is relatively smaller, either because they are primarily domestically – produced (e.g. renewables) or because they are traded in a much more liquid market than gas (e.g. oil). This is linked to the design on the policies modelled which target buildings in particular, where the share of gas for heating is especially high.

While the potential of energy efficiency in this respect depends on the specific situation of different Member States, it needs to be stressed, as in the European Energy Security Strategy, that the EU's energy system is increasingly integrated, while at the same time

Member States are importing from the same supplier countries and it is therefore important to consider energy security from an EU perspective. Choices taken on the level of fuel supply, infrastructure development, energy transformation or consumption lead to spill-over effects on other Member States.

Table 5. Impacts on energy security in 2030 and 2050

Indicator *(figures are presented in a 2030/2050 format)*	**Ref**	**GHG40**	**Decarbonisation Scenarios**					
			EE27	**EE28**	**EE29**	**EE30**	**EE35**	**EE40**
Net Energy Imports Volume (2010=100)	96 / 101	89 / 56	86 / 59	85 / 57	83 / 56	82 / 54	78 / 51	74 / 49
- Solid	77 / 49	68 / 42	61 / 40	65 / 38	61 / 38	62 / 34	70 / 30	59 / 29
- Oil	93 / 96	90 / 41	86 / 44	85 / 43	85 / 43	84 / 43	82 / 41	81 / 41
- Gas	105 / 122	91 / 74	88 / 82	84 / 78	81 / 74	78 / 69	67 / 65	60 / 59
- Renewable Energy Forms	492 / 601	505 / 1043	509 / 1002	500 / 972	493 / 947	48 / 9202 / 924	458 / 875	433 / 852
Import Dependency (% net imports to total gross inland energy consumption)	55.1 / 56.6	53.6 / 36.8	53 / 38.1	53 / 38	52.6 / 38.2	52.8 / 38.3	53.5 / 38.6	54.4 / 39.1
Value of Fossil Fuel Net Imports (bn €'10) *(average annual 2011-30 and 2031-2050)*	461 / 548	452 / 377	447 / 380	446 / 373	444 / 366	441 / 358	436 / 340	434 / 330
- Oil	330 / 390	327 / 263	323 / 265	323 / 262	322 / 259	321 / 257	319 / 248	318 / 245
- Gas	115 / 146	110 / 104	108 / 107	107 / 102	106 / 98	105 / 93	101 / 84	100 / 76
- Solid	16 / 12	15 / 10	15 / 9	15 / 9	15 / 9	15 / 8	15 / 8	15 / 8
Fossil Fuels Import Bill Savings compared to reference (bn € '10) *(cumulative 2011-30 and 2031-2050)*	n.a	-190 / -3404	-285 / -3349	-311 / -3490	-346 / -3637	-395 / -3798	-503 / -4145	-549 / -4360

Source: PRIMES 2014

The **final energy demand** is projected to decrease differently in the different sectors. Looking at the specific sectors in detail, the residential and tertiary sectors experience the strongest reduction (in comparison to the Reference) as they are affected by a majority of energy efficiency policies with the biggest changes brought about by improving thermal integrity of buildings – consequently their share in total final energy demand decreases. The share of industry in final energy demand almost does not change from the Reference case demonstrating the countervailing effects of EE policies and ETS prices. Finally, the share of transport grows slightly in EE25 and EE28 and more significantly in the scenarios with more energy savings reflecting relatively smaller potential for GHG abatement in transport.

Gross electricity generation decreases by 2030 for all scenarios in comparison to Reference. In a 2050 perspective, however, it grows (except for EE35 and EE40 scenarios) reflecting increasing demand for electricity from heating, appliances and transport. In electricity generation, for all scenarios the share of gas declines while the share of RES increases. Electricity grid losses remain the same for all scenarios and Reference except for EE35 and EE40 scenarios, in which losses decline slightly.

Among impacts on **technologies**, a key impact to be observed is the increase of shares of electricity produced from **combined heat and power (CHP)** up to 17% already in 2030 in EE27, EE28, EE29 and EE30 scenarios (from 16% in the Reference). The increase in 2030 is due to synergies between the RES target and co-generation which mainly uses biomass as a feedstock. In 2050 perspective, however, the CHP indicator declines (in comparison to the Reference) for all scenarios as there is increasing competition for biofuels/biomass feedstocks in transport.

Concerning **CCS** development, the % of electricity it represents is higher than in Reference in EE27 and EE28 scenarios but its role is lesser than in the Reference in scenarios with more energy savings reflecting low ETS prices.

Energy related CO_2 emissions decrease strongly in all scenarios already in 2030 and then even more in 2050 reflecting the declining demand for energy as well as declining carbon intensity of power generation, the latter mostly influenced by ETS and renewables policy.

Table 6. Other energy system impacts

Indicator *(figures are presented in a 2030/2050 format)*	**Ref**	**GHG40**	**Decarbonisation Scenarios**					
			EE27	**EE28**	**EE29**	**EE30**	**EE35**	**EE40**
Final Energy Demand (Mtoe)	1126 / 1151	1073 / 885	1039 / 904	1020 / 876	1002 / 848	981 / 819	920 / 759	859 / 712
- Industry share	27.3 / 26.8	27.5 / 28.3	26.8 / 24.9	27.3 / 24.9	27.6 / 25.6	27.8 / 26.4	28.1 / 28.4	29.8 / 30.2
-Residential share	26.4 / 26.4	25.9 / 25.5	26.2 / 27.1	25.7 / 26.4	25.3 / 25.2	24.8 / 23.8	23.4 / 21.4	21 / 18.8
-Tertiary share	14.9 / 15	14.2 / 13.4	14.5 / 16.1	13.9 / 15.8	13.6 / 15.3	13.2 / 14.6	12 / 13.5	10.1 / 11.9
-Transport share	31.4 / 31.8	32.4 / 32.9	32.5 / 31.9	33.1 / 33	33.6 / 34	34.3 / 35.2	36.5 / 36.7	39.1 / 39.1
Gross Electricity Generation (*TWh*)	3664 / 4339	3532 / 5040	3469 / 5038	3461 / 4936	3423 / 4796	3336 / 4560	3080 / 4267	2804 / 3969
- Solids Share	13 / 8.4	11.6 / 10.1	10.9 / 10.8	11.9 / 10.7	12.5 / 10.5	13.4 / 10.1	16.6 / 9	15.5 / 9
- Oil Share	0.6 / 0.5	0.5 / 0.1	0.5 / 0.1	0.5 / 0.1	0.5 / 0.1	0.5 / 0.1	0.5 / 0.1	0.5 / 0.1
- Natural Gas Share	19.5 / 17.3	15.3 / 12.5	14.8 / 12.5	14.2 / 12.3	13.8 / 11.9	13 / 11.2	10.2 / 11	9.8 / 10.3
- Nuclear share	21.8 / 21.3	22.6 / 21.6	21.5 / 20.8	21.5 / 20.9	21.3 / 20.8	21 / 20.7	20 / 19.8	19.1 / 19.1
- Renewables share	44.5 / 51.6	49.3 / 54.2	51.7 / 54.4	51.3 / 54.6	51.2 / 55.2	51.5 / 56.4	52.1 / 58.5	54.6 / 59.8

- of which hydro share	10.8 / 9.8	11.2 / 8.6	11.5 / 8.7	11.5 / 8.8	11.6 / 9.1	11.9 / 9.5	12.8 / 10.1	13.9 / 10.8
- of which wind share	21 / 24.8	23.9 / 26.5	24.8 / 27	24.5 / 27.1	24.4 / 27.2	24.4 / 27.3	24.2 / 27.8	25.2 / 27.6
- of which Solar, tidal, etc share	5.8 / 8.4	6.4 / 9.5	6.8 / 9.6	6.6 / 9.4	6.6 / 9.4	6.6 / 9.5	6.7 / 9.8	6.9 / 9.8
- of which Biomass & waste share	6.6 / 7.9	7.5 / 8.6	8.3 / 8.2	8.4 / 8.4	8.4 / 8.7	8.4 / 9.2	8.1 / 9.9	8.3 / 10.7
CCS indicator (% of electricity from CCS) (difference in p.p.)	0.45 / 6.9	0.77 / 14.72	0.65 / 14.53	0.58 / 13.67	0.41 / 12.98	0.27 / 11.83	0.29 / 10.65	0.3 / 10.19
CHP indicator (% of electricity from CHP) (difference in p.p.)	16.1 / 16.2	16.4 / 14	17 / 14.9	17 / 14.6	16.9 / 14.7	17 / 15.1	16.2 / 15.2	16.3 / 15.3
Carbon intensity of power generation *(per MWhe+MWhth)*	17.8 / 7.9	15.1 / 0.7	14.4 / 1.1	15 / 1.2	15.5 / 1.2	16.1 / 1.2	17.7 / 1.3	16.9 / 1.1
Electricity Grid Losses[54]	6.4 / 6.7	6.3 / 6.4	6.4 / 6.6	6.4 / 6.6	6.3 / 6.6	6.1 / 5.8	5.6 / 4.9	5.5 / 4.9

Source: PRIMES 2014

5.3.2. Economic impacts in the energy system

The EU Reference scenario 2013 - projecting the consequences of already adopted policies as well as developments largely unrelated to policy (renewal of ageing power generation capacity in Europe, growing international fossil fuel prices) - shows, until 2030, the **ratio of total energy system cost to GDP** will be increasing from 12.8 % in 2010 to 14.0% in 2030, before decreasing to 12.3 % in 2050. The policy scenarios evaluated in the 2030 IA all showed higher energy system costs up to 2030 and beyond, with costs being the lowest for the GHG40 scenario and highest for the scenarios with the most energy savings.

This chapter revisits the costs estimation and shows the level of cost increase brought by different levels of ambition of EE policies, including the GHG40 scenario presented in the 2030 IA. Looking at **differences in average annual costs for the period 2011-2030** across all scenarios, they range between 0.01 and 0.79 percentage points of GDP higher compared to the Reference. Looking specifically at the year 2030, energy system costs in policy scenarios are between 0.13 and 3.97 percentage points of GDP higher than the Reference. The additional increases are higher in 2050, reflecting the costs necessary to achieve decarbonisation, in addition to the costs of energy efficiency policy.

[54] Ratio of electricity transmission and distribution losses to electricity supply excluding self consumption

Regardless of the method of comparison, these additional increases of system costs are much smaller than those resulting under the Reference scenario itself.

Total energy system costs from an end user perspective (as calculated in the modelling) comprise mainly three elements: 1) annuities for capital expenditure on energy using equipment, 2) fuel and electricity costs (energy purchasing costs[55]), including capital expenditure for the production and distribution of electricity and 3) the as so-called direct energy efficiency investment costs[56] (not related to energy equipment itself), such as expenditure for insulation. The latter being also expenditures of capital nature are also expressed in annuity payments.

These components of energy system costs differ substantially across policy scenarios analysed in this IA:

- **Energy purchases** are significantly reduced in all scenarios, most significantly in EE30, EE35 and EE40. For the period 2011-2030, average annual energy purchasing costs are between €33 bn to €89 bn lower than for the Reference. Across all scenarios, the reductions are mainly achieved in residential and tertiary sectors.
- On the other hand, **direct efficiency investments**, representing mainly investment in the thermal integrity of buildings, increase in all scenarios and sharply in EE35 and EE40 scenarios. For the period 2011-2030, average direct efficiency investment costs are between €16 bn to €181 bn higher than for Reference.
- **Capital costs** remain relatively stable across scenarios and mainly concern the residential and transport sectors. For the period 2011-2030, average annual capital costs are between €15 bn to €19 bn higher than for Reference.

