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COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT for a 2030 climate and energy policy framework

Accompanying the document

[mandatory element]

[mandatory element]

JOINT STAFF WORKING DOCUMENT

DRAFT **IMPACT ASSESSMENT for a 2030 climate and energy policy framework**

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[mandatory element]

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[mandatory element]

Contents

1. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

1.1. Organisation and timing

The preparations of the Impact Assessment (IA) for the 2030 framework for climate and energy policies formally started in April 2013 subsequent to the adoption of the Commission's Green Paper on the matter[1], but the IA builds on the update of the new reference scenario (hereinafter "EU Reference Scenario 2013") used as the benchmark for the quantitative assessments, which started already in late 2011.

An interservice group (ISG) was established in February 2013 in view of preparing the Green Paper, and this group continued to meet to steer the work on the IA also after its adoption up to the finalisation of this IA. The ISG met [4] times for the purposes of preparing this IA; on 30 May 2013, the ISG met to discuss e.g. the work plan and the results of the EU Reference Scenario 2013; on 16 July the ISG met to discuss a first outline of the IA and first outcomes of the consultation launched by the Green Paper, on 23 September the group met to discuss policy options and preliminary results. The final draft IA was submitted to the ISG group on [X] 2013.

The following DGs participated in the Steering Group: [A, B, C].

1.2. Consultation and expertise

Consultation

As a preparatory step for the development of the 2030 framework for climate and energy policies, the Green Paper was adopted on 27 March 2013[2]. It presents progress made and challenges under the current policy framework and sets out for consultation four key issues the 2030 framework needs to address: targets; coherence of instruments, fostering competitiveness of the EU economy and security of supply; and acknowledging the differing capacity of Member States. In addition, the Green Paper consults on the main lessons learned so far from the 2020 framework for climate and energy policies.

The Green Paper launched a public consultation of all interested parties which lasted until 2 July 2013. The Green Paper included a set of 22 questions on which the Commission sought viewpoints and input. Some [556] contributions from a broad spectrum of stakeholders including from [14] Member States were received. Given the very broad participation, the consultation offered insights into a large range of stakeholder opinions. All of the Commission's minimum consultation standards were met. The full report presenting results of the public consultation is found in annex [X] to this IA.

In addition to the public consultation itself, a high-level stakeholder conference was organised on the 2030 framework on 19 June 2013, with stakeholders and Member States represented as speakers and with more than 200 participants in the audience. The conference provided useful first-hand accounts on the major issues addressed by the consultation and was a valuable complement to the formal public consultation.

[1] COM(2013)169
[2] COM(2013)169

Box 1: Main findings of the public consultation

The public consultation showed an almost universal support for the development of a common European framework for climate and energy policies. Many stakeholders expect the EU to provide a 2030 framework to reduce uncertainty among investors, governments and citizens. Member States and stakeholders emphasized the need for climate and energy policy to continue to take into account the three prime objectives of energy policy: competitiveness, security of supply and sustainability. Targets: There is a broad consensus among the various stakeholders on the need for a new GHG target, whereas there are diverging views on the appropriate ambition level. Stakeholders have mixed views on the usefulness of renewables and energy savings targets. Instruments: Most stakeholders agree that the European Emission Trading Scheme (EU ETS) should remain the central instrument for the transition to a low carbon economy. There are mixed views on the extent to which an EU ETS reform is needed. Many stakeholders agree that additional policies and instruments can be utilized to reduce emissions for non-ETS sectors. Many stakeholders focus on the need for harmonization of policies across Europe to create a level playing field and avoid market distortion. The Internal Energy Market's benefits are well recognized and this is seen as key to ensure competitive prices and security of supply. Higher interconnection capacity between Member States is fundamental to meet energy and climate objectives. There is broad consensus among stakeholder that innovation is essential to ensure the flexibility and the security of the EU energy system and for the further development of a cost-effective energy options. Competitiveness: Many stakeholders note increased attention should be paid to competitiveness due to the economic crisis and changing international circumstances. The increasing cost of some climate and energy policies such as RES support needs to be contained. There is also a general consensus that public support schemes have to be revised to be more in line with changing costs of deploying renewables. Distribution of efforts: From the consultation emerges that fair distribution of efforts for the non-ETS sectors is needed. Socio-economic and geographical differences between Member States have to be considered. Financial instruments can play a key role to help Member States less capable to act and to leverage private investment.

Member State Ministers in charge of energy and climate policy had a first exchange on the main issues addressed by the Green Paper at a joint session of the Informal Energy and Environment Councils in Dublin on 23 April 2013. The European Council of 22 May 2013 welcomed the Commission's Green Paper and stated they will return to this issue in March 2014.

The Commission also organised meetings between Member States' Director Generals in charge of energy policy (on 14 March 2013) and of climate policy (on 19 February 2013) to discuss the 2030 Framework prior to the adoption of the Green Paper.

External expertise and contributions of Commission services

In order to ensure a complete and thorough quantitative assessment of future impacts in the EU, the Commission contracted the National Technical University of Athens, IIASA and EuroCare to model EU scenarios. The energy system and C02 emission modelling is based on the PRIMES model. The non-C02 GHG emission modelling is based on the GAINS model, with additional input by the Joint Research Centre's Institute for Environment and Sustainability concerning air pollution. LULUCF emission modelling is based on the GLOBIOM-G4M models. Important information about the PRIMES modelling system, modelling assumptions and modelling results is found in annexes [X to Y] of this IA.

A comprehensive update of the reference scenario was conducted between November 2011 and June 2013 in close cooperation of DGs ENER, CLIMA and MOVE and in association with the JRC. The macroeconomic assumptions for the EU Reference Scenario 2013 were consulted with and draw on work of DG ECFIN and the Economic Policy Committee. Extensive consultations during four meetings with experts from Member States on assumptions used and draft results took place to ensure appropriateness and quality with regard to Member State specific results. Moreover, in order to improve transparency and to gain useful third party views on the methodology applied by the Commission, the PRIMES model was peer-reviewed in 2011 by a group of recognised modelling experts concluding that the model is suitable for the purpose of complex energy system modelling.

Macroeconomic modelling, including impact of mitigation action by third countries, was performed using the GEM-E3 model, a general equilibrium model, maintained and used by the Joint Research Centre's Institute for Prospective Technological Studies (IPTS) and the E3MG model, a macro-econometric model run by Cambridge Econometrics. IPTS also contributed using the POLES model which is a global sectoral simulation model for the development of energy scenarios and global GIIG emission pathways until 2050.

An empirical study assessing Carbon Leakage and Competitiveness was undertaken by [add information on the consultant / CLIMA work in this regard].

[Reference to studies ENER/CLIMA/EMPL on employment impacts]

ICF GHK conducted a study analysing the employment impacts through macroeconomic modelling, using the E3ME model by Cambridge Econometrics, and by bottom up assessment for the power sector.

[Reference to work by on energy prices lead by ENER with the dose involvement of ENTR, ECFIN, EUROSTAT, CLIMA, COMP and TAXUD] I

ECFIN conducted a study on economic aspects of energy and climate policies. The report is composed of three chapters, investigating the evolution of electricity and natural gas markets across the EU, with a particular focus on the unit energy costs and the shale gas impact on the competitiveness of EU economy, the impact of energy and climate policies on the energy and carbon prices, as well as the impact of renewable developments on trade.

[Reference to other work by ENTR?]

1.3. Opinion of the Impact Assessment Board (IAB)

The draft IA was submitted to the Impact Assessment Board (IAB) on 9 October [TBC] and was discussed at the IAB hearing on 6 November 2013 [TBC], subsequent to which the IAB issued a |positive | negative| opinion. The IAB recommended improving the IA in the following aspects: [A, B, C].

Responding to these suggestions, the Commission reinforced the relevant parts of the draft IA in the following way: [A, B, C].

2. Problem definition

2.1. Policy context

State of play and general policy context

[J] To be published XX.

In the last 20 years, the EU has been successful in decoupling GHG emissions from economic growth. While GHG emissions in EU28 have decreased with 17% over the period 1990-2011, the overall economy grew by 45%[3]. This development is to a considerable extent due to a gradual improvement of the carbon intensity of the EU's energy mix, e.g. through higher shares of renewable energy; and to a decreasing energy intensity of the EU economy e.g. through energy efficiency measures throughout the economy including in industry, and growth in many non-energy intensive sectors, in particular services; as well as to decreases in non-C02 emissions, in particular in the agriculture and waste sectors.

In parallel to these developments, the EU has made significant progress towards the creation of internal energy markets for electricity and gas[4], while obstacles remain[5]. The EU is making considerable progress in ensuring the security of energy supplies in the EU, but dependency on one or a limited number of source countries of natural gas in particular still is a concern for many Member States and other supply concerns emerge as the energy system evolves. At the same time, the affordability of energy for households and the competitiveness of EU energy prices for industry in an international comparison are of increasing concern for these energy consumers and policy makers.

The Climate and Energy package adopted in 2009 presented an integrated approach based on climate and energy targets and a set of policies to implement them. Chapter 2 of the Commission's Green Paper on a 2030 framework for climate and energy policies, together with annex 1 of that Green Paper provides a comprehensive overview of the climate and energy objectives and policies applicable in a 2020 perspective (see also annex [X] and section [X] below on lessons learned). But 2020 is only an intermediate step towards a competitive and secure low carbon economy.

As regards climate change, the long term goal agreed in the context of the UNFCCC is to limit the global average temperature increase to below 2°C compared to pre-industrial levels, which guides EU's climate action. In line with scientific findings reported by the International Panel on Climate Change (IPCC) in the fourth Assessment Report, the European Council stated in 2009 that the EU's objective, in the context of necessary reductions by developed countries as a group, is to reduce GHG emissions by 80-95% in 2050 compared to 1990. The European Council also endorsed the objective to ensure that global emissions peak by 2020 and be reduced by at least 50% compared to 1990 to increase chances to avoid dangerous climate change.

The European Council has also recently addressed energy in a more holistic way: first in February 2011 when it requested that due consideration should be given to fixing intermediary stages towards reaching the 2050 objective and stated e.g. that "safe, secure, sustainable and affordable energy contributing to European competitiveness remains a priority for Europe"; and again in May 2013 emphasising e.g. the importance of the internal energy market and in particular stating that the EU's energy policy "must ensure security of supply for households and companies at affordable and competitive prices and costs, in a safe and sustainable manner", amidst increasing concerns in this regard in many Member States and industry sectors.

2050 Roadmaps and 2030 Green Paper

In order to provide a long term perspective on climate, energy and transport (which accounts for a significant share of both GHG emissions and energy consumption), the Commission came forward with three initiatives in 2011 based on a consistent analytical framework: the *Roadmap for moving to a competitive low carbon economy in 2050*, the *Energy Roadmap 2050,* and the *Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system* (commonly referred to as the *Transport White Paper*)[9], which presented fundamental aspects of the transition to a low carbon economy, cost-efficient GHG emission reduction milestones for e.g. 2030, and "no-regret options" for the transition towards a competitive, sustainable and secure energy system.

In reacting to these initiatives, Parliament underlined the necessity of clear climate and energy objectives

[3] Kyoto progress report 2013 and its SWD [xxx exact reference to be added early October]. Emissions include international aviation emissions as reported under the Common Reporting Format to the UNFCCC.

[4] Through Directives 2009/72/EC and 2009/73/EC. Already before these directives there were functioning internal markets for other energy products such as coal and oil products.

[5] See Commission Communication "Making the internal energy market work", COM(2012) 663 final.

for 2030, building on the Roadmaps[6]. The Council did not adopt conclusions on the Roadmaps, but Council Presidency conclusions underlined the broad agreement by all but one Member States on the core elements of the Roadmaps. In March 2013 the Commission came forward with a consultative Green Paper on a 2030 framework for climate and energy policies. On 22 May 2013, the European Council welcomed the Commission's Green Paper, recognised that significant investments in new and intelligent energy infrastructure are needed to secure the uninterrupted supply of energy at affordable prices, and that such investments arc vital for jobs and sustainable growth and will help enhance competitiveness. The European Council recognised the importance to have a well-functioning carbon market and a predictable climate and energy policy framework post-2020 which is conducive to mobilising private capital and to bringing down costs for energy investment. The European Council invited the Commission to come forward with more concrete proposals in time for the March 2014 European Council. The recently agreed 7th Environmental Action Programme states that the next steps for the EU's climate and energy framework beyond 2020 need to provide a clear legally-binding framework and target(s) to enable investments.

<u>International policy context</u>

While more than 110 countries, accounting for 85% of global emissions and including all major economies in the global community have formally pledged to take action to mitigate climate change in the context of the UNFCCC, no new comprehensive international climate agreement has been achieved that ensures that the global community as such is on track to keep global warming below' 2°C. The lack of such an agreement and the insufficient ambition of pledges, including by major economies, have prevented the EU from raising its 2020 GHG reduction target to 30 percent[7]. At the 2011 Durban UN climate conference, countries however agreed to start negotiations on a new global agreement, applicable to all contracting parties for the period beyond 2020, to be agreed at the UN climate conference in Paris in 2015.

2.1. Progress and lessons learnt from the 2020 framework

An overview of lessons learnt and interactions of the EU's extensive climate and energy policies underpinning the 2020 targets is presented in Annex [X] along with details of relevant evaluations where these are available. The most salient conclusions about current policies are summarised below. [As regards energy efficiency, and pending the detailed review the Commission will carry out in 2014 as required by the Energy Efficiency Directive, this IA does not include any assessment of progress made towards the 2020 targets and lessons learned beyond that provided in the Green Paper],

[Full coherence with detailed annex on this section yet to be ensured]

Headline targets and progress towards meeting them

With a 17% reduction in 2011 compared to 1990, the EU is on track to meet and even exceed its 2020 <u>GHG</u> target on the aggregate level. The 2020 cap for the sectors covered by the EU Emission Trading System (ETS) is expected to be met. In the non-ETS “sectors, the EU as a whole is on track to meet the target. However, 13 Member States need to make additional efforts to meet their respective national 2020 targets under the Effort Sharing Decision, or make use of the flexibility mechanisms foreseen therein". Also other EU policies, high fossil fuel prices and reduced energy demand due to the economic crisis have contributed to GI IG emission reductions.

As regards <u>renewable energy</u>, its share of gross final energy consumption was 12.7 in 2010 (to be compared with 8.5% in 2005). On aggregate, the progress to date means that the EU has met its interim target for [X]. However, as the trajectory grows steeper, more efforts will still be needed from Member States in order to reach it[8] Many Member States need however to make additional efforts to meet their respective national targets under the Renewables Directive, and recent evolutions such as for instance retroactive changes to support schemes is causing concern as to whether the overall EU target will be met".

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[6] European Parliament Resolution on a Roadmap for moving to a competitive low carbon economy in 2050 (2011/2095(INI))

[7] The Climate and Energy Package included an unconditional -20% GHG target by 2020 compared to 1990 and a -30% conditional target in case of a sufficient ambitious comprehensive international climate agreement.

[8] See the Commission Renewables Progress Report.

The 2020 target of saving 20% of the EU's primary energy consumption (compared to projections made in 2007) is not legally binding for Member States, but significant progress has nevertheless been made. After years of growth, primary energy consumption peaked in 2005/2006 (around 1825 Mtoe) and has been slightly decreasing since 2007 (to reach 1730 Mtoe in 2011)[9], in part due to impacts from the economic crisis, but also due to improved energy intensity. Nevertheless, the EU is likely to miss its indicative energy savings target of 20% compared to 2007 baseline projections for 2020 under current policies. The EU Reference Scenario 2013 projects energy savings of some 17% in 2020 (see section 2.3 below).

Implementation climate policy

[9] Primary energy consumption included non-energy uses which are not considered in the energy savings target for 2020. The figure excluding non-energy uses was 1706 Mtoe in 2006 and 1583 Mtoe in 2011.

The EU Emission Trading System (ETS)

From 2013 onwards the new institutional framework with auctioning and EU-wide harmonised benchmarks for free allocation is in place and constitutes a significant improvement compared to the previous trading periods that still had national based allocation plans.

The ETS has adapted flexibly to changed economic circumstances and lowered compliance cost for covered sectors in the midst of the prolonged economic recession. However, as outlined in the Carbon Market report[10], the economic recession and the accelerated inflow of international credits have created a surplus of around 2 billion allowances. If unaddressed, this will have a long lasting effect on the ability of the ETS to incentivise low carbon investments. In combination with today's high gas to coal price ratio it can lead to carbon lock-in. Regulatory uncertainty about the way forward has reduced the confidence of market participants, and in some cases is already leading to fragmentation of climate policies within the EU. The lower than expected ETS carbon prices and corresponding auctioning revenues reduce the envisaged related redistribution effects.

Free allocation to energy intensive sectors and more recently low carbon prices have resulted in a very low risk of carbon leakage at present (see annex [Xxx] for a more detailed assessment). State aid for electricity intensive industries in line with the related 2012 aid guidelines[11] can be an effective way of preventing indirect impacts but has given rise to concerns by some stakeholders regarding distortions of competition across Member States.

Aviation has been included since 2012 in the EU ETS. The scope also includes incoming and outgoing international flights in the EU. This has resulted in criticism from third countries opposing that the EU includes flights of foreign operators in the EU ETS originating from foreign countries. To provide negotiation time for the adoption of an international solution at the ICAO General Assembly in October 2013, international flights into and out of Europe in 2012 were temporarily exempted from enforcement.

The Effort Sharing Decision (Non ETS)

Member States' efforts are effectively supported by a series of measures at the EU level, including regulation of C02 emissions from passenger cars and vans, the Energy Performance of Buildings Directive, the Energy Efficiency Directive, the Renewables Directive, the F-gas regulation and the eco-design framework setting minimum energy efficiency standards for a range of domestic and industrial appliances. Many Member States have also national measures unrelated to EU initiatives helping them to progress towards their effort sharing targets, e.g. with regard to C02 and energy taxation impacting energy end-price differentials and competition between Member States.

Nevertheless, not all Member States are on track to meet their target, so the foreseen flexibilities may be important to ensure compliance. This was also highlighted in several responses to the consultation. However access to international credits to comply and the overachievement at the overall EU level might impact potential prices of emission allocation transfers between Member States and reduce related distribution effects.

Fuel Quality Directive

[10] COM(2012) 652
[11]

The Fuel Quality Directive (FQD), as amended in 2009[12], introduced an obligation for fuel suppliers to reduce the life cycle greenhouse gas emissions from their supply of fuels used in road (and non-road mobile machinery) by 6% in 2020 from a 2010 baseline.

The methodological challenge is to ensure fuel suppliers can calculate life cycle emissions, incorporating an adequate level of accuracy but balancing the associated administrative burden. The development and evaluation of such a methodology is complex. In this context, an impact assessment considering a number of options has now been finalised [add reference / details once available].

Other major economies are reviewing proposals for or have adopted similar legislation, e.g. the US state of California. One benefit of such a policy is that it will apply equally to importers and domestic producers of fuels.

Progress on international action on climate change

The pledges under the Copenhagen Accord and Cancún decisions have led to the development and implementation of a variety of national policies and measures, including carbon markets. While the EU ETS remains at present the largest functioning carbon market, others are being implemented and developed. For example, California and New Zealand have implemented carbon markets; Australia adopted its Carbon Pricing Mechanism legislation[13]; China is pushing ahead with the design of its seven emissions trading pilots which could begin in late 2013; South Korea is developing its trading scheme.

Major economies have enhanced their fuel economy standards (in US, China, Japan, and India is considering new policies) and countries undertake significant reforms of their tax and subsidies to improve their energy security, with GHG emission benefits (Iran, Indonesia, South Africa, India). Over 100 countries have renewable energy policies, and especially fast- growing economies develop support schemes to promote investments in renewable energy (from Philippines to China to Chile).

But neither the existing pledges nor initiated measures are delivering sufficient reductions by 2020 to be on track to prevent a dangerous 2° C rise of temperature. At the UN Climate conference in Durban, in 2011, the need to act collectively, and with greater urgency and ambition was recognised. All parties agreed to negotiate by 2015 a global climate regime applicable to all after 2020 and agreed to enhance mitigation efforts to close the pre-2020 mitigation gap.

Implementation energy policy

Renewable energy policy

The substantial growth in renewable energy has been driven by the EU and Member State targets provided in the Renewables Directive and the national support schemes to achieve those targets. Generally speaking, the EU is on track to meet the 20% target at the aggregate level, but many Member States must make additional efforts to meet their individual targets.

Many renewable energy sources are not yet cost-competitive compared to other energy sources. However, in the last five years renewable energy technologies have matured considerably and costs have come down, most notably for solar PV (more than [50]%), and to a lesser extent for wind; and a number of renewable energy technologies for electricity generation are increasingly becoming competitive with conventional electricity generation.

The increase of renewable energy sources has contributed to containing electricity wholesale prices on many markets by substituting part of the generation of conventional thermal plants, which have higher marginal cost of production. This has not yet been reflected in retail prices or translated into tangible benefits for consumers, in part as the cost for renewables support schemes (often passed on to final consumers) outweigh the reducing impact of renewables on wholesale prices on many markets.[14]. In 2011, the support for electricity produced in the EU from renewable sources reached €[X] billion which is the equivalent for the average electricity consumer of €[X] per MWh[15], although some costs are not reflected in the electricity bills but covered by public budgets, in particular in countries with strong

12 Directive 2009/30/EC
13 The change of government in September 2013 has led to uncertainty with regard to implementation.
14 [Reference to ECFIN's forthcoming publication]
15 [Reference CEER report]

elements of price regulation. On the other hand, avoided fuel import costs due to RES are estimated to be at least 25 bn € in 2010 and expected to significantly increase[16].

Short to medium term cost-efficiency of renewables development has been affected by some Member States choice to support a wide range of technologies (although such an approach could reduce costs in the longer term as has been observed by solar PV) and national support schemes which in many Member States have not been flexible enough to adjust to changing circumstances (such as technology costs and level of development). On the other hand, changes to established support schemes can increase investor uncertainty, in particular if applied retroactively, and have contributed to the reduced investment levels experienced in 2012 and 2013.[17] In addition, diverging Member State support schemes with focus on national production pose significant challenges to further integration of the internal energy market, and some of them have been subject to complaints at the WTO, in particular in the field of biofuels.

With the exception of Sweden and Norway, none of the cooperation mechanisms provided for in the Renewables Directive have been established, and national support schemes are as regards electricity restricted to national production. This presents a further challenge to cost- efficient deployment across the EU and works against market integration.[18] At the same time, higher shares of renewable energy in the electricity mix raise new concerns about grid stability and emphasise the need for further market integration, grid interconnection, demand response, back-up capacity, etc. It is clear that a "system view" must be applied to fully integrate renewables in the energy market.

Priority access to the grid and the lower wholesale prices resulting from renewables development can affect revenues of conventional power plants, especially in Member States with rapid deployment of intermittent renewables. In some Member States, this raises the question of how to ensure adequate investment signals and generation adequacy. National capacity mechanisms are being considered by some Member States as a solution, but risk fragmenting the internal market.[19]

Growth of renewables in the EU has contributed to a globalisation of the renewable energy sector. Many new markets have emerged across the globe, in some cases even bigger than the European market, but at the same time the European renewables industry has been faced with stronger competition. This has on the one hand contributed to lower technology costs in the EU and a continued strong export position of EU firms in particular in the wind sector, but has also resulted in difficult competitive positions and lower market shares for many EU companies in particular in the solar sector[20].

Renewable sub-target for transport

The share of renewables in transport reached 4.7% in 2010 compared to only 1.2% in 2005, to be compared with the 10% target in the Renewables Directive. Member States support biofuels via mandatory blending obligations in transport fuels, tax exemptions or other support schemes. Progress towards meeting the renewables target for transport can under certain conditions improve security of supply as the EU becomes increasingly dependent on imports of fossil fuels. On the other hand, from a strict GHG perspective current costs and support levels for renewables in the transport sector imply an abatement cost significantly higher than in other sectors of the economy and there are increasing concerns about sustainability of certain biofuels (and certain other biomass uses), including their contribution to reduce the LULUCF emission sink (see Annex X)[21].

Since the adoption of the Renewables Directive, the scientific evidence base regarding the GHG emission impacts associated with indirect land use change (ILUC) has grown. In response to the ILUC issue, the Commission has proposed to limit the amount of food-based (1st generation) biofuels that can contribute to the relevant targets (including the 10 % renewables target for transport) and has indicated that first generation biofuels with high estimated indirect land-use change emissions should not continue to receive public support after 2020[2']. However, as projections indicate that Europe will need considerable amounts of biofuels towards 2050, the Commission's proposal includes increased incentives for advanced

[16] [Reference to ECFIN's forthcoming publication]
[17] {Ref to Com guidance 2013]
[18] Ibid.
[19] Ibid.
[13] Reference to ECFfN's forthcoming publication
[21] [Add references]

biofuels that do not need land for their production, such as biofuels made from residues, algae and wastes.

Energy efficiency policy

As regards energy efficiency, the Energy Efficiency Directive requires the Commission to carry out in 2014 a detailed review of the 2020 approach. Some tentative conclusions can already be drawn today.

Despite the 20 % energy savings target not being legally binding on Member States, it has provided significant momentum to the efforts to reduce energy consumption and intensity, and facilitated agreement on strong measures, in particular the EED.

Moreover, energy efficiency standards for a wide range of appliances and equipment have been agreed at the EU level and will lead to important energy savings. The estimated impact of the adopted ecodesign and labelling measures are energy savings represent around [90J Mtoe in 2020. EU Regulations relating to C02 and cars and C02 and vans have led to an accelerated improvement of fuel efficiency of new cars and vans. C02 emission of new cars reduced from 172 g per kilometre in 2000 to 135.7 g per kilometre in 2011.

The revised Energy Performance of Buildings Directive (EPBD) will ensure Member States apply minimum energy performance requirements for new buildings, but delays in implementation are a risk, which could seriously impact the extent to which the EU takes full advantage of the cost-effective savings potential in the buildings sector (equivalent to [65] Mtoe by 2020).

The Energy Efficiency Directive complements these regulations and directives. It is too soon to assess its functioning as it has not yet been transposed by Member States, but a first assessment will be made in the abovementioned 2014 review.

With regard to overall progress in the EU in terms of energy savings, the economic crisis has fully demonstrated the strong correlation between energy consumption and economic activity, especially in industry. This has led to concerns that an absolute savings target is not flexible' enough to reflect the underlying dynamics of the EU economy.

Energy prices and international developments in energy markets

While the gradual completion of the internal energy market has helped to keep EU wholesale electricity and gas prices in check, end-user prices for many business and households have increased significantly in both nominal and real terms over the last decade. The EU Reference Scenario 2013 suggests that this trend will continue also in the absence of new policies variety of reasons (see section 2.3 and annex X] below.

Developments in international markets and exploitation of unconventional hydrocarbons has led to an increasing divergence of prices, most notably for natural gas in the EU compared to the USA where shale gas is now an increasingly important energy source and is considered by e.g. industrial stakeholders to impact positively on the US economy's competitive position. In 2012, industry gas prices were some four times lower in the USA than in Europe, but the price differential has decreased over 2013 primarily due to due to higher US prices. Natural gas prices in the US may further increase as the cheapest shale gas basins deplete. Shale gas can also impact electricity prices through lower costs of input fuels.

As regards electricity, average end-user electricity prices for EU industry are about twice of in the US and substantially higher than those in many other OECD economies (notable is the exception of Japan where prices are higher) and many major developing economies. Between 2005 and 2012, European industry faced electricity price increases of on average 38% in real terms whereas the corresponding figure was minus 4% for the US and plus 16% for Japan“[9]. However, the energy intensity of industry is substantially lower in the EU than in e.g. the US, Moreover, EU industries improved their energy intensity by 19% between 2001 and 2011 while over the same period the US industry improved only by 9%[22].

This trend is driven by many factors other than the EU's climate and energy policies (for such impacts, see annex [X]). EU wholesale electricity prices are still determined mainly by the price of fossil fuels. Member State decisions on network tariffs, levies and taxes also have a significant impact on end user prices. These factors must be taken into account when designing new policies at EU and Member State level.

According to empirical estimates, fossil fuel prices still remain key drivers of electricity and natural gas end-user prices. However, market opening and competition appear to have significant downward effects on prices for both households and industrial consumers. In the natural gas market, high import dependency and low diversification of imports can significantly contribute to increasing end-user prices. In the electricity market, support to less mature renewables technologies can result in higher electricity prices for both industry and households segments. Furthermore, in some Member States, the burden has not been evenly shared across consumer segments, with exemptions for some industries and a corresponding higher burden on households31.

A dedicated study on energy EU energy prices and its drivers, as well as an international comparison, is carried out in parallel to the preparations of the 2030 framework; responding to a request from the European Council on 22 May 2013. The results are expected to be published in [X].

[Other energy developments / implementations?]

Interaction between headline targets and instruments

As foreseen already when the 2020 package was prepared and adopted, there is clearly an interaction

[22] Cfr. (DG ECFIN forthcoming publication) European Commission, European Economy Publication, "The development of shale gas and its impacts on US and EU".

between the headline targets.

First, measures to promote energy efficiency and renewable energy generally contribute to reductions in GHG emissions. The cost of reducing GHG emissions through such measures can be substantially different than the marginal cost of reducing emissions required to reach the cap in the ETS sector (reflected by the ETS price) but at tire same time delivering additional benefits beyond GHG reductions. Such measures can also address innovation- related market failures for the energy transition Specific efficiency measures addressing non-price barriers such as split incentives, high private discount rates, limited access to finance or imperfect information are particular complementary. As far as specific measures increase renewable electricity or lower electricity consumption, also a downwards impact on ETS carbon prices can be expected. However, the impact of the achievement of the renewables target had been taken into account in the design of the climate and energy package and the current surplus of allowances in the ETS is largely driven by other factors such as impacts on demand from the economic crisis and the increasing inflow of international credits in the system.

Second, measures to reduce GHG emissions at EU and national level can in principle incentivise both renewables development and energy savings in and outside the ETS sectors, but it is clear that substantially higher levels of the ETS price than those experienced over the last few years would be needed to have considerable impact. In addition, the ETS price alone is not sufficient to provide incentives for developing innovative low carbon solutions and related infrastructures that are needed for the energy transition. Indications are that national measure such as energy and C02 taxation have had a more tangible impact on energy consumption than the ETS to date.

Third, energy savings help to ensure progress towards higher shares of renewables, as the target in this regard is measured as a share of gross final energy consumption.