It is to be recalled from the previous sections that all scenarios analysed in this IA are in the enabling settings, which lower the overall costs of achieving the targets because of necessary market coordination, public acceptance of policy choices and supportive policies in RDI and infrastructure. All costs (also linked to enabling settings) are fully accounted for.

The **Table 7** below shows various system cost comparisons as in the 2030 IA (e.g. total system cost as average annual 2011-30 and 2031-2050 or total system costs in 2030 as % of GDP increase). In addition, the values are shown for the different sectors.

[55] Energy purchase costs include the capital costs corresponding to power & gas infrastructure (plants & grids), refineries and fossil fuel extraction, recovered in the model through end-user prices of energy products.
[56] Direct efficiency investment expenditures include the costs relating to (a) thermal integrity of buildings, i.e. for building insulation, triple glazing and other devices for energy savings including building management systems, and (b) for the industry sector they also include the investments that relate to the horizontal (not related to specific processes) energy saving investments, such as for energy control systems and heat recovery systems.

It is worth noting that although GHG40 is less costly than EE27 over 2011-2030 in terms of average yearly total energy system costs (by €0.5 bn), EE27 presents lower total energy system costs in 2030. In the periods afterwards, both EE27 and EE28 appear to be less costly than GHG40, both in 2050 and in average yearly terms over 2031-2050. This can be mainly explained by the lower ambition of EE27 and EE28 in terms of GHG emissions reductions over the projection period, but also the introduction of some low-cost EE policies for dismantling non-market barriers (barriers that do exist in GHG40) and which enable to reap the relevant EE potential available in EU – at a lower cost.

This IA does not look into costs and benefits to be borne by specific sectors of final energy demand or specific economic actors (e.g. landlord, tenants, car manufacturers, specific industries). Such assessment will be done for policy/legislative proposals that will follow the agreement on the overall energy efficiency target.

Table 7. Energy system costs and its components[57, 58]

Indicator *(figures are presented in a 2030/2050 format)*	**Ref**	**GHG40**	**Decarbonisation Scenarios**					
			EE27	**EE28**	**EE29**	**EE30**	**EE35**	**EE40**
Total System Costs in bn €'10 *(average annual 2011-30 and 2031-2050)*	2067 / 2520	2069 / 2727	2069 / 2649	2074 / 2686	2082 / 2747	2089 / 2806	2124 / 3001	2181 / 3355
Total System Costs as % of GDP *(average annual 2011-30*	14.3 / 13.03	14.31 / 14.1	14.31 / 13.7	14.35 / 13.89	14.4 / 14.2	14.45 / 14.51	14.69 / 15.52	15.09 / 17.34

[57] Total system costs do not include any disutility costs associated with changed behaviour, nor the cost related to auctioning – but do include an attribution of monetary costs to non-financial barriers such as the effort needed to find out energy performance of appliances, and the deterrent to tenants' adoption of energy-saving behaviours when their landlord is responsible for paying energy bills.

[58] The small difference between the total system costs and the summation of capital costs, energy purchase costs and direct efficiency investment costs is due to the inclusion of the supply side auction payments under energy purchases, embedded in the energy prices (but not included under the reported total system costs which exclude auction payments).

and 2031-2050)								
Total System Costs as % of GDP increase *(average annual 2011-30 and 2031-2050)* compared to Reference in % points	0	0.01 / 1.07	0.01 / 0.67	0.05 / 0.86	0.11 / 1.18	0.15 / 1.48	0.39 / 2.49	0.79 / 4.32
Total System Costs as % of GDP in 2030 *(2010 value: 12.76 %)*	14.03 / 12.3	14.18 / 13.96	14.16 / 13.39	14.33 / 13.62	14.53 / 14.01	14.73 / 14.39	15.79 / 15.54	17.99 / 17.42
Total system Costs in 2030 as % of GDP increase compared to Reference in % points	0	0.15 / 1.65	0.13 / 1.09	0.3 / 1.32	0.51 / 1.71	0.7 / 2.09	1.76 / 3.23	3.97 / 5.11
Capital Costs in bn €'10 *(average annual 2011-30 and 2031-2050)*	590 / 939	598 / 1071	607 / 1076	607 / 1071	606 / 1068	609 / 1072	607 / 1070	605 / 1044
Industry	57 / 84	60 / 91	59 / 86	59 / 84	59 / 83	60 / 84	59 / 83	59 / 82
Residential	304 / 450	305 / 438	312 / 467	312 / 464	311 / 459	314 / 461	313 / 452	313 / 437
Tertiary	52 / 83	51 / 67	51 / 79	51 / 76	50 / 71	50 / 68	48 / 59	47 / 48
Transport	177 / 322	182 / 474	185 / 445	185 / 448	185 / 454	186 / 460	187 / 476	187 / 476

Direct Efficiency Investments in bn €'10 *(average annual 2011-30 and 2031-2050)*	35 / 35	47 / 274	52 / 184	62 / 257	76 / 355	89 / 452	146 / 731	216 / 1182
Industry	1 / 5	2 / 74	4 / 67	5 / 80	5 / 86	6 / 91	13 / 102	15 / 104
Residential	24 / 22	29 / 128	33 / 83	39 / 124	48 / 186	56 / 246	87 / 420	124 / 699
Tertiary	10 / 8	16 / 71	14 / 34	18 / 53	23 / 83	27 / 114	47 / 210	77 / 380
Transport	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Energy Purchases in bn €'10 *(average annual 2011-30 and 2031-2050)*	1454 / 1586	1436 / 1394	1422 / 1402	1417 / 1370	1411 / 1335	1401 / 12891290	1378 / 1206	1365 / 1130
Industry	279 / 291	273 / 258	271 / 246	271 / 240	270 / 237	269 / 233	264 / 225	263 / 223
Residential	426 / 498	421 / 455	416 / 442	414 / 427	410 / 408	405 / 384	395 / 342	388 / 299
Tertiary	238 / 262	234 / 218	232 / 236	230 / 226	228 / 213	225 / 198	217 / 171	212 / 139
Transport	510 / 534	508 / 463	502 / 478	502 / 478	502 / 477	502 / 475	502 / 468	502 / 469

Source: PRIMES 2014

Energy related investment expenditures can be practically divided in:

1. Investments in the supply side, namely in grids, power generation plants and boilers.
2. Investments on the demand side, split between energy equipment (covering appliances, vehicles, equipment, etc) and direct energy efficiency.

The table below describes the average annual investment expenditures across scenarios, providing an alternative view of the projected investment expenditures compared to the total system costs figures, which reflect the entire financial flows related to investment.

The investment expenditures increase in all scenarios - again most significantly in EE35 and EE40 scenarios and again mostly in residential and tertiary sectors. The average annual investment expenditure rises in the period 2011-2030 between €35 bn and €331 bn.

In the residential and tertiary sectors, increases are the most pronounced: the average annual investment expenditure rises in the period 2011-2030 between €9 bn and €154 bn for residential sector and between €6 bn and €156 bn for tertiary. It has to be, however, noted that energy investments in the residential increase property values because of their improved energy performance (for which the benefit is captured in the model through lower fuel costs) and amenity value by an amount that one study estimated to correspond to some 40% of the cost of investments in energy efficiency in the residential sector[59]. More efficient buildings offer the people who live and work in them other benefits. In one study, the "ancillary benefits" of better windows, such as better air quality and protection from external noise, have been found to be just as valuable to residents as the reduction in heating bills[60].

As discussed above, the introduction of some low-cost EE policies for dismantling non-market barriers, allows the EE scenarios to reap early and at low cost the relevant EE potential available in EU. As a result, EE27 presents lower investment expenditures over 2011-2030 than GHG40, mainly due to the removal of non-market barriers (that do exist in GHG40), which allow for "easy" EE gains in the residential and tertiary sectors, while at the same time giving the possibility to exploit a large part of the EE potential in the non-energy intensive industry.

In general, the investment expenditure figures increase more sharply compared to the total system costs. The reason for this is that in the system costs include energy purchases which decrease with a higher EE level and therefore counterbalance the increasing efficiency investments.

The magnitude of investments in the entire economy should be also interpreted as a huge potential for driving jobs and growth in the EU, in particular due to the local nature of much energy efficiency investment and the industrial and technological leadership the EU companies still have in terms of energy efficient and low-carbon technology.

Table 8. Investment Expenditures

Indicator *(figures are presented in a 2030/2050 format)*	**Ref**	**GHG40**	**Decarbonisation Scenarios**					
			EE27	**EE28**	**EE29**	**EE30**	**EE35**	**EE40**

[59] BIO Intelligence Service. 2013. Energy performance certificates in buildings in their impact on transaction prices and rents in selected EU countries. Cited at: http://ec.europa.eu/energy/efficiency/buildings/doc/20130619energy_performance_certificates_in_buildings.pdf

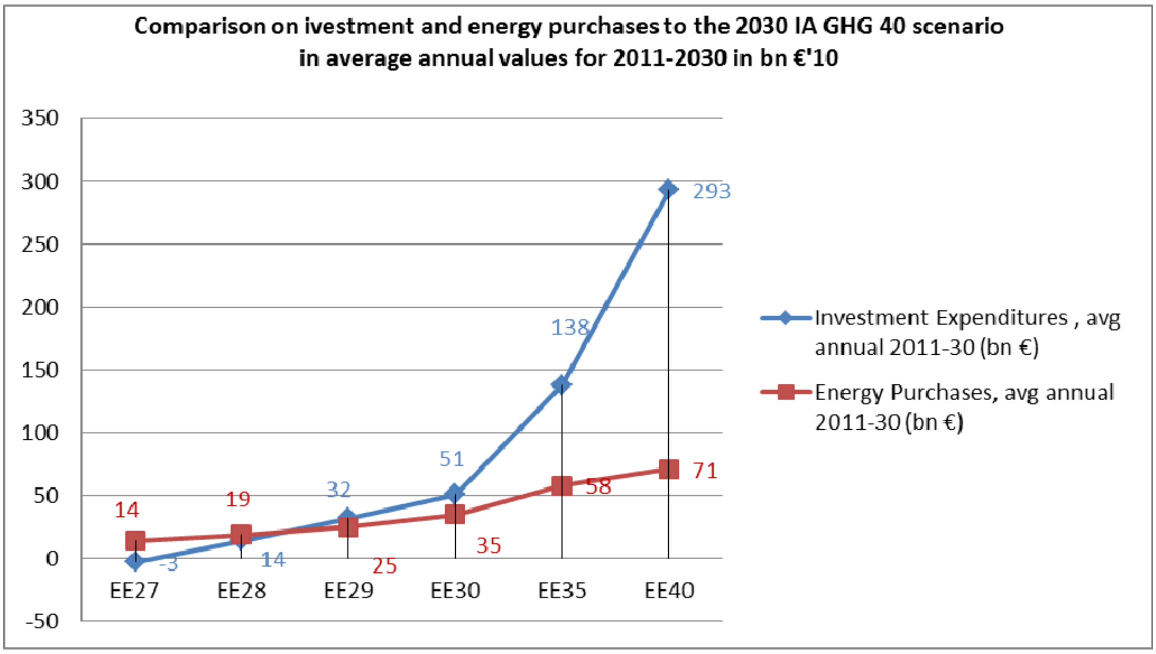
[60] M. Jakob, Marginal costs and co-benefits of energy efficiency investments – The case of the Swiss residential sector, Energy Policy 34 (2006) 172-187. See also [BIO Intelligence Services report for Commission]; [IPCC report on mitigation options, 2014]; Phillips, Y., Energy Policy 45 (2012) 112-121, "Landlords versus tenants: Information asymmetry and mismatched preferences for home energy efficiency"; Scott, F.L., C.R. Jones and T.L. Webb, Energy Policy (2013), "What do people living in deprived communities in the UK think about household energy efficiency interventions?".