A more substantive analysis of these interactions - as well as the lessons learned for other aspects - is found in annex [X],

2.2. Evolution under current policies

The EU Reference Scenario 2013 explores the consequences of current trends, including full implementation of policies adopted by late spring 2012. It includes notably the EU Emission Trading System (ETS) Directive with the linear decrease of the cap continuing also post 2020, the achievement of the legally binding 2020 targets for non-ETS emissions and renewables, including renewables in transport, as well as the implementation of the Energy Efficiency Directive (political agreement in the first half of 2012). Moreover, relevant national policies as well as other EU policies such as the C02 from cars/ vans regulations, implementation measures of the Eco design directive, the energy performance of buildings directive, the F- Gas regulation and the landfill directive are included.

The resulting projections show a decline in total GHG emissions[3]" of 24% in 2020, 32 % in 2030 and 44 % in 2050 relative to 1990. Renewable energy share would increase to respectively 21%, 24% and 29% in 2020, 2030 and 2050. Energy savings would continue to marginally increase up to 2035 but would then marginally reverse afterwards.

The EU would fall short of the milestone for 2030 of minus 40% domestic GFIG emission reductions, despite a strong decoupling of energy consumption from economic growth and a major restructuring of the energy system towards renewable energy and maintaining a significant nuclear contribution, resulting in a reduction of energy related C02 emissions by 31 % compared to 1990.

With full implementation of current policies, the surplus in the ETS is projected to further increase to over 2.5 billion allowances by 2020. Between 2020 and 2050 the surplus in the ETS only a gradual decrease due to longer term effects of present energy policies and the ETS price effects from the continuation of the linear factor of 1.74% per year after 2020. Consequently ETS emissions are projected to reduce by 36% compared to 2005, whereas according to the Low Carbon Economy Roadmap a cost-effective contribution of the ETS to the overall -40% GHG milestone would be around -45% compared to 2005 (ranging from - 43% to -48%).

Non-ETS emissions are projected by 2030 to decrease by 20% on 2005 mainly thanks to the continued impact of energy efficiency policies, however short of the cost effective reduction of around 30% (ranging from -24 to -36%) for reaching the overall -40% GHG milestone.

Analysis for the Low carbon economy roadmap also indicated that delaying efforts to reduce emissions post 2030 increases costs over time. This indicates the need for additional policies addressing notably the period until 2030.

The EU's medium-to long-term security of energy supplies remains an issue:

Currently energy import dependence stands at 53%, with imports to an important extent coming from geopolitically instable regions. Thanks to strong renewables penetration, which counteracts the substantial decline of indigenous fossil fuel production, import dependency increases more slowly than projected in earlier analyses undertaken before the adoption of the climate/energy package. However import dependency might still rise, reaching 55% in 2030 and 57% in 2050 despite the slight decline of total net energy imports, which decrease by 4% from 957 Mtoe 2010 to 921 Mtoe 2030 not least due to expected significant increases in energy efficiency entailing a downward trend for overall energy consumption. In the long term (2050) energy imports return to current levels. Energy imports continue to be dominated by oil and gas, for which geopolitical stability and diversification issues are most virulent. Oil imports decline by only 7% by 2030 and gas imports, for which many Member States are dependent on a very limited number of supply countries and routes, with corresponding impacts on competitive pricing, continue rising (5% from 2010 by 2030). Strongly declining net solid imports and rising biomass imports largely neutralise each other.

In spite of some increase in biomass imports, it is notably the penetration of RES that help containing external energy dependency. RES help thereby also to reduce the external energy bill of the EU. The Reference scenario also demonstrates the positive impact of energy savings / efficiency on containing import dependence for fossil fuels and the external energy bill. But fossil fuel import prices are assumed to continue to increase with import prices[23] increasing from 2010 to 2030 for oil from 80 $ per boe to 121 $ (60€ to 93€), for gas from 38 € per boe to 65 € and for coal from 16€ to 24€. Consequently the EU would be facing increasing outflows of expenditure for purchasing fossil fuels. The external fossil fuel bill of the EU would be rising in constant prices by around 50% from 2010 to 2030 and exceeds 2010 levels by around 80% in 2050, reaching around 500 bn € and 600 bn € (2010 money) in 2030 and 2050, respectively. This together with significant uncertainties associated to the potential of unconventional fossil fuel resources in the EU suggests that present policies will lead to an EU economy more prone to impacts of high and volatile international energy prices in the future. This is of particular concern to energy intensive industries, who are currently confronted with competition from the US which enjoys much lower gas prices, increase and diversification of supply routes can increase competitive pricing of fossil fuels, in particular for gas.

Ensuring competitiveness with increasing energy investment needs:

Under current trends and policies, there is a heavy investment need, notably for the renewal of electricity supply including appropriate infrastructures and for more efficient energy using equipment as well as building insulation. The EU Reference Scenario 2013 projects an increase of energy-related investments (excluding transport) by 47% in the decade 2021-30 compared to the decade 2001-10 (which was marked by, rather low investments in power and energy sectors), and a decrease by 21% compared to the decade 2011-2020. Transport-related investments are projected to increase by 31% in the decade 2021-30 compared to the decade 2001-10, and by 20% compared to the decade 2011-2020. Projected investment increases in demand side sectors are stronger than in the supply side. Total energy system costs related to GDP, which stood at 12.8% in 2010, peak in 2020 at 14.9% as a consequence of heavy energy investment and projected increases in fossil fuel prices, falling thereafter to 14.2% in 2030 and back to 2010 levels (12.6%) by 2050 thanks to fuel cost savings in later years. There is therefore a shift in the costs of energy supplies from operational costs, notably fuel costs, to capital costs. In assessing economic impacts it is important to note that higher capital expenditure largely can create income and employment in the EU for suppliers of low carbon and energy' efficient technologies provided that the industrial leadership on such technology that the EU has enjoyed so far is maintained, rather than using financial resources for paying for energy imports.

Nevertheless, average electricity prices as well as diesel, heating oil and gas prices for households, are projected to increase significantly on the back of projected increases in fossil fuel prices and (for electricity) also increased investment needs. While electricity prices stabilise at higher levels than today

[23] In constant 2010 prices.

in the medium term, notably thanks to fuel cost savings stemming from e.g. RES investment, price increases for oil products would continue through 2050. To the extent that these price increases are not fully compensated by fuel savings (e.g. from energy efficiency investment) and income increases, the resulting energy costs cause concerns about the affordability of energy for vulnerable households and industries exposed to international competition.

Risk of delayed investments and high carbon lock in:

Long investment cycles in particular in the energy, industrial and buildings sectors mean that most infrastructure and other capacity investments undertaken in the near term will still be in place in 2030 and beyond. As pointed out by stakeholders e.g. from the power sector, investors need a stable policy framework which corresponds to this time horizon. The EU's energy system needs significant investments to ensure its medium to long term viability and sustainability. This shift towards increased investments already starts in the projection in EU Reference Scenario 2013, but the low-carbon economy and energy roadmaps indicated the need for even a larger shift.

Current policies do not ensure that these additional investments take place, and with projected ETS carbon prices of 10 €(10)/tCO2 in 2020 and 14€/tC02 in 2025 the ETS and no continuation of non-ETS targets there may be even a significant risk that the investments required under current trends and policies do not occur if renewables or energy efficiency policies are not fully implemented and lead to a lock-in of high-carbon technologies and infrastructures increasing costs to achieve the longer term milestones of the low carbon roadmap[3']'.

In the projections of the EU Reference Scenario 2013, such risks are to some extent mitigated by the expected later increases in ETS carbon price to 35 € in 2030 and 100 € in 2050, which would be for example high enough to trigger significant CCS investment from 2040 onwards. While the CCS share in power generation reaches only 0.5% in 2030, it rises to 3.4% in 2040 and 6.9% in 2050. However, it is unclear to which extent investment decisions in practice take into account such a long time perspective with current low carbon prices and such a large surplus of allowances.

for more information regarding the EU Reference Scenario 2013, see annex [XJ.

2.3. What is the problem the 2030 framework should contribute to address?

The medium to long term challenges in the area of climate and energy are complex and numerous. In consideration of the general objectives of EU action in these areas, the main problems the 2030 framework should contribute to addressing can be summarised as follows [for elaboration, see annex X], In this context, it should be underlined that the specific options for the 2030 framework evaluated in later chapters in themselves will not be sufficient to fully address these problems, many of which need sustained efforts over time, adapted to specific developments difficult to foresee at this moment in time.

I. The EU's present policies are not sufficient to reach the EU's long term climate objective in the context of necessary reductions by developed countries as a group to reduce GHG emissions by 80-95% in 2050 compared to 1990. In the context of international climate negotiations, the EU will need to come forward with a position, including its own ambition level ahead of 2015. This challenge is therefore interlinked with international climate change mitigation efforts.

II. The EU's medium- to long-term security of energy supplies remains an issue by a persisting energy import dependence on sometimes politically instable regions and reliance on fossil fuel usage which in the long term will be incompatible with the EU's climate objectives unless CCS would bring a solution to this dimension. Gradual depletion of the EU's conventional fossil fuel resources together with expectation of continued high and volatile fossil fuel import prices puts pressure on parts of EU industry.

III. The EU's energy system needs significant investments in energy infrastructure and electricity generation to ensure its medium to long term viability and sustainability Long investment cycles mean that infrastructure funded in the near term will still be in place in 2030 and beyond. There are also relevant other barriers and market failures. Authorities, regulators, energy system operators, investors and manufacturers of innovative low carbon technology therefore need urgently a clear and coherent climate and energy policy framework that creates predictability and reduced regulatory risk.

IV. Current policies aiming at achieving a more sustainable economy and energy system, which may reduce costs and avoid damages in the longer run, are expected to contribute to short to medium term cost increases, which cause concerns about the affordability of energy for households and the competitiveness of Eli energy prices in an international context.

The abovementioned challenges are intrinsically interlinked with each other and with challenges at the international level, not the least in relation to international climate change mitigation efforts, increasing international competition for energy resources on global markets as global energy consumption increases, and energy price developments in some other major economies that impacts the competitiveness of in particular EU's energy intensive industry sectors.

Hence there is a need for an integrated framework for climate and energy policies. Policies to address the above problems in a 2030 framework should ensure that:

- Climate and energy objectives are met in a cost-effective way through policies that take account of the affordability of energy, competitiveness and the importance of the internal market in energy.
- Policies are complementary and are internally coherent with each other
- Policies deliver a strong investment signal without compromising the competitiveness of business and flexibility for Member States.
- Climate action isencouraged internationally and be able to adapt tochanging circumstances.
- Concerns about the risk of future carbon leakage are addressed in case EU efforts are not matched by third country efforts.
- The different capacities and circumstances of Member States and consumer groups are taken into account, without distorting competition or market integration.
- The EU's medium- to long-term security of energy supplies is addressed.

2.4. Who is affected

Climate and energy policies affect everyone, citizens and companies alike. Whereas the impacts on the energy sector itself, energy intensive sectors and major GHG emitting sectors currently not covered by the ETS such as agriculture and transport[24] are obvious, the 2050 roadmaps (supported by the quantitative analysis in later sections of this IA) suggest that total investment needs actually are highest in end use sectors such as transport and housing, often related to the need for more energy efficient technologies. Therefore this transition of the energy system towards a low carbon economy will affect all Europeans and all sectors of the economy.

Member States, including regions and local communities, will also be affected. In addition there is a Third Country dimension, in particular vis a vis energy supply countries and the relation with international climate negotiations.

2.5. EU's right to act and EU added-value

As regards climate change it is a problem which is trans-boundary. Therefore coordination of climate action both at global and European level is necessary and EU action is justified on grounds of subsidiarity. Articles 191 to 193 of the TFEU confirm and further specify EU competencies in the area of climate change. Many of the policy options have an important internal market dimension and many of the required investments and infrastructures have an important European dimension. Therefore, the objectives can be better achieved by a EU framework for action.

As regards energy, Member States are increasingly interdependent on each other in ensuring secure, sustainable and competitive access to energy. Moreover, the cost of the transition of the energy system will be lower if Member States cooperate in meeting jointly established targets. For these reasons, the energy challenges of the future are clearly on an EU (if not global) scale, and could therefore not be addressed effectively and efficiently through Member State measures alone. Article 194 TFEU specifics the EU's light to act in the energy domain.

Of course, the role of Member State action within this framework will remain crucial and the

J(S While these sectors will be more affected by the specific policies put in place than the overall setting of 2030 targets, the general framework has a significant indirect impact as it sets the relative share of GHG emission reductions to be achieved by each major sector of the economy.

responsibility for continued progress up to 2030 is shared, as demonstrated e.g. in the climate and energy package for 2020. All future EU action in this regard will respect both Art. 192 and 194 of the TFEU. The importance of the principle of subsidiarity becomes especially important when specific policies to meet the overall objectives for 2030 are formulated. Such policies must strike the balance between the need to fully acknowledge differences between Member States (including regional and local aspects) on the one hand, and the need to ensure a level playing-field, cost-efficiency and undistorted competition and markets on the EU level.

3. OBJECTIVES

3.1. General objective

To ensure progress towards:

- A competitive, sustainable and secure EU energy system
- the EU's objective to reduce GHG emissions by 80-95% in 2050 compared to 1990, in the context of necessary reductions by developed countries as a group to limit global warning to below 2°C. if

3.2. Specific objectives

- To provide more predictability and certainty for Member States and investors and reduced regulatory risk in a 2030 perspective.
- To ensure that the EU is post 2020 on track to meet the 2050 GHG emission objective and 2030 milestones as indicated by the 2050 roadmaps.
- To support progress towards a competitive economy, e.g. by supporting the creation of new opportunities for jobs and growth in low carbon and energy technologies and spurring **RDI;** by ensuring that policies ensure the competitiveness of the EU economy; and contribute to affordable and competitively priced energy.
- To improve security of energy supplies, e.g. through energy efficiency, development of low carbon indigenous energy resources, generation adequacy and infrastructure development.
- To achieve an EU position as regards GHG emission reductions which allows the EU to engage actively with other countries in order to achieve an ambitious international climate agreement by 2015.

3.3. Operational objectives

[All objectives in this section will be calibrated at a later stage to ensure coherence between them and what the Commission ultimately will propose, or integrated into the specific objectives.]

The operational objectives for a 2030 climate and energy policy framework are to:

- propose headline target's and aspirational objectives/ indicators] for climate andenergy for 2030.
- outline a consistent, coherent, cost-efficient and fair policy design to progress towards the broader set of policy objectives, including 2030 targets.
- Maintain the integrity of the internal market and providing appropriate investment signals in the power market and competitive pricing of energy.
- develop measures to foster innovation, jobs & growth in the EU and encourage investments in low-carbon and energy technologies
- develop measures to prevent the risk of carbon leakage.
- consider tools for an equitable effort across the EU.

3.4. Coherence with other policies

As outlined, the aim of the initiative is to develop a coherent framework forclimate and energy policies up to 2030. The work continues the integrated approach pioneered with the climate and energy package and taken up in the Europe 2020 headline targets. It builds on the 2050 roadmaps developed under the Europe 2020 Resource efficient Europe flagship initiative. Not many other current policies are characterised by a similar long term perspective, which extends e.g. beyond the multi-annual financial framework 2014 to 2020. In general, coherence with related other policies is therefore addressed when specific issues are discussed, e.g. competitiveness of energy costs links to industrial policy, improvements in air quality and the extent of use of biomass link to environmental policies, certain aspects of renewables and efficiency target and policy design relate to transport policies, security of energy supply links to external policies, including trade policies etc.

should be defined for 2030, if yes at which level and what should be the accompanying legal and policy measures.

Specifically in the energy sector, reducing GHG emissions requires changing the energy mix towards less carbon intensive energy sources and consuming less energy through more energy efficiency and changes in demand patterns. Concrete energy efficiency and renewable energy policies interact with the EU ETS. On the other hand, together with policies to reduce non- C02 emissions energy efficiency and renewable targets are also the principal tools to effectively reduce emissions in the non-ETS sectors. It is important to assess how targets and measures for GHG reductions, energy efficiency and renewable energy interact in 2030 perspective as well as what their effects will be at the time horizon of 2050. Hence the main policy options analysed in this Impact Assessment consist of different combinations of policies, with sub-options where relevant with their effects presented in 2030 and 2050.

At the same time, other indicators or aspirational objectives (if not targets) more directly relating to the competitiveness and security of supply objectives of EU energy policy could be considered in a 2030 perspective. Such indicators and objectives would help to keep track on developments and to provide a good basis for policy initiatives and later a benchmark to measure progress achieved. Such options are discussed in a qualitative way in section [X] and have not explicitly been subject to the scenario analysis, although the scenarios give guidance on some important aspects.

For the sake of consistency, all policy options are compared with the Reference scenario, which is a projection of developments up to 2050 under already agreed policies. The reference scenario will however not materialise on its own. Significant investments will be necessary to meet the 2020 objectives and comply with climate and energy legislation also thereafter. In this sense, the reference scenario could be seen to represent a policy option without additional climate and energy policies than those already agreed upon. It assumes full implementation of existing policies, including the achievement of the renewable energy and GHG reduction targets for 2020 and implementation of the Energy Efficiency Directive, with a continued but gradually decreasing effect post 2020. After 2020, the existing linear reduction of the cap in the ETS is continued beyond 2020. As such the Reference scenario includes already an important combination of GHG, renewable energy and energy efficiency policies up to 2020 and beyond (see also section [X] and annex [X]). These significant achievements of the Reference scenario must be taken into account while identifying the precise value added of the policy options analysed. This is why in the subsequent chapters the impacts made by the policy options will be often presented as changes relatives to the Reference scenario, while comparison with today's situation is equally relevant on many key issues, in particular in so far as such changes are driven by policy.

Various combinations of ambition levels and policy options for 2030 have been defined and analysed through economic modelling, building on the Commission's 2050 Roadmaps but also reflecting a broader range of targets combinations and ambition levels advocated by a number of stakeholders. As much of the current debate centre around potential GHG, RES and EE measures and ambition levels in a 2030 perspective; scenarios for *quantitative assessment* have been defined primarily on this basis. These scenarios are assessed in chapter 5 as compared to the reference scenario to make the key policy interactions transparent. Other aspects and objectives are primarily treated qualitatively in Chapter 5.

The scenarios selected are characterised according to four aspects:

<u>First,</u> the analysis supporting the 2050 Energy and Low Carbon Roadmaps demonstrated that a number of enabling policies are important to be able to meet this long term transformation. These mainly relate to infrastructure development, R&D and innovation and public acceptance of certain technologies. A more detailed description is included in Annex [X]. These enabling policies also reflect that such long term policy low emissions scenarios require a larger effort, with associated costs, in areas such as infrastructure, storage and grids, which are beyond traditional climate policies. Policy scenarios will have to reflect that the implementation of such enabling policies is not a given and depends on different assumptions about the commitment of the EU to fight climate change, improve its energy security and

develop a sustainable and competitive energy system. The further development of 2030 framework is a concrete step towards establishing such longer term commitment. It will also need to be seen to what extent this framework, and the enabling policies that could come with it, will depend on global efforts compatible with the internationally agreed objective to limit atmospheric warming to below 2°C in a 2050 perspective. While these enabling policies are particularly affecting energy system changes closer to 2050, they do start to have an effect as of 2030.

Scenarios reflecting strong long term EU commitment compatible with 2050 objectives therefore include "enabling policies" which facilitate the transition[7], consistent with the Low Carbon Economy Roadmap and the Energy 2050 Roadmap. The enabling setting supporting such scenarios should be understood as efforts across the economy to ensure that the transition towards a low carbon economy in a 2050 perspective go smoothly.

As it is not certain that the "enabling policies" will materialise, policy scenarios excluding such settings also have to be assessed. They relate to less ambitious scenarios which may achieve significant progress in a 2030 perspective, but do not achieve in the longer term the transformation towards a low carbon economy. Analysing scenarios with and without enabling policies can also illustrate the impacts on costs by 2030 and the benefits of implementing such enabling policies.

<u>Second</u>, the scenarios will have to reflect various levels of GHG reductions, with and without the "enabling" policies. The centre around which variations are defined is the 40% indicated by the Low-carbon Roadmap as the cost-efficient milestone for 2030 towards meeting the 2050 objective.

<u>Third</u>, scenarios will have to reflect various levels of ambition for the energy efficiency policies (irrespective of the discussion around a target in this regard). For the purposes of this IA. this has been done with a bottom-up approach, i.e. without predefining any specific savings or efficiency level, but by analysing the impacts of specific measures.

<u>Forth</u>, scenarios will have to reflect various levels (and the absence of) a pre-set renewables target. Without prejudice to the level or sector(s) that such a target could be applied to, the analysis in this regard applies to the gross final consumption, with the aim to identify the differences of scenarios with specific RES targets compared to scenarios where renewables development would be driven by a GHG target.

A large number of scenarios have been analysed, out of which [X] have been retained for more detailed assessment. In line with the abovementioned characterisations, these scenarios can be divided in the following groups:

I. Scenarios to be understood in the context of decarbonisation by 2050, therefore including "enabling policies":

1) Scenarios driven by a GHG target including moderate renewables and energy efficiency policies [pending final agreement]:

   <u>[40% GHG reductions in 2030. with no only moderate RES and EE policies (without any specific target)</u> based on the assumption of equalisation of marginal abatement cost of GHG emissions across the economy through the carbon price in the ETS and simulated "carbon values" representing a least cost approach to reduce GHG emissions in the non-ETS sector without yet defining how this would be achieved (see also section on economic impacts in chapter 5), and a pull effect on RES and EE through carbon pricing.

2) Scenarios driven by a GHG target, a set level of renewables and energy efficiency policies (higher than what would come out under 1) above) [pending final agreement]:

   <u>140% GHG reductions in 2030, ambitious EE policies, but no explicit RES target</u>

   <u>40% GHG reductions in 2030, ambitious EE policies, a RES target for 2030 at 30%</u>

   <u>45% GHG reductions in 2030, ambitious EE policies, a RES target for 2030 at 35%</u>

   These scenarios are based on explicit energy efficiency policies that ensure progress amidst market imperfections and failures rather than simulated "carbon values" (see section 5 below), and 2030 renewable energy targets Simulated through higher 'renewable values' representing a least cost approach to reach a given renewables target without yet defining how this would be achieved.]

II. Scenarios to be understood primarily as a continuation of the 2020 approach to GHG reductions in a 2030 perspective, but not as a step towards reaching 2050 objectives, and therefore not including "enabling policies":

3) Scenarios driven by a GHG target including moderate RES and EE policies [pending final agreement]:

[35% GHG reductions in 2030, with no change of the annual reduction factor in the ETS and only moderate RES and EE policies

40% GHG reductions in 2030. with only moderate RES and EE policies

These scenarios are also solely based on the use of "carbon values" to achieve equalisation of marginal abatement costs across the economy, as scenarios under 1) above but as opposed to the scenarios under 2) above.]

On this basis, the table below gives an overview of the set of scenarios representing combinations of policy options that are assessed [pending final agreement].

Table 1: Scenarios to assess main policy options with respect to targets

Scenario/ Option *[acronyms have to change]*	*GHG 2030 (vs 1990)*	*RES 2030 (% final En. Cons.)*	*EE 2030 (change vs 2030pro[25].)*
Reference scenario setting			
GHG35®w	37%	No pre-set target (25%)	No pre-set target (-22%)
GHG40®	40%	No pre-set target (26%)	No pre-set target (-23%)
Enabling setting			
GHG40	40%	No pre-set target (27%)	No pre-set target (-24%)
GHG40/EE	40%	No pre-set target (26%)	No pre-set target (-28%)
GHG40/ EE/RES30	40%	30%	No pre-set target (-29%)
GHG45/EE/RES35	45%	35%	No pre-set target (-33%)

In addition to these scenarios, the assessment of impacts in chapter 5 also builds on some of the other scenarios analysed in a more horizontal way.

4.2 Options discarded for detailed assessment

All potential scenarios without an explicit GHG reduction target for 2030 were discarded at the outset as there is a broad consensus *on principle* among Member States and stakeholders that such a target is necessary (see annex X), although there are different views on the suitable level of ambition and extent to which this target should be conditional to international developments in the climate field.

All scenarios based on GHG reductions in the EU below 35% and above 45% were discarded at an early stage. The reference scenario itself results in 32% reduction. A 45% reduction is assessed as an upper range taking into account reduction pathways assessed in the Commission's Low-carbon Roadmap as regards the cost-efficient trajectory towards meeting the 2050 objectives.

A scenario driven by very ambitious levels of renewables and energy efficiency, but with a continuation of the current reduction factor in the ETS was analysed but is not evaluated in full detail in chapter 5, primarily as this approach would result in continuing increases of the surplus of allowances in the EU ETS up to 2030 and therefore seriously undermining the future relevance of the ETS in providing the right incentives for low-carbon investment.

Several scenarios including RES shares above 35% were also analysed but not in full detail as such scenarios would result in GHG reductions with more than 45% in a 2030 perspective, or would need e.g. significant displacement of nuclear incompatible with Member State plans or increased coal use, etc. to stay consistent with the GHG reduction range. Moreover, no scenario with predefined RES levels in specific sectors of the economy were analysed, but all scenarios provide information on a sector level which could inform potential discussions on the need or not for renewables targets covering subsectors of the economy.

[25] Same metric as used for the 2020 energy savings target.

No scenario with predefined absolute energy savings objectives for 2030 were analysed in detail as a target-setting in this regard (also considering a potential change to the metric used for comparison) would have to be analysed once the approach to energy savings in a 2020 perspective becomes clear[49]; but all scenarios include various levels of ambition with regard to energy efficiency, giving indications that would be consistent with other parameters and which could feed into discussions on target-setting in this regard on the political level.

No scenario with only GHG and renewables targets, without additional ambitious energy efficiency policies has been retained as the combined scenario GHG target + RES target + ambitious EE policies is a better reflection on potential future policies and their interaction.

4.3. Interaction with international climate policies

To achieve the stabilisation of atmospheric GHG concentrations at a sufficiently low level to be in line with the 2°C objective, IPCC AR4 concluded that on the basis of present scientific estimations, developed countries would need to take a GHG emission reduction target within the range of 80 to 95%, below 1990 levels by 2050[26]. The IPCC did not specify the contributions that individual developed countries or regions would need to bring to the group for achieving this aggregate level of emission reductions of 80% to 95%, nor the emission reductions delivered through access to the international carbon market.

The Impact Assessment accompanying the Communication 'A Roadmap for moving to a competitive low carbon economy in 2050'[27] assessed how much of this target would need to be reduced domestically, to contribute sufficiently to this overall target, assuming gradually equalisation of carbon prices across countries and sectors globally (for more information see section 5.1 of that impact assessment). The Roadmap concluded that the transition towards a competitive low carbon economy in line with limiting temperature increase to 2°C which necessitates strong climate action at the global level), means that the EU should prepare for reductions in its *domestic* emissions by 80% by 2050 compared to 1990, and that a cost effective pathway towards this 80% GHG reduction would require reductions by 2030 of 40% below 1990 levels.

This said, the Roadmap did not explicitly distinguish between unilateral EU action and EU action within the context of a fair and legally binding international agreement, where commitments have to be individually ambitious, fair and in accordance with responsibilities and capabilities; and collectively sufficient to stay on track for the below 2°C objective.

On this basis, two main policy options can be considered:

i) *One* GHG target: no distinguishing between a unilateral EU GHG reduction ambition level and a (higher) level in case EU action is within the context of a fair and balanced international climate change agreement.

ii) *Dual* GHG targets: a unilateral EU GHG reduction ambition level and a (higher) level in case EU action is within the context of a fair and balanced international climate change agreement.

For both options, sub-options relate to the level of the respective GHG targets for 2030 and the role of international offsets in the EU.

4.4. Policy options for meeting targets

In addition to the overall approach and ambition level as regards GHG, RES and EE presented in section 4.1, and 4.3 the 2030 framework should also be as concrete as possible on the approach to meeting such ambition levels. This includes notably the functioning of the ETS, the approach to the sectors not covered by the ETS, as well as the implementation approach to meeting a potential 2030 target for RES and the implementation approach to EE

ETS

[26] IPCC, 4th Assessment Report, Climate Change 2007: Working Group III: Mitigation of Climate Change, chapter 13.3.3 Proposals for climate change agreements, box 13.7.
[27] SEC(2011)288 final

The functioning of the EU ETS was characterised in the last 2 years of phase 2 (2008-2012) by a large build-up of surplus allowances, with the economic crisis resulting in emissions levels below the foreseen cap and the inflow of a large amount of international credits as major causes, resulting in a supply demand imbalance.

To improve the orderly functioning of the carbon market, the Commission has proposed "backloading" (postponing) some of the auction volumes into the later part of phase 3 (2013 - 2020). The proposal is currently discussed by Council and Parliament. While backloading would address the surplus in the short term, it would not affect the structural surplus, which is projected to continue up to and beyond 2020.

To address this, the Commission adopted a Carbon Market Report in November 2012 listing six possible measures for structural reform of the ETS. Three of them are especially important also within a 2030 context, i.e. a revision of the annual linear reduction factor, extension of the scope of the EU ETS to other sectors, and access to international credits. These are therefore options addressed in chapter 5.

Furthermore, up to 2020 specific measures exist in the EU ETS to address carbon leakage. They are: i) free allocation of allowances to sectors deemed to be exposed to high carbon costs and/or global competition, ii) for the most electricity intensive sectors, the possibility for Member States to grant state aid to compensate for indirect impacts on electricity prices, iii) limited access to international credits. Chapter 5 therefore addresses policy options regarding the continuation and form of carbon leakage provisions post 2020.

Sectors not covered by the ETS

GHG emissions reductions in the sectors not covered by the ETS are presently regulated up to 2020 through the Effort Sharing Decision, defining a national target for every Member State.

In a 2030 framework it will need to be assessed if and how the definition of 2030 targets can contribute to the fair distribution of efforts in a cost-efficient manner, in a way consistent with dedicated EU energy efficiency policies, and while safeguarding the internal market and fair competition between Member States.

Furthermore at present the emissions and absorptions from the land, land use and land use change sectors (LULUCF) are not included in the reduction targets in the current Effort Sharing Decision. In this context, Council and Parliament have indeed expressed the request that all sectors should contribute to cost-effective emissions reductions. It needs to be assessed how LULUCF can be integrated into the 2030 framework, taking note of the important role of agriculture, both with respect its large soil based carbon pool, as well as the most important sectoral source for non CO_2 GHG emissions.

Options for meeting a potential RES target

This IA does not provide a detailed assessment of the various means of meeting a potential RES objective in a 2030 perspective, but the main options for general approach are evaluated in a more horizontal manner.

Such options include .   "If

i) Continuation of Member State specific targets and support schemes.

ii) As option i) but with non-discriminatory treatment of renewables coming from other Member States in national support schemes or strong coordination between Member States, possibly under the condition that there is sufficient transmission capacity between the Member States involved, and

iii) A gradual Europeanization of the approach to ensuring progress towards a 2030 objective.