Investment Expenditures in bn €'10 *(average annual 2011-30 and 2031-2050)*	816 /949	854 /1189	851 /1110	868 /1126	886 /1149	905 /1170	992 /1203	1147 /1211
Industry	19 /30	24 /88	29 /72	30 /83	31 /82	34 /82	45 /69	49 /65
Residential	36 /28	49 /77	45 /49	54 /57	64 /75	73 /95	115 /130	190 /160
Tertiary	14 /10	25 /41	20 /16	28 /16	37 /23	45 /29	87 /33	170 /23
Transport	660 /782	662 /843	663 /834	664 /835	664 /837	665 /839	665 /852	665 /852
Grid	37 /41	40 /55	40 /54	40 /54	39 /52	38 /49	34 /48	29 /44
Generation and boilers	50 /59	53 /85	53 /86	52 /82	51 /80	50 /75	46 /72	44 /66

Source: PRIMES 2014

The incremental increases in investments as well as reductions in energy purchases can be also directly compared to GHG40 scenario as demonstrated in the figure below.

Figure 4. Comparison of average annual investments (2011-2030) with energy purchasing costs



Source: PRIMES

Other important economic impacts directly affecting all energy consumers are impacts on **electricity prices**[61] and the **ETS prices**. In the modelling underpinning this IA, the choice was made not to use carbon values but to model concrete EE policies. RES values and EE values representing the shadow values promoting respectively

[61] Fossil fuel prices are exogenous in the modelling.

renewables and some (but by no means all) aspects of energy efficiency are also summarised in table 9 (see explanations of these metrics in Annex V). RES values change only slightly in comparison to the Reference scenario (as needed to achieve the RES target). On the other hand, the EE values grow very strongly reflecting measures aiming at improving thermal integrity of buildings by accelerated renovation and stricter building codes. The obligation so represented by EE values, which are internalized in the optimizing behaviors of the relevant actors who consider these values as a potential penalty per unit of non-achieved savings relative to the obligation. The Reference demonstrates that significant increases in electricity prices (31% increase in real terms until 2030, compared to 2010) should in any case be expected. Electricity price changes compared to Reference are very small in 2030 ranging from +0.85% to +3.34% in the year 2030. In a 2050 perspective, electricity prices grow slightly more and across all scenarios.

Contrary to electricity prices, differences between policy scenarios are very pronounced with regard to the ETS price although projections in this regard are associated with significant degrees of uncertainty as many assumptions on the future need to be made. Under Reference, the ETS price is expected to reach 35 €/tCO2 in 2030 and 100 €/tCO2 in 2050. In the policy scenarios, it is expected to reach between 39 and 6 €/tCO2 in 2030. In a 2050 perspective, different policy scenarios would result in 243 to 165 €/tCO2, depending on the scenario. The more the energy savings, the lower becomes the ETS price as EE policies reduce the demand for electricity in the ETS sector. Also EE improvements in industry reduce the demand for ETS allowances. In addition, in the EE40 scenario which significantly overshoots the GHG target, efficiency policies shift emission reduction efforts from ETS to non-ETS sectors. In 2030, the ETS prices in the EE scenarios with the highest energy savings are lower than in Reference. In 2050, the ETS prices are higher than in the Reference in all scenarios as the decarbonisation target in achieved.

Similarly as in the 2030 IA, the EU ETS is modelled in the energy efficiency scenarios via carbon prices, but of course emissions are also impacted by other policies, notably EE policies. Across scenarios, the cumulative ETS emissions approximate the cumulative ETS emissions of the GHG40 scenario, with particular focus on the time period until 2030. By doing so, the scenarios are consistent with the 2030 IA.

In general, the concrete impacts of EE policies on the ETS price will depend strongly on the sectors in which EE policies will be suggested in the future to reach a certain amount of energy savings in 2030. If the focus is mainly on the non-ETS sector, the impacts on the ETS price will be smaller than if the EE policies would focus on the ETS sectors.

Table 9. Electricity and carbon prices, energy related costs for energy intensive industries

Indicator *(figures are presented in a*	**Ref**	**GHG40**	**Decarbonisation Scenarios**					
			EE27	**EE28**	**EE29**	**EE30**	**EE35**	**EE40**

2030/2050 format)								
Average Price of Electricity[62] (€/MWh)	176 / 175	179 / 183	180 / 187	179 / 185	178 / 184	178 / 182	177 / 182	182 / 182
ETS carbon price (€/t of CO2-eq)	35 / 100	40 / 264	39 / 243	35 / 220	30 / 205	25 / 180	13 / 160	6 / 165
Implicit carbon price non-ETS (€/tCO2)	0 / 0	40 / 264	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Average Renewables value (€/ MWh)	34 / 16	34 / 15	40 / 16	40 / 15	40 / 15	42 / 15	43 / 15	43 / 14
Average energy efficiency value (€/ toe)	181 / 95	184 / 604	402 / 574	619 / 847	822 / 1251	1011 / 1642	1768 / 2595	2937 / 3798

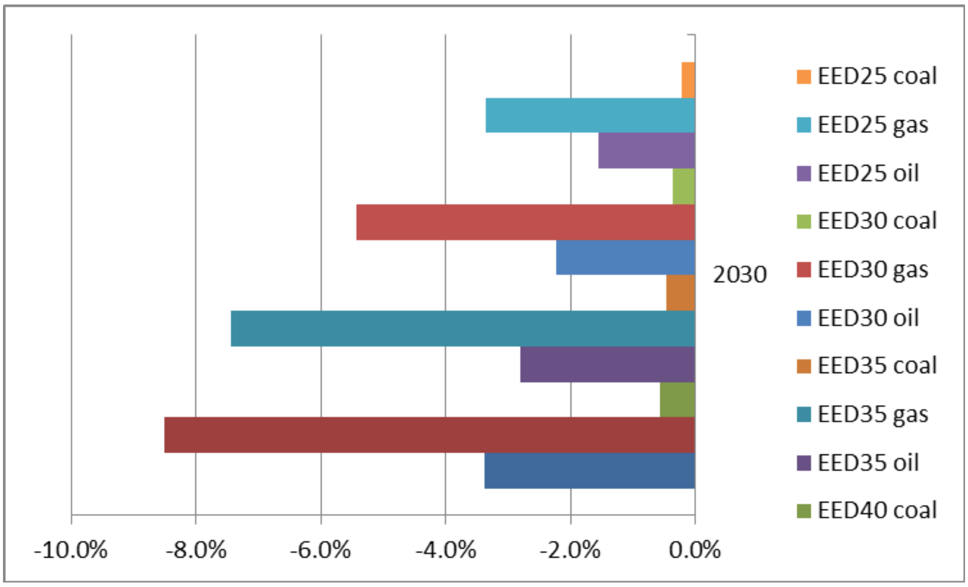
Source: PRIMES 2014

In addition, the impact of energy efficiency policies on international fuel prices was also modelled, using the POLES model. The results presented below show that the international gas price in 2030 would be 3-8% less than in Reference, and the international oil price would be 1-3% less, with energy savings of 25-40%.[63] These results should be further analysed, including their impact on energy consumption and GDP in the EU. In any case though, these results are an indication that the European EE policies would have some impact on international gas prices. This can be explained because of the significant reduction of the gas demand in the EE scenarios in the EU. Other elements, however, have not be taken into consideration, like the missing flexibility of the gas infrastructure produces a higher price effect on the European gas markets, since the gas producers cannot easily redirect their fuel exports to other markets

Figure 5. Projected impacts of EE policies on international fuel prices (in %)

[62] Average Price of Electricity in Final demand sectors (€/MWh) constant 2010 Euros. For reference scenario, corresponding value was 134 €/MWh in 2010.

[63] See more details in Annex VI.



Source: Poles

5.3.3. Macro-economic impacts

The **models E3ME and GEM-E3** were applied to assess the impacts on GDP and employment of policy scenarios, in which there is greater investment in energy efficiency. The complex interactions between different sectors of economy can thus be assessed at the macro-economic level and results can be compared to the respective Reference. (Each modelling exercise builds its own reference this is why the results are presented not in absolute figures but as a difference from the Reference. For the same reason, the results of the scenarios presented in this IA are not comparable with the results of macro-economic modelling in 2030 IA).

The macro-economic scenarios that have been modelled build upon PRIMES scenarios with 25, 28, 30, 35 and 40% energy savings. The scenario with 25% energy savings has ambition similar to GHG40 scenario but is built on the PRIMES scenario that has concrete EE policies rather than carbon values - for better comparability with other scenarios. The macro-economic modelling building on EE27 and EE29 scenarios would likely have very similar outcome to results presented in the chapter for EE28 and EE30, with little additional insight brought to the analysis – for practical reasons a smaller number of scenarios is presented.

The **path and magnitude of investment in energy efficiency** in each scenario is taken from projections made in PRIMES: the E3ME and GEM-E3 **models are then calibrated to represent these changes in the energy system so that their economy-wide impacts can be modelled**. The two macroeconomic models have many similarities. However, there are also important differences that arise from their underlying assumptions and respective structures. E3ME is a macro-econometric model, based on a post-Keynesian framework; GEM-E3 is a general equilibrium model that draws strongly on neoclassical economic theory and optimising behaviour of economic agents –see Annex VI for the description of methodology of each model.

Importantly, in this exercise the E3ME provides the projections only till the year 2030. GEM-E3 model provides projection till the year 2050. Both models estimate only the impact of the EE policies and not of the decarbonisation[64].

Impacts on GDP

Application of both models shows that energy efficiency expenditures lead, first of all, to increased demand in sectors providing goods and services to energy efficiency projects (construction, market services, metals, cement, chemicals, equipment goods, etc.). Depending on their linkages with other sectors of the economy the demand for inputs from these sectors is associated with chain changes in demand for inputs from other sectors of the economy (multiplier effect) as well as for imports. Secondly, additional effects are associated with a reduction in energy demand and subsequent imports for energy inputs resulting from energy consumption saving. Energy efficiency expenditures lead then to substitution of imported fuels with domestically produced goods and services.

In addition, however, in GEM-E3 model, increased expenditures in energy efficiency limit the funds available for other purposes and drive interest rates up (crowding-out effects). As there are no unused resources, this results in higher cost of capital which hampers the competitiveness of the economy further affecting trade and overall economic activity. The net outcome in the economy depends on the equilibrium resulting between the latter forces and assumptions about capital supply. In contrast, in E3ME model, there are some unused resources and the crowding-out effect does not automatically occur.

Importantly, both models make different assumption on the use of the ETS revenue. In GEM-E3 model, ETS revenue is used to lower the social security charges, which has a positive effect on GDP growth (but largely outweighed by the crowding-out effect). In E3ME modelling, ETS revenue is used to finance the EE investment. Whenever there is revenue left over from financing the EE investment, then this is used to reduce income taxes, but in general the EE investment needs are larger than the amount raised in ETS revenues, and the difference is therefore covered by an increase in taxation. The increase in income taxes leads to lower disposable income and, as a result, slightly lower consumer expenditure.