Options for meeting a potential EE target

For reasons referred to in section 5.[X], this Impact Assessment does not define or evaluate in detail potential implementation approaches to meeting a potential energy efficiency / savings target for 2030.

Options for other targets or indicators for aspects relating to competitiveness of the energy system and security of energy supplies

The responses to the public consultation makes clear that many stakeholders consider that targets and objectives for GHG reductions RES shares and EE may be sufficient for ensuring progress towards an environmentally sustainable energy system, but not for progress with regard to the competitiveness of the EU energy system and security of energy supplies; and that other targets or indicators relating to these areas therefore should be established as part of the 2030 framework. Three main options can be envisaged in this regard:

i) No such targets or indicators are set.

ii) Other 2030 targets for other aspects of competitiveness and security of supply are set, and treated in an equal manner as potential targets for GHG, RES and EE.

iii) No other such targets are set, but relevant indicators are defined to keep track of progress over time and to provide a knowledge basis for policy action; potentially associated with aspirational objectives in a 2030 perspective.

Candidates for such indicators are presented in the context of evaluating these options in section 5.X.

5. ANALYSIS OF IMPACTS:

5.1. Options for targets and measures

5.1.1. Methodology

Impacts assessed

This chapter assesses impacts of each of the main scenarios representing the basis for policy options as defined in section chapter 4, supported as appropriate by other scenarios not assessed in full detail. It focuses on the broad impacts of those options, and to a lesser extent on the impacts of specific measures that could be put in place to meet the ambition levels inherent in each of the scenarios V policy options. While specific EE measures in most scenarios including "enabling policies (see chapter 4) are represented in more detail than non- ETS GHG reduction policies and RES policies, where mainly the cost efficient achievement of targets are being considered, an in-depth evaluation of concrete measures to reach yet to be agreed targets and ambition levels has to be left to more specialised IAs once the broad policy directions have been agreed on. The impacts of more strategic choices assessed are:

i) Environmental impacts (see section 5.1.2)

ii) Energy system impacts (non-economic) (see sections. 1.3)

iii) Economic impacts (see section 5.1.4)

iv) Social impacts' (see section 5.1.5)

In assessing these impacts, focus is put on 2030, but an outlook for 2050 is also provided in order to address adequately the long term impacts of the policy choices for 2030. This is particularly important as there are long lead times for energy investments as well as very long life-times for e.g. power plants (20-50 years or more), grids and other energy infrastructure. Much of the current infrastructure and nearly all the new ones constructed based on 2030 policies will still be in place after 2030 and largely also in 2050.

Environmental impacts assessed are primarily those related to GHG emissions, direct land use and various air pollutant emissions. This includes the split of GHG emission reductions across sectors of the EU economy; in particular between the energy system and other GHG emissions, the split between various economic sectors (e.g. electricity generation, transport, residential / tertiary sector, industry and agriculture), as well as the split between GHG reductions in sectors within and outside the ETS at the aggregate level.

Energy system impacts (non-economic) concern notably energy consumption and supply. For the supply side, an important concern is security of supplies which involves issues of managing external dependency - through diversification of fuels, which consequently will enable to diversify production /import regions and transit routes. The assessment of energy system impacts also deals with issues relating to the balance between various energy sources including specific renewables technologies in various sectors, energy consumption and intensities, infrastructure development, import dependency, possible savings in energy imports, structural change to electricity generation, heating and cooling, development of CHP and CCS [and C02 emissions and carbon intensity of power generation]

Economic impacts assessed include such impacts within and outside the energy system, as well on the macro-economic level. Impacts addressed are notably overall system costs and its sub-components (fuel, investments etc.), electricity prices, the ETS price, implicit abatement cost in the non-ETS sector, the role of energy costs for energy intensive industries, etc.; whereas macro-economic impacts focus on GDP impacts as well as an assessment of impacts in a globalised economy on EU energy intensive industries that are subject to international competition, from more ambitious climate and energy policies.

Social impacts assessed are primarily those relating to employment [and distributional aspects and affordability for households, in particular vulnerable households who are particularly impacted by fuel and electricity price increases since due to low income levels they are not as capable to reduce their fuel bills through cost effective energy efficiency investment]. It also includes health impacts related to the reductions of pollutant emissions treated under environmental impacts.

Modelling approach •

All impacts relating to the energy system and important parts of economic impacts and the resulting impacts on C02 emissions are mainly assessed by modelling of various scenarios using the PRIMES model. This analysis is extended to non-C02 GHG and air pollutant emissions by linking the PRIMES and GAINS models along with linkages to more specialised transport modelling (PRIMES-TREMOVE), agricultural and land use models (CAPRI. GLOBIOM/G4M), which also allow covering of impacts on LULUCF emissions. While transport modelling feeds directly into energy system modelling, the GHG mitigation potentials from non-CCA emissions concern mainly activities outside the energy system, and are modelled in a fully consistent way.

A fundamental analytical modelling question relates to the broad strategic choices with respect to a long term policy strategy for which 2030 could be a milestone. As discussed in section 4, the energy and climate modelling with PRIMES, for helping to assess impacts, needs to differ notably with respect to the main long term policy thrust, which influences strongly in the long term how various policies can interact taking account of acceptance issues. As discussed in Chapter 4, energy and climate policy making for 2030 can be embedded in an "enabling policies" or not. The inclusion of these policies assume that the objectives assessed are part of a strong, comprehensive and long term decarbonisation strategy. This would also be facilitated by strong global action. In practice, the enabling policies ensure the availability of necessary infrastructure, progress in R&D and innovation and broad social acceptance of technologies which enable decarbonisation and facilitate the development and deployment of notably renewables and electro-mobility options (see Annex [x] for more information on the differences between reference and enabling policies).

Another important modelling question is the degree of concreteness of policy modelling, i.e. the extent to which GHG and energy consumption reductions in the non-ETS sector as well as the achievement of renewables targets are driven solely by carbon (in the non-ETS), renewable and efficiency values without suggesting how this would be achieved in practice, or more by the simulation of more concrete policies. This aspect has important implications for assessing energy system impacts as well as economic impacts.

Direct comparison between the various scenarios is compounded by substantial differences between them on many dimensions. Differences between scenarios can best be understood through a comparison of pairs of scenarios that differ only with respect to the issue under investigation:

- First, scenarios with *enabling policies* result over time in lower system costs and price impacts. This highlights the benefits and importance of such enabling policies for the transition, in particular post 2030. Until 2030, the impact of the enabling policies are relatively small. So the effect is transparent and results can be compared, Results post 2030, however, are only directly comparable between scenarios with enabling policies, because for all these the same carbon budget constraint consistent with the EU's 2050 climate objective is assumed. In scenarios with Reference setting reductions are not achieved in-line with this long term transformation, which also should be considered in comparing scenarios in a 2030 perspective. Moreover, the EU Reference Scenario 2013 (with which policy options / scenarios are compared), does not include such assumptions about enabling settings.
- Second, and at least as important, scenarios are to various extents stylised to achieve a transformation cost-effectively. The use of carbon values rather than concrete energy efficiency policies in the non-ETS sectors achieve cost efficient GHG reductions which could only be achieved in reality by an extension of the ETS to cover the entire economy[69], while concrete EE measures still would be needed to address market failures; whereas renewable values achieve cost efficient introduction of renewables throughout the EU economy (which may or may not be the case depending on implementation approach). Whereas the EU ETS is a concrete policy tool, achieving set objectives in other sectors and with respect to other targets will require concrete policies that must be put in place to realise these transformations. Scenarios based on concrete EE measures aim to reflect the need for concrete policies that remove barriers to EE due to market failures, split incentives and imperfect information among market actors. On this basis, the use of carbon, renewables and energy efficiency values rather than specific policies may underestimate the cost of reaching set objectives unless the theoretical cost-optimisation can be achieved in reality, through an extensive set of policies that improve the functioning of energy markets, remove the barriers to energy efficiency and facilitate investment in low carbon technologies, such as nuclear and CCS. Comparability between scenarios with more extensive use of such "values" in so far as they do not reflect concrete policies, and those that to a greater extent are based on concrete polices is therefore reduced, in particular as concrete energy efficiency policies are needed to address market failures.

To assess the complex interaction between sectors on the aggregate macro-economic level, the GEM-E3 and the E3MG models are used (see section xxx and xxx), with GEM-E3 being a general equilibrium model and E3MG a macro-econometric model. Both models assess the impact of a 40% domestic GHG reduction in the EU based on the equalisation of marginal abatement costs through the use of "carbon values" and compared to a Reference scenario (based on the PRIMES EU Reference Scenario 2013). This analysis assumes that third countries implement policies to achieve their 2020 pledges in the context of the UNFCCC but do so in a conservative manner. The impacts of more than 40% GHG emissions reductions in a 2030 perspective coupled with potential recognition of international offsets in the ETS are also assessed through these models (see section 5.2). This modelling set up does not allow assessing the impacts of specific renewables objectives or energy efficiency policies beyond those resulting from the "pull-effect" of a GHG target.[70]

[69] Or a carbon tax in the non-ETS sector that would exactly mimic the price movements of the ETS.

[70] These models reduce GHG emissions on the basis of carbon price constraints. This allows assessing different carbon pricing

Social and in particular employment effects are also primarily analysed using the same macro- economic models and scenarios as are used to consider macro-economic impacts, focused on the impact of achieving a GHG target only. Furthermore the E3ME model was adapted to assess next to the achievement of a GHG reductions, also the impact of achieving higher energy efficiency in relation to the building sector and higher renewables penetration, but only limited to the power sector. The quantitative modelling of employment effects is enhanced by other more qualitative means of assessing such impacts, as well as by a dedicated study looking at employment impacts of the scenarios in the Commission's Energy Roadmap 2050.

Qualitative assessment of key aspects

In addition to the quantitative assessment of impacts based on modelling, this Impact Assessment is also based on important qualitative assessments of various potential aspects of the 2030 framework. Such analysis draws heavily from the results of the public consultation launched by the Green Paper, and the extensive analysis of progress made and lessons learned under the 2020 framework (see section 2.[X] and annex [X], Qualitative assessments are particularly important for sections 5.X to Y discussing possible implementation means of meeting set objectives for 2030; as well as for section 5.X discussing options for additional indicators and / or aspirational objectives more directly relating to the competitiveness of the energy system and security of energy supplies.

5.1.2. Environmental impacts

This section first analyses how the overall GHG emission impacts are distributed between sectors covered by the EU ETS and non-ETS sectors currently covered by the Effort Sharing Decision. Then it assesses impacts on GHG emissions other than energy related C02 emissions followed by a summary of sectoral GHG emission impacts. Furthermore this section will assess impacts on emissions and absorptions from Land Use, Land Use Change and Forestry (LULUCF) as well as impacts on air pollution, including health impacts.

ETS vs non-ETS emissions

ETS emissions in 2030 compared to 2005 decrease in reference scenario significantly more than non-ETS emissions, given that the ETS linear reduction factor continues post 2020 under the ETS Directive, while some key policies impacting the non-ETS sectors currently agreed upon do not include such a gradual tightening. Correspondingly, additional decreases in the 35% GHG reduction scenario under reference settings, which re-establishes carbon price equalisation, are significantly higher in the non-ETS compared to the ETS.

Differences between the different 40% GIIG reduction scenarios under enabling policies are significant. In scenarios mainly driven by ETS carbon prices and carbon values in the non- ETS sectors, the additional emission reductions in ETS and non-ETS sectors are (with 11 % and 13% compared to reference) very similar. Lowest additional GHG reductions in the ETS of only 3% are realised in scenarios where non-ETS GHG reductions are achieved mainly through ambitious additional energy efficiency measures, resulting in much higher levels of additional GHG reductions in the non-ETS sectors of up to 18% compared to reference. The scenario results also show that higher levels or dedicated renewables policies typically increase GHG reductions more in the ETS in relative terms, because cost-efficient RES potentials are higher within than outside the ETS (notably in the power sector). A scenario with a RES target of 30% in 2030 adds 4% ETS emission reductions and decreases non-ETS emission reductions compared to a scenario that has only ambitious EE policies. In the 45% GHG reduction scenario shows higher additional reductions compared to reference in ETS as in non-ETS sectors, strongly driven by the 35% RES target.

Nevertheless, if emission reductions in 2030 are compared to 2005, the base year of current EU GHG legislation, they are across all scenarios higher in the ETS sectors than in the non- ETS sectors. The

tools such as emission trading with free allocation or auctioning or simply a carbon tax, and assess the effects of how revenues are used. The tools are less well equipped to assess a whole set of specific energy efficiency policies and have less detail regarding the options for renewables penetration than for instance an energy focussed model like PRIMES, which explains why such aspects were not modelled in GEM-E3 and the E3MG.

policy options that achieve a 40% overall GIIG reduction result in reductions compared to 2005 in ETS of -38% to -43%, further decreasing to -49% in the 45% scenario, and in the non-ETS sectors of-30% to -35%[71]

With regard to 2050 emissions, the scenarios consistent with the 2050 GHG objective (i.e. those with "enabling settings") show rather similar additional emission reductions to reference for the ETS and non-ETS sectors, usually well over 60%. That the 45% GHG reduction scenario shows the lowest additional reductions reflects simply the comparability condition of having the same carbon budget constraint over the entire period up to 2050, so that higher 2030 reductions imply lower efforts later.

Compared to 2005, ETS sector 2050 emission reductions are beyond 85% and still considerably higher than non-ETS sector reductions, which are between 70 and 72%, confirming roughly the dimensions indicated by the low carbon economy roadmap.

Table 2: ETS and non-ETS emissions

Scenarios with enabling policies (compatible with 2050 GHG objectives):

Indicator	**"ETS + Carbon val." 2030/2050**	"**ETS** + concrete **EE** measures + **RES** val." **2030 / 2050**		
	GHG40	GHG40EE	GHG40EE RES30	GHG45EE RES35
ETS sectors (% to reference)	-11/-68	-3/-66	-7/-65	-21/-55
Non-ETS sectors (% to reference)	-13/-61	-18/-64	-16/-64	-18/-62
ETS (% to 2005; Ref: -36/-59%)	-437-87	-38/-86	-41/-86	-49/-81
Non-ETS (% to 2005, Ref: -20/-23%)	-30/-70	-35/-72	-33/-72	-34/-72

Scenarios with reference settings (not compatible with 2050 GHG objectives):

Indicator	**"Reference settings** , ETS + **carbon values"** **2030 / 2030**	
	GHG35	GHG40
ETS sectors (% to reference)	-2/-4	-10/-14
Non-ETS sectors (% to reference)	-10/-23	-13/-25
ETS (% to 2005; Ref: -36/-59%)	-38/-61	-42/-65
Non-ETS (% to 2005, Ref: -20/-23%))	-28/-41	-31/-43

Non-C02 and non-energy related C02 GHG emissions

71 Compared to the scenarios made for the 2050 Low Carbon Economy roadmap, this is a range of reductions in the ETS that is broader and has a lower end (-43 to -48% in the Low carbon Roadmap), while the range of reductions for the non- ETS is a bit smaller and start at higher levels -27 to -36% of the Low Carbon Economy Roadmap. The different lower ends are mainly due to the inclusion of more energy efficiency policies in all 40% scenarios, but also by higher projected oil and gas import prices as in the roadmap, which foster non-ETS emission reductions.

Table 3 shows the expected development of non-C02 GHG emissions and C02 emissions not related to energy or land use. Non-C02 emissions are modelled with the GAINS model, with mitigation cost curves for technical emission reductions beyond reference introduced in the PRIMES model.

In the reference scenario total non-C02 GHG decline by nearly 20% in 2030 compared to 2005. The reduction in agricultural non-C02 GHG emissions, which are more than half of all non-C02 emissions, is 4% in the same period. The reduction in other non-C02 sectors is 36%. In the reference scenario, non-C02 emissions decrease because of EU waste policy, national bans on landfill of biodegradable waste, EU and national regulations to reduce F-gas emissions and national subsidies for anaerobic digesters enabling energy recovery.

The table shows significant further non-C02 GHG emissions compared to reference as well as to 2005 reductions across all policy scenarios. For the scenarios that achieve 40% GFIG reductions, the reduction is lowest in the option with a 30% RES share and ambitious EE policies, with only 32% non-C02 GHG reductions by 2030 compared to 2005. In general reductions are lowest in options that have ambitious EE policies and higher RES targets, given that in these options higher energy savings and energy-related C02 reductions, reduce the need for reductions from non-C02 GHG to achieve the same overall reduction of aggregated GHG emissions. Instead highest reductions are achieved in case of a 40% GHG target only in reference settings, reducing non-C02 emissions by 29% compared to reference and 44% compared to 2005[72]

Agricultural sector emissions follow a similar pattern but reductions are smaller since the potential to reduce emissions at the projected carbon prices is more limited. As a result the reduction of agricultural non-C02 emissions (CH4 and N20) ranges between 19% and 28% in 2030 compared to 2005 for the scenarios that achieve 40% GHG reductions. It should be noted that these emission reductions do not presuppose behavioural changes such as changes in diet, given that GAINS focuses on technical emission reduction options[73] and of course will require the introduction of concrete policies to achieve the reductions now simulated through a carbon price incentive, as e.g. already the case in some of the other non-C02 sectors with the inclusion of industry non-C02 emissions in the ETS and with the currently on-going review of the F-gas regulation, for which estimated 2030 reductions[74] are in line with the cost- effective potential simulated by mitigation cost curves and carbon price incentives. The recent reform of the Common Agricultural Policy contains provisions on greening which could be used by Member States to foster such emission reductions.

Non-energy related C02 emissions are to a large extent (around 75%) covered by the EU ETS, in particular process emissions in the metal, cement and chemicals industries. They decline in the reference scenario by 15% in 2030 compared to 2005, mainly driven by the continuation of the annual reduction factor in the ETS and the projected ETS price of €35 that results from it. Emissions decrease further only in policy options with higher carbon prices resulting from scenarios driven uniquely by a GHG target, with a maximum among the analysed scenarios of 7% compared to reference and 21% emission reductions between 2005 and 2030 in the policy scenario with 40% GHG emission reductions and renewables and efficiency policies as in reference settings[75]. In scenarios with both ambitious RTS and EE policies, the necessary effort to reduce non-energy related Co_2 emissions is lower (as the ETS in total needs to reduce less), reflected in a lower carbon price and carbon value, leading to increasing non-energy Co_2 emissions compared to reference and to stable non-energy related C02 emissions in 2030 compared to 2005.

[72] Typical means to reduce non C02 emissions are farm scale aneaerobic digesters, diet changes for animals and selective breeding to control methane emissions of cows, doubling of control frequency of gas distribution networks and the use of alternatives for F-gases in various application (foams and fire extinguishers e.g.).

[73] A recent study on behavioural mitigation options has shown that relevant behavioural mitigation potentials exist in the food domain, e.g. shifts to a more healthy diet or reduced animal protein intake (Faber et al. 2012, see) However, there are a number of barriers to realise these potentials with specific policies, including limited EU competences. The additional potential which could be addressed by specific policies in the EU is estimated at 40 Mt C02eq.

[74] SWD(2012) 364

[75] A scenario with 45% GHG reductions and moderate RES and efficiency policies shows larger non-energy related C02 emission of 9% compared to reference and 22% compared to 2005,

Table 3: Non-C02 and non-energy related GHG emissions in the EU28 in 2030 (MtC02eq.).

	2005	2030						
		Refe rence	-35% GHG (ref settings > :	-40%; GHG * (ref settings)	-40% GHG	-40% EE	-40% GHG EE 30% RES	-45% GHG EE 35% RES
Total non-C02	903	728	-22%	-29%	-26%	-22%	-17%	-19%
Non Agriculture	422	268	-19%	-24%	-24%	-19%	-19%	-21%
Agriculture	481	460	-28%	-38%	-29%	-28%	-15%	-17%
Non-energy related C02	280	240	-6%	-7%	-7%	12%	18%	17%
		GHG emission reduction vs 2005						
Total non-C02		-19%	-38%	-44%	-41%	-38%	-33%	-34%
Non Agriculture		-36%	-53%	-62%	-56%	-48%	-48%	-49%
Agriculture		-4%	-25%	-28%	-28%	-24%	-19%	-21%
Non-energy related C02		-15%	-20%	-21%	-20%	-4%	0%	0%
Carbon price (€/tC02)		35 (ETS only)	35	53	40	22	11	15

Source: GAINS, PRIMES, CAPRI

Summary of sectoral GHG emission impacts

The reference scenario shows for 2030 rather different sectoral GHG emission trends if compared to 2010 emissions. The power sector (including district heating and CHP) is projected, with around 40%, to experience the biggest reduction, which reflects the availability of substantial mitigation potentials put into practice under the continuation of the decreasing ETS cap and the continued increase of renewables. Reductions of around 25% are seen in the residential and tertiary sector (mainly heating and cooling of buildings and some other fuel uses, given that emissions of electrical appliances and lighting are indirect and hence covered under the power sector) and in the broad group of non-agricultural non-C02 sectors. In the transport, industry and agriculture sectors the reductions between 2010 and 2030 projected in the Reference Scenario are below 10% (for a detailed explanation see Annex x on the reference scenario). This has to be taken into account when changes compared to reference in 2030 are assessed.

Ensuring equal marginal carbon abatement costs across the economy via the introduction of carbon values in non-ETS sectors, as in the 35% GHG scenario, leads in 2030 to additional reductions compared to reference in the agriculture, other non-C02 and to a lesser extent the residential and tertiary sector, while the other sectors only reduce very slightly compared to the Reference Scenario. Sectoral reduction differences in 2030 between reference settings and enabling policies are small.

The key insight is that sectoral emission impacts of the additional policy options vary considerably depending if the main drivers of emission reductions are carbon prices, energy efficiency measures or are combination of them with RES targets. This can be illustrated by comparing the different 40% GHG reduction scenarios. The highest additional reductions compared to Reference Scenario are projected to occur with regard to non-C02 GHG emissions outside the energy system, and in the residential and tertiary and agriculture sectors. In scenarios where carbon prices and carbon values are the main driver of change, also the power sector reduces emissions significantly, and in those scenario more than the residential and tertiary sector. In scenarios primarily driven by explicit energy efficiency measures, the additional reduction efforts of the power sector become the smallest of all sectors. Explicit RES targets results in additional reductions in the power sector, leading to lower GHG reductions in all non-C02 emissions. Industry and transport remain across all scenarios the sectors with the smallest additional reductions compared to reference, with a stronger contribution of transport in the scenarios with ambitions EE policies

In a 2050 perspective, the differences between different scenarios consistent with the 2050 GHG objective (i.e. those with enabling policies) reduce considerably. The power sector shows then the biggest additional reductions compared to reference across the scenarios, followed by the buildings sector (residential & tertiary). Transport, industry and other non- C02 sectors also contribute significantly.

Table 4: Sectoral GHG emission impacts

Scenarios with enabling policies (compatible with 2050 GHG objectives):

Indicator	**"Carbon val." 2030/2050**	**"Concrete EE measures" 2030/2050**		
All indicators are presented as % increase/decrease in comparison to the Reference	GHG40	GHG40EE	GHG40EE RES30	GHG45EE RES 35
Power generation, CHP, district heating	-18/-92	-3/-85	-12/-82	-36/-62
Industry (energy + processes)	-6/-60	-5/-61	-6/-64	-11/-58
Residential&tertiary (mainly buildings)	-11/-71	-26/-80	-23/-80	-25/-79
Transport	-2/-S9	-9/-60	-9/-60	-9/-61
Agriculture (non-C02)	-24//xx	-19/xx	-15/xx	-17/xx
Other non-C02 sectors	-29/xx	-28/xx	-19/xx	-21 /xx

Scenarios with reference settings (not compatible with 2050 GHG objectives):

Indicator	"Reference settings, carbon values" 2030 / 2030	
All indicators are presented as % increase/decrease in comparison to the Reference	GHG35	GHG40
Power generation, CHP, district heating	-3/-5	-15/-28
Industry (energy + processes)	*-21-6*	-6/-10
Residential&tertiary (mainly buildings)	-9/22	-14/-26
Transport	0/-1	0/-3
Agriculture (non-C02)	-24/xx	-24/xx
Other non-C02 sectors	-23/xx	-38/xx

GHG emissions related to land use and land use changes (LULUCF)

LULUCF is at present a net sink in the EU. In the reference scenario this LULUCF sink for the EU28 is expected to gradually decline from 239 $MtC0_2$ in 2005 to around 216 $MtC0_2$ in 2030. This is the result of different trends among which the development of the forest sector is the most important one, notably overall timber demand (energy & non-energy) increases with 17% between 2005 and 2030/ Energy wood demand increases by some 40% in the same period. For further details see Table 5 which shows the impacts of representative policy options as estimated with the PRIMLS model.

The 35% and 40% GFIG reduction with moderate EE and RES policies do not show a significant increase in demand for biomass for energy purposes or biofuels compared to reference. Neither does the scenario with 40% GFIG and ambitious EE. Instead demand for biomass for energy purposes increases notably in the scenarios with higher RES target. The option with 45% GHG reduction 35% RES share and very ambitious EE policy sees demand increase to 223 Mtoe.

In order to assess specifically the impact on the LULUCF scenarios of 40% and 45% GHG reductions, with and without RES target are assessed, [xxx Results at present focus on 45% GHG scenario with RES and EE, 40% GHG scenarios are still being processed, so text will be updated later to include them and impacts are expected to be smaller than the higher ambition scenarios already assessed.]

In the 45% GHG option biomass demand increases with 8 Mtoe, all met through domestic production, whereas in the 45% GHG with 35% RES and ambitious EE demand increases with 46 Mtoe of which 34 Mtoe are met through domestic production and the remainder with increased imports.

Table 5: Biomass demand for energy products

	2005	2030	
		Reference	GHG 45% RES 35% EE
Domestic production biomass feedstock (Mtoe)	87	194	231
of which: forestry	33	48	51
of which: crops	4	65	92
of which: agricultural residues	12	16	17
of which: waste	28	47	49
of which: other (i.e.black liquor)	9	17	20
Net imports biomass feedstock (Mtoe)	1	4	5
Processing losses of feedstock (Mtoe)	2	40	45
Bioenergy production (Mtoe)	85	157	191
Net imports of bioenergy (Mtoe)	0	21	32
Demand biomass(Mtoe)	85	178	223

Source: PRIMES

The estimated changes in domestic production of biomass where then used as input in the GLOBIOM/G4M model to assess the impacts on the LULUCF sink.

What is the most notable outcome from these projections is that most of the additional demand for biomass production in the EU is met through increases in production from fast rotating plantation wood, classified as a crop, and only by small increases in harvest from existing forest area. The land use changes to meet the increased biomass demand are represented in Table 5. The main change in 2030 is the increase in cropland area compared to the reference, which is made available for plantation wood (cropland for perennials), even though clearly overall also for other crops more marginal land is taken in production.

Table 6: Land use changes EU28 (million hectares)

Areas	2005	2030	
		Reference	GHG -45% + RES35% + EE
Forest land	138	145	145
Cropland	100	105	107
Of which: cropland for perennials (including plantation wood)	0	7	12
Of which: cropland other crops	100	98	95
Grassland	62	62	62
Wetlands, settlements, other land	73	75	75
Other Natural Vegetation	73	59	57
TOTAL LAND	446	446	446

In the reference the sink decreases to 216 MtCO2. In the 45% GHG with ambitious EE and RES policies it decreases by 7 MtCO2 to 209 MtCO2 compared to the reference. In the latter scenario, increases of harvest removals of forest wood to meet biomass demand (from 619 million m in reference to 623 million m), translates in reduction of the forest management sink from -127,5 MtCO2 in reference to -116,4 MtCO2. This negative effect on the forest sink can be partially compensated by the increases in plantation wood (perennial crop, not harvested every year) which has a positive effect on the amount of carbon stored in the soil compared to other crops normally planted on cropland. Therefore cropland emissions in that case are lower compared to the reference and as a result the net impact of this option on the LULUCF sink is limited compared to the reference.

Table 7: Impact on LULUCF sink

	2005	2030	
		Reference	GHG -45% + RES35% + EE
Total harvest removal (tm)	529443	619071	629888
of which forest wood for energy (thousand m^3)	76768	108069	119280
Plantation wood used for energy (thousand m^3)	136	98959	169614
LULUCF ($MtC0_2$)	-239.1	-215.5	-209.1
Of which:			
Total forest land	-315.7	-209.8	-198.4
of which forest management	-340.2	-127.5	-116.4
of which afforestation/reforestation	-26.6	-94.6	-94.4
of which deforestation	51.1	12.3	12.3
Total cropland	35.7	14.5	9.9
Total grassland	5.9	-4.9	-5.0
Harvested Wood Products	-9.4	-60.0	-60.4
Wetlands, settlements, other land	44	45	45

Source: GLOBIOM/G4M, based on PRIMES biomass demand

To conclude, overall the impacts on the LULUCF sink seem limited if increased demand for bio-energy is met largely through increased use of energy crops, and in part due to increased demand for biomass being met by imports for the scenario that achieves 35% RES. This would imply a significant expansion of cropland for bio-energy (increase of cropland with some 10%). The eventual impact on GHG emissions would depend in part also on crops used and farming practices and will need further analysis. This will have knock-on effects on other policy domains, including impacts on available land for other purposes. If in reality increased demand is rather met through increased imports, or if increased demand is rather met through higher rates of harvest removals of forest wood, the negative impact on the sink, be it directly or indirectly through Indirect Land Use Changes, might be higher as estimated in this assessment, while at the same time the expansion of cropland could be more limited.

Air Pollution

Three scenarios were assessed. The 40% GHG (with moderate EE policies and 30% RES target) as well as both the 40% and 45% GFIG with very ambitious EE policies and level of RES target. For this analysis the same methodology, based on the GAINS model was used as in the impacts assessment for the roadmap to a competitive carbon economy. Table 8 shows that the different options to reduce GHG emissions in 2030 all reduce emissions of PM2.5, SO2 and NO_x compared to the reference scenario, but that such reductions are significantly larger in scenarios including ambitious EE policies and higher RES targets , reducing fossil fuel consumption and combustion.

The reduction in air pollution has positive impacts on human health. The option with moderate EE and RES policies reduces the number of life year lost due to lower PM2.5 concentrations (a result of lower PM2.5, S02 and NOX emissions) by some 4 million in 2030. Whereas the option with ambitious EE and RES policies reduces impacts of PM2.5 concentrations by 11 million life years lost in case of the 40% GHG + RES 30% +EE and by even 13 million for the GHG45% + RES35%+EE. Similar positive impacts occur also for mortality due to ozone, but are very small in relative terms.