[64] The energy scenarios quantified using PRIMES have assumed that the energy efficiency policies for 2030 take place in the context of decarbonisation targets until 2050. The macroeconomic models, however, were required to assess the macroeconomic effects and particularly the employment effects of specific energy efficiency policies until 2030 not to assess in general decarbonisation pathways until 2050. Quantifying the macroeconomic impacts of decarbonisation until 2050 is out of the scope of the assessment of impacts of energy efficiency policy until 2030 because the restructuring and investment effort towards decarbonisation which has to be undertaken mainly after 2030 requires by far ampler resources of the economy than the energy efficiency policies until 2030.

In GEM-E3 modelling, for the scenarios simulating the effects of achieving higher energy efficiency targets, the assessment of impacts on GDP generally found small but negative impacts especially in 2030 when energy efficiency expenditures peak (see table 10). In fact, the effects of crowding-out leading to higher cost of capital and competitiveness losses surpass the effects of improved energy efficiency and the multiplier effect of increased economic activity in sectors providing inputs to energy efficiency projects[65]. The magnitude of the effects increases with the amount of expenditures undertaken for energy efficiency improvements. In 2030, the negative effects of different levels of ambition of EE policies (25 to 40%) range between -0.7 and -1.2% in comparison to the Reference.

In the long term, the negative effects tend to diminish as the sectors benefit from reduction of costs due to the achieved level of energy efficiency – but less so for scenarios with a high level of ambition.

Table 10. GDP impacts in EU28 (2030, 2040, 2050) in GEM-E3 model

% change from the Reference	2030	2040	2050
Reference (in bn 2010€)	16.766	19.277	22.129
EE25	-0,07	-0,03	0,00
EE28	-0,13	-0,04	-0,02
EE30	-0,22	-0,04	-0,02
EE35	-0,52	-0,15	-0,03
EE40	-1,20	-0,19	-0,04

Source: GEM-E3

In E3 ME modelling, the impacts on GDP are positive, owing to the approach which does not assume that optimisation in markets has previously occurred. Consequently, investment in one particular sector does not automatically lead to a crowding out effect on investment in other sectors. If there is spare capacity in the baseline case, then it is possible for there to be an increase in investment in the scenarios without necessarily having a reduction in investment elsewhere. As described above, investments are funded through higher taxes which will result in a reduction in consumption. Therefore, also the E3ME model assumes a certain amount of crowding out effects regarding consumption.

[65] As explained in Annex VI, the policy scenarios analysed in this IA have assumed significant increase of expenditures for energy efficiency purposes especially in the period until 2030. These expenditures are assumed to be partly financed by economic agents (households and firms) and partly by economies' aggregate savings.
Consequently, a fairly realistic approach has been adopted assuming that the financing of the energy efficiency expenditures from saving resources in the economy is effectively leveraged throughout the projection period (till 2050); this implies less pressure until 2030 and a smaller crowding out effect. Should a full funding of the energy efficiency expenditures was made through the closure with savings till 2030, the macroeconomic impacts would be found increasingly negative after 2030 and higher in magnitude.

There is an increase in GDP in all scenarios compared to Reference, mainly driven by the investment in energy efficiency that occurs after 2025. The model results suggest that these positive changes could be in the range of 0.5 – 4.5% increase (for the range of scenarios achieving between 25 and 40% energy savings) in comparison to the Reference case. The EE40 scenario is subject to more uncertainty and possible resource constraints.

The table below confirms that the main driving force behind the increase in GDP is investment. The table also outlines the large scale of the energy-efficiency investment required to achieve the reductions in final energy demand. Despite higher GDP, household expenditure in all scenarios is *lower* than in the reference case. The reason for this is that higher taxation rates are required to fund the investment undertaken by industry sectors – and that energy efficiency measures reduce operational energy costs.

Although there is no measure of welfare in E3ME, in these types of model a reduction in household expenditure is typically interpreted as being consistent with a loss of welfare. However, there are cases where the two do not necessarily move together: in this case, the investment in energy efficiency means that households can achieve the same level of comfort while spending less on energy.

Table 11. GDP impacts in EU28 (2030) in E3ME model

% change from the Reference	2020	2025	2030
Reference (in bn 2010 €)	14.479	15.699	16.960
EE25	0,05	0,20	0,49
EE28	0,06	0,27	0,75
EE30	0,08	0,53	1,06
EE35	0,07	0,90	2,02
EE40	0,05	0,82	4,45

Source: E3ME

It is important to emphasise the assumption made in this modelling that revenues from auctioned ETS allowances are supposed to be recycled into financing the energy-efficiency investment. However, in all policy scenarios the revenues are not enough to cover the scale of the investment, leading to an increase in direct taxation to cover the investment spending and preserve budget neutrality. Although modest in the medium to high ambition cases, in the EE40 scenario there would be noticeable increases in European tax rates.

Regarding the projected GDP impacts the two used macroeconomic models differ. This is mainly due to different assumptions regarding crowding-out effects. Both models are used to analyse possible effects.

In general the analysis and the different results shows, that EE policies beyond 2020 should be designed in such a way that crowding-out is limited to avoid negative GDP effects. To make it possible, accompanying policies should tackle the factors that could prevent unemployed people to fill the vacancies created by energy efficiency, which are mainly related to labour skills shortages and barriers to mobility. The factors that could provide stimulus to higher investments, leading to a "virtous cycle" with higher growth and more savings to fund more investments, are more complex to identify. This is also related to the confidence of the banking system and investors which can in general be favoured by a credible policy scenario providing stable incentives in the medium and long term.

Sectoral impacts

Looking at impacts by sector, it is clear that higher energy efficiency ambition drives consumption expenditures towards sectors producing energy efficient equipment (i.e. more efficient electrical appliances for households, retrofits, materials improving thermal integrity of buildings, etc.) and savings towards the financing of energy efficiency projects (i.e. insulation to improve thermal integrity, etc.). Demand shifts from energy producing sectors towards sectors which provide inputs to energy efficiency projects. The direct positive effect of increased energy efficiency expenditures on domestic activity, especially for sectors producing and installing the energy efficient equipment, is further strengthened by multiplier effect, which is the increased intermediate demand for goods and services due to sectorial interconnections and long supply chains. In the GEM-E3 model (and not the E3ME model, however,), expenditures in energy efficiency projects exert crowding-out effects on other investment projects that would have otherwise been undertaken.

Table 12 summarizes the effects on sectoral production in the policy scenarios as simulated in GEM-E3 modelling. Sectors delivering to energy efficiency products and services record increases in their production (particularly the construction sector).

Sectors with low exposure to foreign competition record relatively higher increases in their activity (i.e. construction and market services) while for sectors characterized by higher trade exposure (i.e. electric goods and chemicals) part of the increased demand is satisfied by imports, depending on the degree of exposure to foreign competition, thus the positive effect of increased expenditures on their activity is weakened. Demand for energy products falls in all scenarios causing both domestic production and imports to decrease.

Table 12. Impacts on production by sector in EU28 (2030) in GEM-E3 model

EU 28 Domestic production in 2030 (bn €'2010) % change from Reference for policy scenarios	Reference	EE 25	EE28	EE30	EE35	EE40
Agriculture	547,4	-0,44	-0,27	-2,33	-4,21	-4,11
Coal	8,2	0,69	-1,15	-11,21	-18,58	-24,60
Crude Oil	2,8	-0,81	-3,26	-6,82	-13,24	-17,72
Oil	261,9	-0,95	-1,58	-4,78	-7,79	-10,84
Gas Extraction	4,6	-1,46	-4,10	-11,57	-18,03	-23,19
Gas	25,1	-1,33	-6,28	-24,63	-35,80	-44,17
Electricity supply	320,6	-1,17	-6,72	-20,11	-32,01	-41,32

Ferrous metals	242,8	2,52	8,83	11,54	24,22	27,81
Non ferrous metals	730,7	0,82	2,52	3,63	7,80	9,28
Chemical Products	1334,8	-0,33	3,12	6,05	9,07	12,75
Paper Products	623,7	-0,09	0,27	0,65	1,02	0,79
Non metallic minerals	437,9	2,13	6,18	10,06	17,72	24,35
Electric Goods	481,1	-0,09	-0,27	0,33	0,71	0,14
Transport equipment	1490,7	0,35	0,66	1,09	1,40	1,81
Other Equipment Goods	1852,7	0,17	0,78	1,32	2,82	0,43
Consumer Goods Industries	2066,1	0,05	0,34	0,22	0,16	-0,13
Construction	2524,9	0,99	3,42	6,07	11,14	16,28
Transport (Air)	295,4	1,68	1,62	2,69	2,28	2,19
Public Transport (Land)	1545,4	0,51	0,66	1,11	1,44	1,57
Transport (Water)	271,9	0,19	0,12	0,28	0,30	0,06
Market Services	11108,0	-0,02	0,01	0,44	0,63	0,65
Non Market Services	4623,2	-0,02	-0,05	0,06	-0,06	-0,09

Source: GEM-E3 model

The results in E3ME modelling are different because of the underlying assumptions about investment financing, which is not affected by the crowding-out. Table 13 shows the main impacts at broad sectoral level. Similarly as in GEM-E3 modelling, the sectors that benefit the most in all the scenarios are the ones that produce investment goods related to energy efficiency products and services, such as construction and engineering. The non-energy extraction sector is also expected to benefit, as it supplies the construction sector with raw materials.

The effects on other sectors are more nuanced. Consumer goods producing sectors are the most affected by the tax increase needed to finance the energy-efficiency investment. On the other hand, distribution activity also benefits from the increased activity in the investment sectors. Consequently, output in these sectors is expected to be higher, but by a smaller amount than in other sectors not so closely linked to consumer expenditure patterns.

The energy-efficiency savings are expected to lead to reduced use of electricity and gas, resulting in a fall in output in the sectors supplying them, and so output in the utilities sector is substantially lower than in the reference case.

Table 13. Impacts on output in key sectors in EU28 (2030) in E3ME model

EU28 Output in 2030 (in bn €2010) % change from Reference for policy scenarios	Reference	EE25	EE28	EE30	EE35	EE40
Agriculture	483	0,30	0,33	0,33	0,13	-0,14
Extraction Industries	116	-0,29	-0,23	0,23	2,39	7,02
Basic manufacturing	3.762	0,61	0,96	1,43	3,08	7,56
Engineering and transport equipment	3.752	1,06	1,86	2,80	6,18	14,67

Utilities	910	-3,04	-6,12	-8,01	-12,24	-17,92
Construction	2.175	1,61	4,46	7,64	18,13	41,88
Distribution and retail	3.401	0,53	0,56	0,58	0,65	1,40
Transport	1.609	0,35	0,53	0,77	1,51	3,03
Communications, publishing and television	2.971	0,56	0,86	1,21	2,22	4,74
Business services	7.331	0,51	0,72	0,98	1,73	3,74
Public services	4.958	0,13	0,13	0,12	0,01	-0,23

Sources: E3ME

Whereas in both models the negative and positive impact on certain sectors appears intuitive (e.g. construction and gas) other impacts necessitate further interpretation against the assumptions used in the model.

Employment effects

As an important assumption, the baseline modelling based on GEM-E3 projects persisting unemployment (frictional unemployment under equilibrium conditions) in the EU in 2030 which implies that unused labour resources exist and can be used in more labour-intensive scenarios with only small effects on the equilibrium wage rates. This modelling assumption is more realistic than standard general equilibrium projections that would assume no labour resources availability in the future.