The reduction in mortality can also be valued economically. The table shows that a 40% GHG reduction with moderate EE and RES policies reduces health damage due to air pollution by €4.8 to 11.1 billion compared to the reference[35]. This is mainly from lower concentrations of PM2.5 that result from the

35 The range results from the use of a high and low valuation of mortality (value of life year lost), also used for the Thematic

joint impact of reduction in S02, NOX and PM2.5 emissions. In the options with ambitious EE and RES policies, reductions in health damage are higher: 12.6 to 29.2 billion €/year for the 40% GHG + RES 30% +EE and by even 13 million for the GHG45% + RES35%+EE even by and by €15 to 34.6 billion/year for the GHG45%RES35%+EE option.

Because of lower emissions air pollution, costs to control them are lower as well, €2.4 billion to €7 billion/year depending on the option assessed.

In addition forest, catchment and ecosystems areas where acidification and euthrophication exceed critical loads are reduced. Other morbidity (health effects) and damage to crops are also reduced (e.g. lower ground level ozone emissions), but these benefits have not been quantified in this impact assessment. Furthermore, damage to materials, crops and sensitive ecosystems (due to acidification, excess nitrogen deposition and ground level ozone) are also expected to be reduced. The forest area not exposed to acidification exceeding critical loads is expected to be 1800 km^2 higher in case of the scenarios with 40% GHG reductions with moderate EE and RES policies, but this area increases to 4590 km^2 GHG40% for the option with 45% GHG reductions, 35% RES and ambitious EE policies. A comparable improvement occurs for the area of natural ecosystems exposed to excessive nitrogen loads. For the option with 40% GHG reductions with moderate EE and RES policies, the exposed area decreases with 2171 km^2 whereas for the option with 45% GHG reductions, 35% RES and ambitious EE policies this area reduction increases to 4287 km2.

Table 8: Impacts on air pollution and air pollution control costs in 2030 (change compared to the reference)

2030	GHG -40%	GHG -40% + RES 30% + EE	GHG -45% + RES 35% + EE
S02 (kton)	-103 »	-145	-269
NOX (kton)	-193	-326	-371
PM (kton)	-26	-98	-92
Health impacts (mln life years lost due to PM2.5)	-4.2	11.0	-13.0
Premature deaths ozone (cases per year)	-233	-450	-455
Monetary damage health PM2.5 (bn€/yr). Low estimate	-4.8	-12.6	-15.0
Monetary damage health PM2.5 (bn€/yr). High estimate	-11.1	-29.1	-34.5
Monetary damage health ozone (bn€/year): low estimate	0.01	-0.03	-0.03
Monetary damage health ozone (bn€/year): high estimate	-0.03	-0.06	-0.06
Reduction pollution control costs (bn€/yr)	-2.4	-4.1	-7.0
Increase (monetized part of the) benefits-low (€bn/yr)	-4.8	-12.7	-15.0
Increase (monetized part of the) benefits-high (€bn/yr)	-11.1	-29.2	-34.6
SUM reduced pollution control & damage reduction (€bn/yr)	7.2 to 13.5	16.7 to 33.3	22 to 41.5

Source: IIASA (2013) based on GAINS for emissions, health impacts and air pollution control costs (in €2010). Benefit valuation uses valuation of mortality (value of life year lost) used for the Thematic Strategy on Air Pollution €57000 to 133000 per life year lost

In conclusion, all policy options analysed come with very significant environmental and health benefits, in particular those including ambitious EE policies and RES ambition levels.

Strategy on Air Pollution.

5.1.3. *Energy system impacts*

Total primary energy consumption[36] is reduced in all scenarios analysed. While consumption reductions happen under all scenarios (5 to 15% in 2030 and 12 to 32% in 2050 in comparison to the Reference scenario) much higher reductions are achieved in scenarios with the enabling setting, especially if they are coupled with ambitious or very ambitious energy efficiency policies. While, the renewables targets obviously change the relative importance of each energy source in the system, they also result in further reductions in primary energy consumption thanks to high efficiency of RES in electricity production. Importantly, the reduction in primary energy consumption does not come from a decrease of GDP or value added of different sectors but primarily from technological improvements in industrial processes in power generation and on the demand side (also coupled with change in consumers' behaviour).

Final energy' demand declines in a similar manner as primary energy consumption with similar differences in magnitude of the decreases brought by the enabling setting, energy efficiency policies and RES targets. The residential and tertiary sectors demonstrate the strongest reduction (in comparison to the Reference) as these are targeted by a majority of energy efficiency policies and which can most easily switch fuels. The relative share of electricity increases in the final energy demand especially for the scenarios with specific RES targets.

As a result of reduced primary energy consumption, **energy intensity** of the EU economy is reduced under all scenarios and most significantly under 45 GHG target coupled with very ambitious EE policies and REs target. In scenarios resulting from 40% GHG reductions in 2030, energy intensity is the most reduced in scenarios which contain additional RES target and energy efficiency policies.

The policy scenarios demonstrate significant difference with regard to the consumption of various **energy sources.** As regards solid fuels (notably coal), already in 2030 their consumption in absolute terms declines substantially under all scenarios achieving 40% GHG in 2030 except those with increased EE. This is not the case after 2020, with the GHG only scenario seeing increased **solid fuels consumption** as of 2040 with significant CCS development counterbalancing the associated C02 emissions. Conversely, the scenarios with renewables targets result in the highest decreases of solid fuel consumption by 2050 (up to 38% 2050 in comparison to the Reference scenario). The consumption of **nuclear energy** resulting from economic modelling for all countries allowing use of this technology remains stable or decreases in 2030 in all policy scenarios, ranging from a 0.25% reduction under the scenario driven by a 40% GHG target to strong decreases in scenarios with renewables targets (as much as -59% for the scenario with a 45% GHG target coupled with strong EE policies and 35% RES target in a 2030 perspective. In 2050 the corresponding range is from plus 17% (scenario driven by 40% GHG reductions in 2030) to minus 58% (scenario including RES target).

Oil consumption decreases in all scenarios, but much faster in those with enabling setting reflecting the facilitation of transport electrification with such enabling policies. **Natural gas** consumption also declines in all scenarios (in general less sharply than oil) but slightly more under the scenarios featuring renewables targets, as the displacement of gas by renewables is not fully compensated by the increased need for gas in backup generation to intermittent renewables. Consumption of **RES** grows in 2030 in most scenarios except in case of a 35% GHG reduction target and of a 40% GHG target coupled with strong efficiency and moderate RES policies. The growth is naturally the strongest under scenarios with explicit RES targets. In 2050, there is strong RES growth across all scenarios in enabling settings. The changes in **relative shares in the energy mix** largely follow those in absolute levels of consumption although some trends are less clear-cut because of the shrinking total primary energy consumption.

Concerning specifically **RES consumption**[37]**,** their growth is to large extent driven by the GHG targets (present in all scenarios analysed) but it can be further boosted in presence of the dedicated RES targets. Enabling setting presupposing the necessary grid improvements, also facilitate the RES penetration. Finally, increased RES strengthens EE through increased efficiency, but impacts the energy mix.

[36] Gross Inland Consumption according to Eurostat convention

[37] The development of RES is measured witli RES share in final energy consumption - in line with the 2020 RES target.

Without a dedicated RES target for 2030, the pull effect of GHG reduction is projected to lead to RES shares ranging from 26 to 27% in 2030 and from 49 to 51% in 2050. While RES shares increase alongside the ambition on GHG reductions, it has to be noted that higher ETS prices needed for more ambitious GHG cuts would not only trigger more RES investment, but also lead to fuel switching and more energy efficiency investment. The overall RES share in 2030 would translate into RES-E shares between 46 % and 49%. RES-FI&C develops in parallel with the overall RES share, while RES-T would reach 13 to 14%.

A 30% RES target on the basis of 40% GHG reduction would entail a RES-E share of 53-54% in 2030. Again RES-H&C rises similar to overall RES, while RES-T shares increase would be negligible in comparison to scenarios without RES target. The presence of ambitious energy efficiency policies results in some reduction in RES penetration mostly in electricity and to smaller extent in heating and cooling.

A 35% RES target in the context of 45% GHG cuts would in 2030 lead to a two third contribution from RES to electricity (RES-E share: 66-68%), slightly over one third RES contribution to heating and cooling demand (34-35%) while RES-T shares increase would be negligible in comparison to scenarios without RES target.

The changes in the energy mix translate accordingly in the **power generation capacity** installed for different fuels: by 2030 all scenarios sec a reduction in the consumption of solids, except the scenarios with ambitious EE policies. By 2050 this reverses with only the scenario driven by a 40% GHG target, seeing power generation capacity for solids increase, with mitigation occurring through CCS. Similarly this scenario is also the only one that sees not significant decrease for nuclear by 2030 and in increase in comparison to the Reference scenario by 2050. On the other hand, capacity clearly increases for renewables in all scenarios with enabling settings, whereas for gas it decreases for all scenarios. Regarding the **investment in power generation capacity,** there are no such clear trends as for installed capacity since investments have very long time horizons and only partially react to polices and changing fuel prices. Investments in power generation from renewables increase strongly in all scenarios in enabling setting whereas investments in gas-fired power generation decrease for all of the scenarios. For the solids, no specific pattern can be distinguished apart from the strong decline in investments under all scenarios featuring RES target.

Closely linked with energy consumption and energy mix is the issue of import dependency. **Net energy imports** decrease significantly (in comparison to the Reference) for all scenarios already in 2030 but the trend is even more pronounced in 2050. The decreases are more significant for scenarios under the enabling setting since these are based on the assumption of adequate development of infrastructure for domestically produced renewables. While the scenario driven by a 40% GHG target by 2030 demonstrates a reduction of net imports by 7% in 2030 and 44% in 2050 (compared to the Reference scenario), the scenario combining 40 % GHG reductions, 30% RES and ambitious energy efficiency policies brings 16% decrease in net imports in 2030 and 53% in 2050. The scenario with the highest ambition for GHG, RES and energy efficiency measures target makes even more pronounced difference in 2030 but towards the end of the project period the differences with other scenarios become smaller reflecting the fact that all scenarios in enabling setting reflect the carbon budget constraint.

Import dependency is in the short term much less affected by policy choices and there are little differences between scenarios in 2030, also with respect to the Reference scenario and present levels. In 2050, however, the Reference scenario and scenarios in reference setting have still 55-57% import dependency whereas all other scenarios decrease it to below 40%, due to the higher use of renewables across scenarios and the lower use of mainly imported fossil fuels. While RES targets foster the domestic production of renewable energy sources they also reduce overall energy consumption because of their high efficiency (including compared to other indigenous sources). Consequently, no lower import dependency is demonstrated in scenarios with explicit RES targets compared with those without as import dependency is measured in relative terms.[38]

As regards the net **imports for specific fuels,** oil and gas imports decline for all the scenarios under the enabling setting throughout the projection period. Solids imports decline for all scenarios but in a most pronounced manner in the scenarios with RES targets, which represent much stronger reductions of the fossil fuel import bill. On this basis, it is clear that while RES does not necessarily impact import dependency as such, it has a positive impact on the imports of fossil fuels in absolute terms. RES imports grow' slowly throughout the projection period for all scenarios and there are no additional increases in imports that would be accountable to RES targets.

Net energy import decreases translate into the savings in the **energy fossil fuel imports bill.** Whereas savings (calculated as a cumulative value over 20 year period) are very limited for scenarios in reference settings, with enabling settings they range from € 189 to 547 bn in 2030 and from 3,234 to 4,394 bn in 2050. These savings indicate that rather than paying for exports, the EU economy can have these resources invested either in technology development or new assets or education all of them contributing to creation of job and growth.

Table 1: Impacts on primary energy consumption in 2030 and 2050.

[38] This is also in part due to some replacement of nuclear with RES, and as nuclear energy generated on EU soil is considered domestic irrespectively of the origin of Uranium etc.

Scenarios with enabling settings (compatible with 2050 GHG objectives):

Indicator		"Carbon val." 2030 / 2050	"Concrete EE measures" 2030/2050		
	Reference	GHG40	GHG40EE	GHG40EE RES30	GHG45EE RES35
Total primary energy consumption decrease in comparison to the Reference	n.a.	-5/-15%	-10/-27%	- 11/-31%	- 15/-32%
Energy intensity: primary energy to GDP (1995= 100) Reference in 2010 = 80	54/41	51/35	48/30	48/28	45/28
Consumption of :					
- Solid fuels	n.a.	-11/+ 7%	+3/-12%	-1/-38%	-29/-38 %
-Oil	n.a.	-3/-62 %	-11/ -63 %	-10/ -63%	-11/ -64 %
- Natural gas	n.a.	-13/ -37%	-21/ -48 %	-27/ -54 % '	-29/ -54 %
- Nuclear	n.a.	0/ +17 %	-8/-3 % -	-22/-41 %	-59/ -58 %
- Renewables	n.a.	+4/ +44 %	-4/ -20%	+9/ +40 %	+30/+45 %
(increase/decrease in comparison to Reference scenario)					
RES Overall	24/29%	27/51%	26.51%	30/59%	35/62%
RES-E	43/50%	47/53%	46/55%	53/70%	66/76%
RES- H&C	24/27%	26/49%	26/46%	31/54%	35/54%
RES-T	12 14%	13/68%	14/68%	15/72%	16/75%
Net energy imports decrease in comparison to the Reference	n.a.	-7/ -44%	-14/-50%	-16/-53 %	-19/-53 %
Import dependency (net imports to primary energy consumption)	55/57%	54/37	53/38	52/38	52/38
Fossil fuels import bill savings in bn € TO (cumulative 20 year savings from imports in comparison to the Reference) in 2011-2030/2031-2050	n.a.	189/3381	399/4062	447/4243	547/4394

Scenarios with reference settings (not compatible with 2050 GHG objectives):

Indicator •		"Reference settings, carbon values" 2030 / 2030	
	Reference	GHG35	GHG40
Total primary energy consumption decrease in comparison to the Reference	n.a.	-2/ -5%	-4 / -5%
Energy intensity (1995= 100) Reference in 2010 = 80	54/41	52/39	51/39
Consumption of;			

EN

EN

- Solid fuels -Oil - Natural gas - Nuclear - Renewables	n.a. n.a. n.a. n.a. n.a	-3/-4 -1/-4 -4/-10 *-31-7* -1/-2	-16/-8 -2/-4 -6/-14 -3/-4 +0.5/+1
RES Overall	24/29%	25/30%	25/31%
RES-E	43/50%	43/51%	45/51%
RES- H&C	24/27%	24/28%	26/30%
RES-T	12/14%	12/16%	12/17%
Net energy imports decrease in comparison to the Reference	n.a.	*-21-5*	-4/-7 $
Import dependency (net imports to primary energy consumption)	55/57%	55/56	55/55 ...
Fossil fuels import bill savings in bn € '10 (cumulative 20 year savings from imports in comparison to the Reference) in 2011-2030/2031-2050	n.a.	46/382	83/592

Energy related C02 emissions decrease between 9 and 14% in 2030 and by 66-68% in 2050 (in comparison to the Reference) for the scenarios resulting in 40% GHG reductions in 2030. Only very small increases are achieved for the scenarios under the reference setting, causing the EU to miss the 80% GHG reduction objective for 2050, as discussed above. In the most ambitious scenario in terms of GHG, RES and energy efficiency measures the decreases are even higher already in 2030 but in line with carbon budget constraints, they become more moderate towards the end of the projection period.