In general, in GEM-E3, the energy efficiency expenditures inherent to each policy scenarios induce increased employment for all scenario mostly in 2030 and less afterwards without strong effects on wage rates (because of the assumption mentioned in the paragraph above). The positive labour impacts combined with negative impacts on GDP imply that the EU economy becomes more labour intensive under energy efficiency assumptions. The employment multiplier effect depends on the labour intensity of the sectors delivering inputs to energy efficiency projects (relatively high for sectors like market services, high-tech manufacturing) and the energy sectors (relatively low labour intensity) as well as on the share of domestically produced inputs to total inputs used in the production process (high shares of domestically produced inputs in the production process imply that an increase in the sectorial activity is associated with an increase in employment of sectors of domestic origin rather than that of sectors located outside the EU).

From the **GEM-E3** modelling results, it is clear that total labour demand and employment are affected to a greater extend by positive changes in the activity of the more labour intensive sectors of energy efficiency products and services as well as building renovation. The decreased labour demand in energy sectors is thus more than compensated. In 2030, the positive effects of different levels of ambition of EE polices range between 0.5 and 3% in comparison to the Reference.

Table 14. Employment impacts in EU28 (2030, 2040, 2050) in GEM-E3 model

% change from Reference for policy scenarios	2030	2040	2050
Reference EU 28 employment (in million people)	218,76	211,24	204,08
EE25	0,50	0,48	0,57
EE28	1,47	0,67	0,71
EE30	1,90	0,81	1,07
EE35	2,53	0,97	1,24
EE40	2,96	1,21	1,59

Source: GEM-E3 model

The time pattern of employment changes indicate strong positive effects at times of implementation of energy efficiency expenditures and smaller effects at times subsequent to implementation.

Changes in employment follow the changes in sectoral demand and production as a result of energy efficiency expenditures (see table 15), particularly the increase in production of relatively labour intensive sectors (services sectors which provide inputs to energy efficiency projects) or sectors with significant forward and backward linkages with other sectors of the economy (construction sector).

Table 15. EU28 sectoral employment impacts (2030) in GEM-E3 model

Sectoral Employment EU28 (% change from Reference)	Reference in millions of persons	EE25	EE28	EE30	EE35	EE40
Agriculture	7,75	1,09	2,92	1,07	-0,83	-1,17
Coal	0,11	1,89	2,16	-8,05	-14,69	-20,42
Crude Oil	0,01	4,65	9,31	9,52	2,74	2,76
Oil	0,16	0,43	1,65	-0,78	-4,18	-6,57
Gas Extraction	0,01	4,09	7,09	3,38	-2,51	-4,99
Gas	0,31	2,13	1,86	-10,95	-23,15	-29,62
Electricity supply	3,64	1,52	-0,89	-11,01	-21,39	-29,56
Ferrous metals	1,07	4,62	13,14	16,72	27,43	31,73
Non ferrous metals	4,63	1,46	4,08	5,41	9,16	10,78
Chemical Products	5,32	0,16	4,74	6,83	10,49	14,40
Paper Products	4,28	0,16	0,85	1,22	1,37	1,02
Non metallic minerals	2,90	2,60	7,76	11,41	18,88	25,79
Electric Goods	1,66	0,45	1,26	2,00	2,74	2,32
Transport equipment	5,83	0,89	1,93	2,30	2,61	3,15
Other Equipment Goods	11,82	0,77	2,28	2,89	4,26	2,08
Consumer Goods Industries	11,42	0,75	2,03	1,83	1,56	1,32
Construction	18,07	1,42	4,88	7,97	13,64	19,12

Transport (Air)	1,01	1,64	1,74	2,87	2,53	2,34
Public Transport (Land)	7,79	0,65	1,47	2,27	2,47	2,93
Transport (Water)	0,75	0,12	0,12	0,35	0,27	0,16
Market Services	53,65	0,23	0,66	1,25	1,47	1,59
Non Market Services	76,56	0,09	0,24	0,42	0,31	0,26

Source: GEM-E3

In **E3ME**, employment is determined primarily by the level/growth of economic output analysed above as well as relative labour costs and consequently shows less pronounced effects than in GEM-E3 modelling. As presented in the table below, up until 2020 there is very little change in overall EU28 employment levels in the scenarios and even up to 2025 the changes are quite small. However, once the energy-efficiency investment starts to grow quickly after 2025, employment is expected to increase substantially. In 2030, the positive effects of different levels of ambition of EE polices range between 0.3 and 1.5% in comparison to the Reference. In the EE40 scenario, the increase in employment levels could be up to 3.5% by 2030. These results of the EE40 scenario are of course subject to more uncertainty and possible labour market constraints.

Table 16. Employment impacts in EU28 (2030) in E3ME model

% change from Reference for policy scenarios	2020	2025	2030
Reference EU 28 employment (in million people)	233,503	232,971	231,726
EE25	0,02	0,07	0,23
EE28	0,02	0,08	0,29
EE30	0,02	0,19	0,35
EE35	0,02	0,31	0,62
EU28	0,01	0,27	1,50

Source: E3ME

The outcomes for sectoral employment as presented in Table 15 broadly follow those for sectoral output described above, with construction, engineering and their supply chains benefiting the most. The largest increase in employment is expected in the construction sector, on the assumption that a large share of the investment will require construction or installation activities. Relatively more modest increases are also projected in the engineering and transport equipment sector as well as basic manufacturing.

Employment in distribution and retail and business services is expected to fall, despite the increase in output in these sectors. The reason for this is that higher employment levels overall (mainly due to the relatively labour-intensive construction sector) and lower unemployment lead to increases in wage demands, a form of labour market crowding out. Employment in utilities is also predicted to fall, in line with the projected fall in output in the sector.

Table 17. EU28 sectoral employment impacts (2030) in E3ME model

Change from Reference for policy scenarios	Reference (in millions of persons)	EE25	EE28	EE30	EE35	EE40
Agriculture	9,726	0,21	0,04	-0,10	-0,95	-3,06
Extraction Industries	0,479	-1,25	-1,67	-1,46	-0,84	-2,51
Basic manufacturing	14,868	0,28	0,32	0,46	0,94	2,11
Engineering and transport equipment	15,268	0,58	0,69	0,90	1,72	3,81
Utilities	2,274	0,09	-1,36	-3,47	-6,29	-8,00
Construction	16,524	0,71	2,11	3,59	8,57	19,77
Distribution and retail	35,266	0,13	-0,03	-0,18	-0,73	-1,75
Transport	9,388	0,17	0,14	0,18	0,22	0,12
Communications, publishing and television	20,278	0,23	0,27	0,36	0,62	1,45
Business services	40,985	0,33	0,24	0,12	-0,12	-0,28
Public services	66,671	0,05	0,07	0,03	0,02	0,36

Source: E3ME

5.3.4. *Environmental impacts*

As explained in Annex V, all scenarios feature assumptions on policies which reduce non-CO_2 GHG emissions. The volume of reduction of these emissions as achieved by the GHG40 scenario from the 2030 IA has been used as a starting point. The policies to reduce non-CO_2 GHG emissions do not belong to the domain of the energy efficiency (mainly agriculture and waste treatment are concerned). In the GHG40 a certain amount of non-CO_2 GHG emissions reduction was necessary in order to reach 40% GHG reduction in 2030. Because of the higher level of energy savings in the EE policy scenario modelled in this IA the contribution of non-CO_2 GHG emissions to achieve the 40% GHG target decreases.

Total GHG reductions in 2030 for the modelling scenarios are in line with 40% GHG reduction target proposed in 2030 framework for EE27 to EE30 scenarios. While and EE35 overshoots this target slightly, reaching 41%, for EE40 the overshooting is significant (44%) taking into account the strong EE policies. All scenarios reach in 2030 between 42-46% **reductions in the ETS sector** (in comparison to 2005) and in **non-ETS sectors** between 28-35% reductions (in comparison to 2005) – broadly in line with the respective reductions referred to in the 2030 Communication.

With regard to **emission reductions in 2050**, the scenarios are all consistent with deep decarbonisation in 2050 and show rather similar additional emission reductions to Reference ranging from 76 to 80%, with scenarios EE27 to EE30 achieving less.

Table18. ETS and non-ETS emissions

Indicator *(figures are presented in a 2030/2050 format)*	**Ref**	**GHG40**	**Decarbonisation Scenarios**					
			EE27	**EE28**	**EE29**	**EE30**	**EE35**	**EE40**
Total GHG emissions (% to 1990)	-32.4 / -43.9	-40.6 / -79.6	-40.1 / -77.6	-40.2 / -78	-40.1 / -78.3	-40.1 / -78.5	-41.1 / -79.5	-43.9 / -80.2
ETS (% to 2005)	-36.1 / -59.3	-43.3 / -87.1	-45.3 / -85.6	-44.4 / -85.7	-43.3 / -85.7	-42.2 / -85.7	-41.8 / -85.8	-45.6 / -86.5
Non-ETS (% to 2005)	-20.3 / -22.9	-30.5 / -70.3	-27.6 / -67.6	-28.7 / -68.3	-29.5 / -68.9	-30.5 / -69.4	-32.9 / -71.2	-35.3 / -72

Source: PRIMES 2014

Some differences between the scenarios are visible in **sectoral GHG emission** reductions in comparison to 2005. Looking at scenarios that achieve close to 40% GHG reductions[66], in a 2030 perspective, the **power generation** and **tertiary** sectors are projected to experience the biggest reduction across all policy scenarios. For power generation, reductions remain relatively constant across scenarios from -54 to -60% (wrt 2005), with the effectiveness of the EE policies in reducing energy consumption taking over ETS prices as the driving force for emission reductions in the sector as EE ambition increases. In the residential sector, reductions range from -34 to 63% (wrt 2005) and for the tertiary sector, reductions range from -51 to -73% (wrt 2005). In both sectors reductions increase together with the ambition of EE policies, reducing the effort required for industry and power generation, and are significantly higher than those achieved by Reference. In **transport**, the reductions are smaller (between -16.7 and -17.5%) and only slightly deeper than in Reference.

In a 2050 perspective, again only looking at scenarios that achieve close to 40% GHG reductions, emission reductions increase significantly across all sectors as they are all compatible with the 2050 GHG objective. The power sector is almost fully decarbonised as with -95 to -97% reductions compared to 2005 it remains the sector with the highest reductions. The transport sector sees the lowest: -61% to -64% reductions.

If changes in sectoral GHG emissions are compared to Reference, the key insight in a 2030 perspective is that in all final energy demand sectors the reductions are increasing their magnitude in line with the level of ambition of the scenarios, except for the power generation sector where strong EE policies result in slightly smaller reductions because of lower ETS prices and the fact that majority of GHG reductions happen in non-ETS sector.

Table 19. Sectoral CO2 emission impacts compared to 2005

Indicator *(figures are presented in a 2030/2050 format)*	**Ref**	**GHG40**	**Decarbonisation Scenarios**					
			EE27	**EE28**	**EE29**	**EE30**	**EE35**	**EE40**
Power generation. CHP and district heating	-46.7 / -72.9	-56.5 / -97.7	-57.9 / -95.6	-56.6 / -95.3	-55.5 / -95.5	-54.6 / -95.7	-54 / -96.1	-60 / -97.2
Industry (energy + processes) [67]	-22.5 / -43.8	-27.4 / -77.8	-31.5 / -76.7	-30.8 / -77.1	-29.8 / -76.8	-28.6 / -76.2	-29.1 / -75.7	-29.7 / -76
Residential	-26.7 / -34.1	-34.1 / -80.3	-33.8 / -75.7	-37.5 / -78.2	-40.3 / -80.8	-44 / -82.9	-53.1 / -86.8	-62.9 / -90.3
Tertiary [68]	-40.1 / -48.3	-48.2 / -85.6	-50.5 / -77	-55.6 / -79.4	-58.5 / -81.4	-60.8 / -82.9	-66.6 / -85.4	-73 / -87.7
Transport	-11.6 / -10.3	-13.6 / -63.5	-16.7 / -61.3	-16.8 / -61.4	-17.1 / -61.5	-17.3 / -61.7	-17.5 / -64.2	-17.4 / -64.2

Source: PRIMES 2014

[66] For EE40 scenario the trend described below does not show because of higher GHG reduction.
[67] Including energy industries, such as refineries and coke production.
[68] The tertiary sector includes the small energy-related emissions from agriculture.

Table 20. Sectoral CO2 emission impacts compared to Reference

Indicator *All indicators are presented as % increase/decrease in comparison to the Reference for 2030/2050*	**GHG40**	**Decarbonisation Scenarios**					
		EE27	**EE28**	**EE2**	**EE30**	**EE35**	**EE40**
Power generation, CHP and district heating	-9.8 / -51	-11.2 / -48.9	-9.9 / -48.6	-8.8 / -48.8	-7.9 / -49	-7.2 / -49.4	-13.2 / -50.5
Industry (energy + processes) [69]	-4.9 / -55.3	-9.1 / -54.2	-8.3 / -54.7	-7.3 / -54.3	-6.1 / -53.7	-6.6 / -53.2	-7.2 / -53.5
Residential	-7.5 / -53.6	-7.1 / -49	-10.8 / -51.5	-13.7 / -54.2	-17.3 / -56.2	-26.4 / -60.1	-36.2 / -63.7
Tertiary [70]	-8.1 / -45.5	-10.4 / -36.9	-15.5 / -39.4	-18.4 / -41.3	-20.7 / -42.9	-26.6 / -45.3	-32.9 / -47.6
Transport	-1.9 / -51.9	-5.1 / -49.7	-5.2 / -49.7	-5.4 / -49.9	-5.6 / -50	-5.8 / -52.5	-5.8 / -52.5

Source: PRIMES 2014

5.3.5. Additional environmental and health impacts

As indicated in the 2030 IA environmental and health benefits associated with higher energy efficiency should also be taken into account when considering costs and benefits. Although these effects were not modelled as part of this specific impact assessment the 2030 IA indicates that *"reduced fossil fuel consumption improves health conditions through lower emissions of pollutants and lowers costs for air pollution control with benefits being disproportionately larger in lower income Member States expressed as a % of GPD and much larger in scenarios with ambitious energy efficiency policies and a renewables target."* These findings based on modelling find confirmation in ex-post evaluations of existing energy efficiency programmes. For example research undertaken in Northern Ireland on the impact of the Warm Homes Scheme 2000-2008 (a free, government-funded retrofit scheme for households in energy poverty) has demonstrated that 42% of the cost of the programme could be offset against reduced healthcare costs. This implies that every euro spent on house retrofits yields a saving of 42 cents in terms of healthcare no longer needed.

In addition to health impact and lower GHG emissions other environmental impacts associated with higher energy efficiency include the following:

- Reduction of pollution resulting from energy extraction, transformation, transportation and use. This applies primarily to air pollution resulting from energy combustion but it also applies to e.g. soil and water pollution. Co-

[69] Including energy industries, such as refineries and coke production.
[70] The tertiary sector includes the small energy-related emissions from agriculture.

benefits in terms of human health and ecosystems state can subsequently be expected;

- Reduction in resources used for energy extraction, transformation, transportation and use: For instance, water used for energy purposes (hydropower, cooling of power stations, irrigation) is significant. Therefore, increasing energy efficiency also leads to water savings. And this also applies to land and materials use, hence leading to several co-benefits in terms of resource efficiency.

The higher the energy efficiency target, the higher these environmental co-benefits would be.

5.3.6. Competitiveness and Affordability of energy

From the perspective of **affordability of energy**, the key items are both operational and capital expenditure related to energy use. Operational expenditure (cost) is clearly dependent on both energy prices (which are projected to rise in the longer term) and consumption volumes, the latter impacted by the efficiency of energy use. These expenditures need to be compared to available household income. Energy costs as such are of particular relevance for those consumers which have very low incomes or that, for other reasons, cannot take advantage of cost saving energy efficiency investments.

While fossil fuel prices are treated as exogenous in the PRIMES modelling work, the **price of electricity** is not. The analysis in the chapter above indicates that most significant price increases happen already in the Reference scenario, mainly until 2020. After 2020, prices are rather stable in the Reference scenario. Average **electricity price changes** in different scenarios (compared to the year 2010) are very small. For example, while average electricity price increase (compared to 2010 price) in Reference is 31%, it ranges between 32 and 35% in policy scenarios in 2030 and the changes are only slightly higher in 2050 perspective. **Electricity price changes compared to the Reference** are also very small in 2030 ranging from 1 to 3% in the year 2030, with smallest increase in the EE35 scenario.

The share of energy costs in value added created by energy intensive industries remains stable among the Reference and policy scenarios in 2030. It grows slightly in longer-term perspective. For households, the share of energy-related costs (both including and excluding transport) grows slightly already in 2030 as the scenarios achieve more energy savings and continues to grow in 2050 perspective.

Table 21. Share of energy costs in household expenditure and energy intensive industries value added

Indicator *(figures are presented in a 2030/2050 format)*	**Ref**	**GHG40**	**Decarbonisation Scenarios**					
			EE27	EE28	EE29	EE30	EE35	EE40

Share of energy costs in energy intensive industries value added[71]	41.8 / 41.0	42.1 / 54.2	43.9 / 50	43.7 / 51.5	43.6 / 51.5	43.5 / 51.2	43.8 / 50.1	44.1 / 49.8
Share of energy related cost (including transport) in household expenditure (In 2010: 12,4)	14.6 / 12.6	14.8 / 14.1	14.8 / 13.6	15 / 13.8	15.2 / 14.3	15.5 / 14.8	16.5 / 16.3	18.6 / 18.5
Share of energy related cost (excluding transport) in household expenditure (In 2010: 7.5)	9.3 / 8.0	9.4 / 8.7	9.5 / 8.3	9.7 / 8.6	9.9 / 9	10.1 / 9.5	11.1 / 11	13.2 / 13.2
Avg. electricity price incr. compared to 2010 price	30.8 / 30.1	33.3 / 36.2	34.1 / 38.9	33.2 / 37.7	32.6 / 36.7	32.4 / 35.12	31.9 / 35.3	35.2 / 35.6
Average electricity price change compared to Ref. (percentage points)	n.a.	1.9 / 4.7	2.5 / 6.8	1.8 / 5.8	1.4 / 5.1	1.2 / 3.9	0.8 / 4	3.3 / 4.2

Source: PRIMES 2014

5.4. Architecture of the 2030 energy efficiency policy framework

5.4.1 Overall architecture

Chapter 4 identified the following options:

I No action

II Indicative EU target coupled with specific EU policies and indicative MS targets

III Binding EU target coupled with specific EU policies and indicative MS targets

IV Binding MS targets

These options will be compared against the following criteria:

- Effectiveness (achievement of the objectives identified in Chapter 3)
- Economic efficiency (cost-effectiveness)
- Coherence (with the overall EU energy and climate policy framework and its objectives)

Under Option I the policy framework post 2020 would not include a target for energy efficiency. This implies that the framework would not benefit from: (i) a benchmark for

[71] Percentage of energy costs excl. auction payments to value added in energy intensive industries in PRIMES. For Reference Scenario corresponding value was 38.2% in 2010.

tracking progress and making policy adjustments; (ii) a signal to relevant actors, such as investors and consumers, about the policy direction; (iii) a basis for additional policy elements, such as prioritisation for funding through the European Structural and Investment Funds. Without an overall target trade-offs between energy efficiency solutions in different sectors of the economy could be harder to assess, potentially increasing the marginal cost of energy efficiency improvements. Certain policy tools, such as Ecodesign and the EPBD, would continue to apply. Nevertheless, the contribution of energy efficiency would certainly be lower and its cost for a given ambition level would be likely to be higher. Given the low carbon abatement cost of many energy efficiency options and their contribution to GDP and job creation, this would be neither coherent with the current energy and climate goals nor economically efficient. The effectiveness of Option I in achieving the EU's energy and climate goals would also be limited compared to the current setting.

Option II would be a continuation of the current approach, retaining the benefits described above and the added value of ensuring a continuity of a framework to which relevant stakeholders, including Member States, have become accustomed. An indicative energy efficiency 2030 target would accommodate the differences in the national/domestic markets and their energy efficiency potentials. It would also limit the risk of imposing too much rigidity on the overall energy and climate framework which includes also the GHG and RES targets, and thus potentially limit costs of GHG abatements. On the other hand, the indicative nature of the current target has sometimes made it difficult to mobilise the necessary policy effort. For example, experience with the setting of indicative national targets under Article 3 of the EED in 2013 has shown that there is only limited scope for adjusting them when their sum remains below the overall EU target. While being coherent with the current energy and climate policy framework and providing for economic efficiency, the effectiveness of this approach is in some respects limited.

Option III would replicate the approach proposed by the Commission in the 2030 Communication for a future RES target. National plans would include an explicit aim of contributing to the overall EU target for energy efficiency[72]. If a review by the Commission showed an insufficient level of ambition, an iterative process would take place with the aim of reinforcing the content of the plan(s). This approach implies that an additional lever is put in place to ensure that the collective national policy ambitions correspond to the EU target. This would increase effectiveness. This approach also has the merit of ensuring coherence with the governance of put forward in the 2030 Communication into which energy efficiency would be integrated, helping increase the economic efficiency of its implementation. In terms of economic efficiency the need to consult neighbouring Member States as part of the establishment of national plans would mean that decisions about managing energy demand and deciding on supply

[72] In particular, the national plans should set out a clear approach to achieve domestic objectives regarding greenhouse gas emissions in the non-ETS sector, renewable energy, energy savings, energy security, research and innovation and other important choices such as nuclear energy, shale gas, carbon capture and storage.

options would be better coordinated among Member States across the internal energy market. On the other hand it can be argued that, in theory, the setting of a binding energy efficiency target in addition to GHG and RES target could add rigidity to the system, bringing, under certain conditions, higher costs of GHG abatement than the marginal cost of abatement required to reach the cap in the ETS sector. This can be avoided by establishing the target at a level that is coherent with the other targets and allowing for periodical adjustments on the basis of developments in the economy or other. The analysis included in section 5.3 indicates that savings up to 35% are coherent with the 40% GHG and 27% RES targets, as they do not lead to overshooting the 40% target or to altering the size of emission reductions between the ETS and non-ETS sectors.

Under Option IV there would be a restructuring of the current policy setting. Much would be devolved to Member States, with EU-wide rules maintained only in areas fully relevant to the internal market, such as product efficiency requirements. This is because fully allocating policy responsibility to the national level implies that policy tools be allocated accordingly[73]. Experience with the renewable energy Directive shows that this approach can be a strong driver for national action: a target at Member State level can ensure political accountability and commitment to deliver results while providing flexibility to choose and apply the most suitable tools to achieve the target. On the other hand important synergies in policy making (e.g. common methodologies for establishing cost-optimal levels for building renovations) would be lost. The effectiveness of this approach remains uncertain, therefore. Regarding coherence this approach would run counter to recent proposals on governance. In addition, possible increases in administrative cost linked to fragmented EU action and potential harm to businesses operating across the internal market would limit the economic efficiency of this approach. Moreover, a basis for the shared efforts between Member States would have to be devised, taking into account for example such factors as the energy efficiency potential, early action, the structure of the economy. Such considerations are beyond the scope of this impact assessment.

5.4.2 Formulation of a 2030 target

Chapter 4 identified the following options:

A. Consumption target

B. Intensity target

C. Hybrid approach

[73] The opposite has been also argued, namely that a binding target would be a driver for Member States to make full use of existing provisions, notably under the EPBD and the EED (*How to shape a binding energy savings target for Europe that allows for effective evaluation?*, R. Harmsen, B. Wesselink, W. Eichhammer).

These approaches will be compared with regard to their effectiveness, efficiency and coherence, as well as their transparency and ease of monitoring (identified as key criteria for targets by the EU 2020 strategy[74]).

Energy **consumption** is the most straightforward option. It is most directly related to long term decarbonisation objectives. This indicator is, however, directly influenced by the development of the economy. If growth turns out to be higher than anticipated, realising the target will require additional energy efficiency measures, potentially making them no longer cost-effective. If on the other hand growth is lower than anticipated, the target can be met without the energy efficiency improvements that were originally envisaged and therefore the some of cost-effective potential will not be realised.

Energy **intensity** is defined as a ratio between energy consumption and an indicator of economic activity (GDP, added value). Its use can eliminate the dependency of the target on the rate of economic development. On the other hand, changes in energy intensity can sometimes result from structural changes that do not reflect real improvements (e.g. a shift from energy-intensive industries to higher value-added ones). And energy consumption in some sectors is not closely linked to the development of the economy.

Thus, consumption and intensity indicators each have pros and cons. Factoring in a target the dynamics of the economy can be done through the following options:

i. Formulating a target based on two components with an absolute energy consumption component corresponding to the share of energy consumption in those sectors where the correlations between energy consumption and economic growth is low (residential, services, and generation), and intensity component corresponding to the energy consumption of those sectors where this correlation is high (industry, transport). An analysis of these correlations is included in Annex IV.

ii. Establishing a single target formulated in absolute terms as it is today, with a review clause allowing for adjusting the target in case changes in the economy significantly differ from the assumptions made when the target was established.

Option i) has the downside of being expressed in a relatively complex way which potentially weakens the role of the target in benchmarking progress. The establishment of the target would also be fairly complex, including the decision on the split between the ‘absolute’ and ‘intensity’ shares and taking into account primary energy conversion factors in the different sectors. At the same time it provides for an automatic adjustment of the efforts required to the changes in economic cycles. The opposite can be said of option ii): while it is expressed in a clear way it would be up for revision providing less certainty for policy and market actors, and it would be devoid of an automatic adjustment mechanism. This could be however overcome if the circumstances under

[74] European Commission 2010.

which a revision happens and the margin by which the target is corrected are clearly defined.

5.5. The role of financing

There is evidence of increasing momentum for energy efficiency financing. The draft Operational Programmes beginning to be submitted under the European Structural and Investment Funds indicate an increase in sums allocated for the low–carbon economy, in some cases significantly above the minimum requirements for this objective. Also there is a general shift from grants towards a greater use of financial instruments (leveraging private capital), such as soft loans or guarantees.

Reaching the level of energy-savings considered in this impact assessment will require significant additional investments which will have to be primarily private. Public money, including the European Structural and Investment funds will have to be used to leverage these private investments and the right regulatory framework will have to underpin them. About €38 billion that has been set aside for low carbon economy investments under the Structural and Investment Funds (ESIF) 2014-2020 – and this sum can be multiplied by attracting private capital through Financial Instruments to deliver the necessary investments.

The additional investments in energy efficiency will range from €48 bn to €216 bn annually over the period 2011 to 2030 depending on the chosen level of ambition. These sums are significant, especially at the upper end of the range, but it is useful to put them in perspective: For illustration, institutional investors in the EU (adherents of the Principles of Responsible Investments initiative) currently manage over €12 trillion of funds, and the amount invested in private real estate is estimated at over €1.5 trillion in 2012.

To unlock the desired level of investment[75], it will be necessary to address the main identified drivers of energy efficiency investment. According to the Energy Efficiency Financial Institutions Group[76], these are the following:

- The benefits of energy efficient refurbishments of buildings and energy efficiency investments in SMEs and industry need to be captured and well-articulated, with evidence, to key financial decision makers (public authorities, buildings owners, managers, householders, CEOs and CFOs of companies). To achieve this, three requirements need to be met: (a) the full benefits of energy efficiency investments must be identified, measured and presented for each investment in ways in which key

[75] For illustration, the institutional investors (signatories of the charter of Principles of Responsible Investment) manage over €12 trillion of funds (amount invested in private real estate is estimated as over €1,5 trillion in 2012).
[76] Energy Efficiency Financial Institutions Group Report (2014); http://ec.europa.eu/energy/efficiency/studies/doc/2014_fig_how_drive_finance_for_economy.pdf

financial decision makers can understand and respond to; (b) the evidence and data must be easy to access and cost effective to compile and assess in investment decision making processes; (c) internal procedures, reporting and accounting systems should be adapted so as not to additionally handicap viable energy efficiency investments.

- Processes and standards for energy performance certificates, building codes and their enforcement need to be strengthened and improved. A step change in how energy efficiency potential is identified, measured, reported and verified is needed and achieving this is fundamental to unlocking the market at scale.

- Making it easy to get the right data to the right decision makers: There are too many hurdles between the relevant and credible data and the decision makers who need it; and the processes and resources required to extract that data and qualify it appear specialist and costly. For energy efficiency investments in buildings to enter the mainstream, it must be as easy for a key property decision maker to understand and value the benefits of those investments as it is for other comparable decisions. The data structures must clearly enable the connection and validation of value increases (in the broadest sense) with energy efficiency investments[77].

- Standards should be developed for each element in the energy efficiency investment process, including legal contracts, underwriting processes, procurement procedures, adjudication, measurement, verification, reporting, energy performance (contracts and certificates) and insurance. The use of standardised MRV and legal documentation is particularly important to facilitate the bundling of investments for recycling to the bond market – creating a route to significant volumes of capital market finance.

- Priority and appropriate use of EU Funds (in particular ESIF) and ETS revenues through public-private financial instruments from 2014-2020 will boost investment volumes and help accelerate the engagement of private sector finance through scaled risk-sharing: Scalable models and successful case studies of dedicated credit lines, risk sharing facilities and on-bill repayment schemes abound. Member States should be encouraged to move away from traditional grant funding and look more to identifying the working models which best address the energy efficiency refurbishment investment needs in their buildings (as articulated in their National Buildings Refurbishment Strategies). ESIF

[77] Bullier, A., Sanchez, T., Le Teno, J. F., Carassus, J., Ernest, D., & Pancrazio, L. (2011). *Assessing green value: A key to investment in sustainable buildings.* Retrieved from: http://www.buildup.eu/sites/default/files/content/Assessing%20Green%20Value%20-%20Bullier,%20Sanchez,%20Le%20Teno,%20Carassus,%20Ernest%20and%20Pacrazio%20-%20ECEEE%202011.pdf

2014-2020 funding (and other sources such as ETS revenues) will be required to kick-start and complement national energy efficiency funds (EED Art 20) and energy supplier obligations (Art 7) to deliver Europe's 2020 targets and National Buildings Renovation Strategies (Art 4).

6. CONCLUSIONS

6.1. Policy options for 2020

The analysis suggests that the best approach for **achieving the 2020 target** is to focus on the implementation of existing legislation. This is based on the following premises:

- The gap to the 2020 target is not expected to exceed 2 percentage points;
- Proposing new legislation now would not have a significant effect by 2020 and could be disruptive;
- A better implementation of current legislation and policies can close the gap.

Efforts need to be focused on the proper implementation of the EED, improved implementation of the EPBD and strengthened enforcement of product regulations – exploiting opportunities for improved financing, including from the European Structural and Investment Funds, to the full.

6.2. Ambition level 2030

6.2.1 Energy system impacts including security of supply

The analysis shows that, in all scenarios, energy efficiency policies reduce effectively energy consumption (both primary and final) and decrease the energy intensity as compared to the Reference scenario.

The different policy scenarios demonstrate some differences in terms of the consumption of various primary energy sources. Notably for solids, their share in fuel mix in 2030 does not change in EE27, EE28 and EE29 in comparison to the Reference whereas for EE30, EE35 and E40 their share grows slightly. The absolute consumption of solids in 2030 declines substantially in all except EE35 scenario. The shares of natural gas in 2030 decline slightly in all scenarios (in comparison to the Reference) with the declines more pronounced as the scenarios achieve more energy savinggs. The reductions in absolute consumption are, however, more pronounced – with more energy savings. The absolute consumption of RES grows but with high levels of energy consumption sheer reduction of energy consumption lessens the need for RES development in absolute consumption. The shares of renewables grow, however, in all scenarios – driven by the RES target as proposed in the 2030 framework and decarbonisation in longer term perspective.

Energy efficiency has a significant impact on security of supply and the level of gas imports in particular. Energy efficiency policies achieving 40% savings, would result in 2030 in lowering gas imports by as much as 40% in comparison to 2010, whereas in the Reference the imports would grow by 5% in that year. Already energy savings of 30% achieve a 22% decrease. Net energy import decreases translate into savings in the energy fossil fuels imports bill. For the period 2011-2030 cumulative savings range from €285 bn to €549 bn and for the period 2031-2050 from € 3349 bn to € 4360 bn.

6.2.2 Economic impacts

Energy system costs increase in all scenarios compared to the Reference. Increased energy efficiency ambition leads to average annual energy system costs (2011-2030) in policy scenarios that are between 0.01 and 0.79 percentage points of GDP higher than the Reference.
The additional increases are higher in 2050 and reflect the costs necessary to achieve the overarching decarbonisation objective, including also the costs of energy efficiency policy. Regardless of the method of comparison, the additional increases are smaller than those resulting under the Reference itself.

There is a general shift in the structure of costs with diminishing energy purchases and increasing capital costs and direct efficiency investments. The decreasing energy purchases with higher EE levels counterbalance to a certain extent the other two components. For the period 2011-2030, the average direct efficiency investments are between €16 bn to €181 bn higher than for the Reference.

Investments increases sharply in all scenarios - more significantly in more ambitious scenarios and again mostly in residential and tertiary sectors.

Electricity price changes compared to the Reference are also very small in 2030 ranging from 1% to 3% in the year 2030, with smallest increase in the EE35 scenario.

The ETS price differs substantially across the various scenarios, reflecting the important contribution of energy efficiency to emission reductions in the ETS sectors. Under EE35 and EE40, EE policies reduce significantly both costs and incentives from the ETS itself for other types of abatement. Regarding the ETS price, it is expected that the influence of EE policies on the ETS price will be mitigated by the structural ETS measures (back loading) and the market stability reserve which was proposed by the Commission.

GDP impacts for scenarios reducing emissions by 40% GHG can be either negative or positive depending on theoretical approach in modelling with the main driver being the magnitude of investments. In general-equilibrium modelling, the crowding out effect leads to negative results. If it is not assumed that all resources are fully employed, the effects on GDP are positive.

6.2.3 Social impacts

The overall net employment impacts, as for GDP, depend on the theoretical approach to modelling which determines the impact of investment on economic growth as well as the assumptions on the use of revenue from carbon pricing and the employment level assumed in the baseline. In general, employment is positively impacted by using carbon pricing revenue to lower labour costs. The analysis also suggests that the employment effect will overall be more positive in scenarios with stronger energy efficiency policies reflecting the significant job-creation potential in these areas – with magnitude of effect depending on theoretical approach.

Affordability of energy for households is already negatively affected under the Reference, but is not significantly affected compared to the Reference in policy scenarios. The scenarios with most energy savings slightly increase the share of energy-related costs in household budgets as energy efficiency improvements typically need investment resulting in capital cost increases. The extent to which households are able to proceed with such investment depends on the means of financing it.

6.2.4 Environmental impacts

In order to ensure consistency with the other objectives of the 2030 energy and climate framework, all scenarios (except for EE40) demonstrate reduced GHG emissions compared to the Reference in line with the GHG target proposed in 2030 framework as well as decarbonisation objective. All scenarios are consistent with the (at least) 27% share of renewables target.

Scenarios are broadly in line with regard to respective reductions in ETS and non-ETS sectors as proposed in 2030 framework. In all scenarios, the reductions in ETS sectors are close to 43% (wrt 2005) and the reductions in non-ETS sectors are close to 30% (wrt 2005). Only the EE40 scenario diverges from this pattern.

The balance of GHG reductions in the various sectors of the economy does not change between the scenarios as the mix of energy efficiency policies is not altered among the scenarios (it always follows the logic of current legislation and only the overall level of ambition intensifies). The highest reductions occur in the power generation sector (driven by ETS as proposed in 2030 framework) and in residential and tertiary sector (as the key EE policies address specifically these two sectors).

6.3. Architecture of the 2030 policy framework

The 2020 target proved to be a useful element of the policy framework providing a benchmark for tracking progress and making policy adjustments; a signal to relevant actors, about the policy direction; and a basis for additional policy elements. A post-2020 policy framework without a target would not benefit from these elements.

A purely indicative target would be economically efficient and coherent with the 2030 energy and climate policy framework. National binding targets would be incoherent with the proposed energy and climate policy framework. Their effectiveness and economic efficiency is uncertain.

The target formulation should take into account unexpected developments in the economy. This can be done either automatically (by formulating a hybrid target, with a component fluctuating according to changes in the economy) or through periodical revisions. Both approaches have advantages and drawbacks.

6.4. Financing

Significant energy efficiency improvements will require significant investments. These will have to be primarily privately financed although public investments, notably under the European Structural and Investment Funds will continue to play a role, notably in leveraging private capital. The business case for investing in energy efficiency need therefore to become more apparent to the financial sector and this will entail a number of actions, such as establishing reliable procedures for measuring and verifying energy savings, developing standards for energy efficiency investment processes and providing technical assistance in order to make energy efficiency projects bankable.

The table below gives an overview of the main impacts of the different scenarios assessed in Chapter 5. All impacts are with respect to 2030 if not otherwise stated, while keeping in mind that impacts and differences between scenarios may be quite different in a post 2030 perspective.

	Reference	GHG40	EE27	EE28	EE29	EE30	EE35	EE40

Table 22. Overview table with the key results for the IA for the different scenario projections

	Reference	GHG40	EE27	EE28	EE29	EE30	EE35	EE40
ENERGY SYSTEM IMPACTS								
Energy Savings in 2030 (*evaluated in % against the 2007 Baseline projections for Primary Energy Consumption)*	21.00%	25.10%	27.40%	28.30%	29.30%	30.70%	35.00%	39.80%
Gross Inland Energy Consumption (Mtoe)	1611 / 1630	1534 / 1393	1488 / 1423	1470 / 1380	1450 / 1338	1422 / 1286	1337 / 1196	1243 / 1129
- Solids share	10.8 / 7.6	10.1 / 9.5	9.9 / 9.5	10.4 / 9.4	10.8 / 9.4	11.3 / 9.3	12.9 / 9	12.4 / 9.2
- Oil share	32.3 / 30.5	32.8 / 13.5	32.4 / 14.2	32.6 / 14.5	32.7 / 14.8	33 / 15.3	34.2 / 15.6	36.2 / 16.4
- Natural gas share	24.6 / 24.3	22.5 / 17.9	22.5 / 19.5	21.9 / 19	21.5 / 18.6	21 / 18.3	19.2 / 18.3	18.5 / 17.6
- Nuclear share	12.5 / 13.2	13.1 / 18.1	12.7 / 17.2	12.8 / 17.4	12.7 / 17.4	12.5 / 17.1	11.8 / 16.5	11.1 / 15.8
- Renewables share	19.9 / 24.4	21.6 / 41	22.6 / 39.9	22.4 / 39.8	22.3 / 39.9	22.3 / 40.1	22 / 40.8	22.1 / 41.2
Energy Intensity (2010=100)	67 / 52	64 / 44	62 / 45	61 / 44	61 / 42	59 / 41	56 / 38	52 / 36
Renewables share in final consumption	24.4 / 28.7	26.5 / 51.4	27.8 / 49.9	27.7 / 50.1	27.7 / 50.4	27.7 / 50.6	27.4 / 51.8	27.4 / 52.3
Gross Electricity Generation (TWh)	3664 / 4339	3532 / 5040	3469 / 5038	3461 / 4936	3423 / 4796	3336 / 4560	3080 / 4267	2804 / 3969
- Gas share	19.5 / 17.3	15.3 / 12.5	14.8 / 12.5	14.2 / 12.3	13.8 / 11.9	13 / 11.2	10.2 / 11	9.8 / 10.3
- Nuclear share	21.8 / 21.3	22.6 / 21.6	21.5 / 20.8	21.5 / 20.9	21.3 / 20.8	21 / 20.7	20 / 19.8	19.1 / 19.1
- CCS share	0.45 / 6.9	0.77 / 14.72	0.65 / 14.53	0.58 / 13.67	0.41 / 12.98	0.27 / 11.83	0.29 / 10.65	0.3 / 10.19
ENVIRONMENTAL IMPACTS								
GHG reductions vs 1990	-32.4 / -43.9	-40.6 / -79.6	-40.1 / -77.6	-40.2 / -78	-40.1 / -78.3	-40.1 / -78.5	-41.1 / -79.5	-43.9 / -80.2
GHG emissions reduction in ETS Sectors vs 2005	-36.1 / -59.3	-43.3 / -87.1	-45.3 / -85.6	-44.4 / -85.7	-43.3 / -85.7	-42.2 / -85.7	-41.8 / -85.8	-45.6 / -86.5
GHG emissions reduction in non-ETS Sectors vs 2005	-20.3 / -22.9	-30.5 / -70.3	-27.6 / -67.6	-28.7 / -68.3	-29.5 / -68.9	-30.5 / -69.4	-32.9 / -71.2	-35.3 / -72
CO2 emission reductions vs 2005								
Power generation +District Heating	-46.7 / -72.9	-56.5 / -97.7	-57.9 / -95.6	-56.6 / -95.3	-55.5 / -95.5	-54.6 / -95.7	-54 / -96.1	-60 / -97.2
Industry	-22.5 / -43.8	-27.4 / -77.8	-31.5 / -76.7	-30.8 / -77.1	-29.8 / -76.8	-28.6 / -76.2	-29.1 / -75.7	-29.7 / -76
Residential, Services & Agriculture	-26.7 / -34.1	-34.1 / -80.3	-33.8 / -75.7	-37.5 / -78.2	-40.3 / -80.8	-44 / -82.9	-53.1 / -86.8	-62.9 / -90.3
Transport	-11.6 / -10.3	-13.6 / -63.5	-16.7 / -61.3	-16.8 / -61.4	-17.1 / -61.5	-17.3 / -61.7	-17.5 / -64.2	-17.4 / -64.2
	Reference	**GHG40**	**EE27**	**EE28**	**EE29**	**EE30**	**EE35**	**EE40**

SECURITY OF SUPPLY								
Import dependency	55.1 / 56.6	53.6 / 36.8	53 / 38.1	53 / 38	52.6 / 38.2	52.8 / 38.3	53.5 / 38.6	54.4 / 39.1
Net Energy Imports (2010=100)	96 / 101	89 / 56	86 / 59	85 / 57	83 / 56	82 / 54	78 / 51	74 / 49
Net Imports of Gas (2010=100)	105 / 122	91 / 74	88 / 82	84 / 78	81 / 74	78 / 69	67 / 65	60 / 59
Fossil Fuels Import Bill Savings compared to reference (bn € '10) *(cumulative 2011-30 and 2031-2050)*	n.a	-190 / -3404	-285 / -3349	-311 / -3490	-346 / -3637	-395 / -3798	-503 / -4145	-549 / -4360
SYSTEM COSTS *(2011-30/2011-2050)*								
Total System Costs, avg annual (bn €)	2067 /2520	2069 /2727	2069 /2649	2074 /2686	2082 /2747	2089 /2806	2124 /3001	2181 /3355
compared to reference (bn €)	n.a.	2 / 207	2 / 129	7 / 166	15 / 227	22 / 286	57 / 481	114 / 835
Total System Costs as % of GDP (average annual)	14.3 /13.03	14.31 /14.1	14.31 /13.7	14.35 /13.89	14.4 /14.2	14.45 /14.51	14.69 /15.52	15.09 /17.34
compared to reference (bn €)	n.a.	0.01 / 1.07	0.01 / 0.67	0.05 / 0.86	0.11 / 1.18	0.15 / 1.48	0.39 / 2.49	0.79 / 4.32
INVESTMENTS AND ENERGY PURCHASES								
Investment Expenditures , avg annual (bn €)	816 /949	854 /1189	851 /1110	868 /1126	886 /1149	905 /1170	992 /1203	1147 /1211
compared to reference (bn €)	n.a.	38 / 240	35 / 161	52 / 177	70 / 200	89 / 221	176 / 254	331 / 262
Energy Purchases, avg annual (bn €)	1454 /1586	1436 /1394	1422 /1402	1417 /1370	1411 /1335	1401 /1290	1378 /1206	1365 /1130
compared to reference (bn €)	n.a.	-18 / -192	-32 / -184	-37 / -216	-43 / -251	-53 / -296	-76 / -380	-89 / -456
Fossil Fuel Net Imports, avg annual 2011-30 (bn €)	461 / 548	452 / 377	447 / 380	446 / 373	444 / 366	441 / 358	436 / 340	434 / 330
compared to reference (bn €)	n.a.	-9 / -171	-14 / -168	-15 / -175	-17 / -182	-20 / -190	-25 / -208	-27 / -218
OTHER ECONOMIC IMPACTS								
Average Price of Electricity (€/MWh)	176 / 175	179 / 183	180 / 187	179 / 185	178 / 184	178 / 182	177 / 182	182 / 182
compared to reference (€/MWh)	n.a.	3 / 8	4 / 12	3 / 10	2 / 9	2 / 7	1 / 7	6 / 7
ETS price (€/t of CO2-eq.)	35 / 100	40 / 264	39 / 243	35 / 220	30 / 205	25 / 180	13 / 160	6 / 165