As regards **carbon intensity of power generation,** there are important improvements in all the scenarios, including in the Reference scenario. The strongest improvements occur already in 2030 under the most ambitious scenario in terms of GHG, RES and energy efficiency measures, while other scenarios achieve much greater improvements post-2030 perspective.

The annual electricity grid **cost** (grid maintenance and investment) is already significant in the Reference scenario and differences with regard to Reference are visible only for scenarios with RES targets. As renewable energies require more sophisticated infrastructure (electricity lines, smart grids, storage facilities, etc.), the grid costs are higher under the scenarios featuring RES targets by 4-13 % in 2030 and by 6-11% in 2050 in comparison to Reference scenario.

Among **impacts on technologies,** a key impacts to be observed is the increase observed for **shares of combined heat and power (CHP),** which increase substantially already in 2030 under scenarios with RES targets (between 2 to 3 percentage points compared to Reference) whereas they stay almost constant for other scenarios. This is due to synergies between the increased penetration of renewable energies and co-generation which mainly uses biomass as a feedstock. In 2050, however, the CHP shares decline (in comparison to the Reference) for all scenarios as there is increasing competition for biofuels/biomass feedstocks in transport. The sharpest decrease happen under scenario driven by a 40% GHG target for 2030. Concerning **CCS development,** the development is very slow up until after 2030 in all scenarios but the one driven by a 40% GHG reduction target in 2030 (+ 77% compared to the very low level for Reference in 2030). Post 2030 the most significant deployment happens under the scenario driven by a 40% GHG target for 2030, partly because under carbon pricing as main driver solids coupled with CCS become a cost effective option to mitigate C02 emissions, also reflected in the higher share of coal in the fuel mix under that scenario. Towards 2050, CCS deployment increases quite significantly in all scenarios, except scenario driven by 35% GHG in 2030. The CCS share in 2050 is significantly lower in scenarios with RES targets.

Table 2 Other energy system impacts

Scenarios with enabling settings (compatible with 2050 GHG objectives):

Indicator	**"Carbon val." 2030 / 2050**	**"Concrete EE measures" 2030 / 2050**		
All indicators are presented as % increase/decrease in comparison to the Reference	GHG40	GHG40EE	GHG40EE RES30	GHG45EE RES35 -
Energy related C02 emissions decreases	-9/-67	-11/-68	**-14/-68**	-22 -65
Carbon intensity of power generation	-15/ -92	+3/ -85	-7/-81	-29/-61
Annual electricity grid cost	+2.7/-0.4	r0.7/-3.0	+3.9 +5.8	+10.3/+10.9
CCS indicator (% of electricity from CCS) (difference in p.p.)	0/+8	0/+4	0/+1	0/-4
CHP indicator (% of electricity from CHP) (difference in p.p.)	0/-2	0/-2	+2/-1	+3/0

Scenarios with reference setting (not compatible with 2050 GHG objectives):

Indicator	**"Reference settings, carbon values" 2030/2030**	
All indicators are presented as % increase/decrease in comparison to the Reference	GHG35	GHG40
Energy related C02 emissions decreases in comparison to the Reference	-3/-6	-8/-12
Carbon intensity of power generation	-1/-1	-12/-23
Annual electricity grid cost	-0/-1.2	+1.0/-1.0
CCS indicator (% of electricity from CCS) (difference in p.p.)	0/0	0/3
CHP indicator (% of electricity from CHP) (difference in p.p.)	0/0	0/-1

5.1.4. *Economic impacts*

5.1.4.1. Economic impacts in the energy system

As explained in section 2.[X], the EU Reference scenario 2013 projecting the consequences of already adopted policies as well as developments largely unrelated to policy shows until 2020 an increasing ratio of total energy system cost to GDP, from 12.8 % in 2010 and still at 14.2 % in 2030, and then decreasing to 12.6 % in 2050. This development reflects rising energy import prices, the need to replace ageing energy infrastructure and the extension and enhancement of network infrastructures and other investment costs in the framework of already agreed policies; while the benefits of this investment in terms of fuel spending is more tangible in the longer term. The policy scenarios evaluated all show higher energy system costs up to 2030 and beyond. Compared to EU Reference Scenario 2013, energy system costs in policy scenarios compatible with 2050 objectives (i.e. those with enabling settings) are in the year 2030 0.15 to 0.84 percentage points higher compared to GDP (see box X). These additional increases are smaller than those resulting under the reference scenario itself. This said, differences between policy scenarios and the reference scenario as regards the *average* annual system costs over the period 2011 to 2030 are small in relative terms, though differences exist between policy scenarios. In 2050 all policy scenarios show significantly higher total energy system costs compared to GDP than the reference scenario. with 1.65 to 3.18 percentage points.

The modelling results of the various scenarios compatible with 2050 objectives (i.e. those with "enabling settings") suggest that such system cost increases both for 2030 and 2050 are the highest in the scenario with a 45% GHG reduction in 2030 (see table [X]). Moreover, the level of ambition as regards renewables and energy efficiency policies can also impact system costs[39] while at the same time reduce compliance costs related to the ETS itself (and have a positive impact on e.g. the fossil fuel trade balance; see section X below). Costs are in part higher in the scenarios with ambitious EE and RES because the achieved levels of EE and RES penetration are higher than those achieved in the scenarios focusing only on GHG reductions, as well as due to the method of modelling more concrete policies to achieve GHG and energy consumption reductions or on a "carbon value" in the non-ETS to find the theoretical least cost combination of energy efficiency, fuel switching, RES and CCS penetration, nuclear energy etc and the extent to which the scenarios assume completely functioning market for energy efficiency improvements through price signals, lack of regulatory and market barriers and sufficient incentives for people and companies to invest, (see section 5.1).

The modelling results also show synergies between vigorous RES and EE policies. Adding a specific renewables target (higher than what otherwise would have resulted) to a comparable scenario without such a target has a very low impact on cost increases in relative terms (see box X). In other words, the benefits from additional RES targets in terms of local employment as well as domestic investment expenditure rather than outflows of income for fossil fuel imports having positive growth and further employment effects come a little additional energy system costs [to be confirmed / verified]. In addition, there are important interactions between the two areas, with higher energy efficiency resulting in lower energy consumption, which directly impacts the share of renewables (which is measured as a percentage of final energy

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[39] A scenario resulting in 40% GHG reductions in 2030 based on very high ambition level of both RES and EE but no changes to the ETS reduction factor (not shown in table X) would result in even higher system costs (X percentage points higher in 2030 and X higher in 2050 than in EU Reference Scenario 2013), as many abatement and efficiency options in the ETS sectors with relatively low cost would not be taken advantage of.

consumption). Strong energy efficiency measures can therefore *themselves* contribute to increased shares of renewables because of reduced need for additional new renewables development.

The *components* of energy system costs differ substantially across policy scenarios: Energy Purchases (including fuel, steam and electricity costs) are significantly reduced in all scenarios, most notably in scenarios with explicit EE policies and RES targets, while investment costs increase, again more notably in scenarios with explicit EE policies and RES targets (see box X). This is due to the higher levels of EE and RES achieved in these scenarios, as well as the approach to how policies are modelled. Furthermore, energy investments in e.g. the residential sector increasing property values because of their improved energy performance (for which the benefit is captured in the model through lower fuel costs) with an amount that would correspond to some 40% of the cost of investments in energy efficiency in the residential sector[55].

These indications should be put in the context of the EU's deteriorating trade balance for fossil fuels (see section X below). While the EU possesses significant reserves of some fossil fuels, in particular coal, reduced fuel costs would positively impact the EU's trade balance and retain funds in the EU economy. Moreover, while higher investment needs add to system costs, investment costs for the "buyer" will be revenue for the "seller", i.e. for sectors and companies providing technologies and solutions to reducing emissions, improving energy efficiency, deploying renewables, etc. In an increasingly open world economy, part of this revenue will go companies outside the EU, but such investments have greater potential for driving jobs and growth in the EU than fuel imports, in particular due to the local nature of much energy efficiency investment, renewables installation, etc. and the industrial leadership the EU companies still have in terms of energy efficient and low-carbon technology (see also social impacts section xxx).

Table X: Energy system costs and sub-components

Scenarios with enabling settings (compatible with 2050 GHG objectives):

Indicator		"Carbon values" 2030 / 2050	"Concrete EE measures" 2030 / 2050		
	Reference	GHG40	GHG40EE	GHG40EERES30	GHG45EE RES35
Total system cost (excl. auct. and disut.) as % of GDP (2010 value: 12.76%)	14.03/ 12.30	14.18/13.96	14.57/15.25	14.56/15.35	14.87/15.48
Total system cost (excl. auct. and disut.) as % of GDP increase compared to Reference in % points	n.a.	0.15/1.65	0.54/2.95	0.54/3.05	0.84/3.18
Average annual system costs (excl. auct. and disut.) in bn € TO (av. 2011- 2030/av. 2031-2050)	2,067/2,520	2,069/2,727	2,089/2,881	2,089/2,891	2,102/2,925
Average total annual energy purchases difference compared to Reference in bn € TO (av. 2011-2030 / av. 2031-2050)	n.a.	-18/-192	-34 / -339	-31/-319	-23 / -309

[1] BIO Intelligence Service. 2013. Energy performance certificates in buildings in their impact on transaction prices and rents in selected EU countries. Cited at:

Total average annual investment needs compared to reference (in bn 6 TO) (av. 2011-2030/av. 2031-2050)	n.a.	38/239	59/365	63/384	93 / 384
		5/58	18/122	18/122	22/118
Industry		25/79	40/175	34/183	47/176
Residential and tert.		2/61	2 / 5 9	2 / 5 9	2 / 7 1
Transport		4 / 1 5	1 / 1	3 / 6	5 / 1 1
Grid				5 / 1 3	1 8 / 8
		3 / 2 6	- 2 / 7		
Generation and boilers					

Scenarios with reference settings (not compatible with 2050 GHG objectives):

[55] Constant €.

Indicator		**"Reference settings, carbon values"** **2030 / 2030**	
	Reference	GHG35	GHG40
Total system cost (excl. auct. and disut.) as % of GDP (2010 value: 12.76 %)	14.03/12.30%	14.16/12.63%	14.23/12.71%
Total system cost (excl. auct. and disut.) as % of GDP increase compared to Reference in % points	n.a.	0.13/0.33	0.20 0,11
Average annual system costs (excl. auct. and disut.) in bn € '10 (**av.** 2011- 2030/av. 2031-2050)	2,067/2,520	2,073/2,569	2,074/2,590
Average total annual energy purchases difference compared to Reference in bn € '10 (av. 2011-2030 / **av.** 2031 -2050)	n.a.	-87-58	-8 -65
Total average annual investment needs compared to reference (in bn € TOWav. 2011-2030/av. 2031-2050)	n.a.	19/30	30/37

Source: PRIMES 2014.

The total investment needs will obviously differ between various sectors of the economy, with the most pronounced additional needs especially in the residential sector (25 to 47 bn € in scenarios with enabling settings) but also in industry. The EU Reference scenario 2013 projects significant investment needs in both transport and the energy sector up to 2030 and beyond, but in a 2030 perspective there are no significant changes in relative terms. Post 2030, investment needs in the transport sector increase very significantly, in large part relating to electrification. Additional investment needs for industry compared to EU Reference Scenario 2013 range from 5 to 22 bn € '10 per year on average over the two decades until 2030[56] in the scenarios with enabling settings, the upper number representing the scenario resulting in 45% GHG reductions in 2030. Investment needs in industry are also more pronounced in scenarios with ambitious EE measures because they foresee the introduction of best available technologies for all industries, in particular compared to scenarios solely based on carbon and efficiency values.

[56] Constant €.

Other important economic impacts directly affecting all energy consumers are impacts on electricity prices[40], the ETS price and the abatement cost in the non-ETS sectors presented in Box X below. The significant increases in electricity prices already under the Reference scenario (31% increase in real terms until 2030, compared to 2010) are described in Annex [X] , with important drivers being the impact of rising energy import prices of all fossil fuels by 40% and more up to 2020, the need for strong necessary infrastructure investment to replace obsolete capacity and extend the grids, as well as agreed policies to achieve the energy and climate objectives of the package. Electricity price changes compared to EU Reference Scenario 2013 in the policy scenarios resulting in 40% GHG reductions in 2030 are small and range from 1.8 to minus 0.7 percent in the year 2030. The positive reducing impact on electricity prices from ambitious energy efficiency policies[41] - both in a 2030 and 2050 perspective is noticeable, with price projections for 2030 lower than in EU Reference Scenario 2013. The analysis suggests, assuming cost-efficient deployment of RES across the EU, that adding an explicit renewables target of 30% in 2030 already including ambitious EE policies would lead to somewhat higher electricity prices reflecting impacts on investment needs for deployment of new capacity and adaptation of the electricity system[42] that overcompensate for the low operational costs of most renewables. However, differences in 2030 compared to EU Reference Scenario 2013 among scenarios resulting in 40 % GHG reductions in 2030 are small. Without ambitious EE policies, the impact of higher RES penetration on electricity prices would be higher, reflecting the need for more RES deployment to ensure a specific share if energy consumption is higher.

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. Under EU Reference Scenario 2013, the ETS price is expected to attain 35 €/tC02 in 2030 and 100 in 2050. In the policy scenarios, it is expected to attain between 11 and 53 E/tC02 in 2030, depending on the specific scenario (see box X). In a 2050 perspective, a continuation of the approach to 2030 would result in 84 to 255 E/t/C02, depending on the scenario. Scenarios based on more ambitious and explicit energy efficiency policies and higher ambition levels for renewables than those that would result from carbon pricing demonstrate a *significantly lower* ETS price compared to scenarios driven by a GHG target, reflecting the positive contribution of both renewables and energy efficiency to emission reductions in the ETS sectors, in particular in the power sector (both directly and indirectly through lower electricity consumption), as well as, driven by ambitious efficiency policies, shifting emission reduction efforts from ETS to non-ETS sectors to attain the same overall GHG reduction. Higher levels of renewables and energy efficiency than those resulting from scenarios driven by a GHG target will therefore have a containing impact on the ETS price and compliance cost, but at the same time significantly reduce incentives from the ETS itself for e.g. a switch in power generation to less C02 intensive fuels, introduction of CCS etc.

Energy related costs (including operational and energy intensive capital costs) for energy intensive industries compared to their value added are projected to increase from some 38 % in 2010 to 44% in the Reference scenario and some 44 to 46 % in 2030 in the policy scenarios, with relatively small differences between them and also in comparison to EU

5' Fossil fuel prices do not depend on the policies quantitatively assessed by the modelling and are therefore exogenous in the modelling.

41 Reflecting both efficiency gains in power generation and the impacts from lower demand.

42 E.g. backup-capacity to intermittent generation, smarter grids accommodating decentralised generation, storage needs etc.

Reference scenario 2013 in that time perspective. In a 2050 perspective, this ratio is projected to increase significantly under the policy scenarios, but significantly less in the scenarios bases solely on carbon and efficiency values.

Box [X]: Electricity and carbon prices, energy related costs for energy intensive industries

Scenarios with enabling settings (compatible with 2050 GHG objectives):

Indicator		"Carbon val." 2030/2050	**"Concrete EE measures"** 2030/2050		
	Reference	GHG40	GHG40EE	GHG40EERES 30	GHG45EERES 35
Avg. electricity price incr. compared to 2010 (%)	31 /30	33/36	30 / 33	32/43	46/47
Average electricity price change compared to ref. (%)	n.a.	1.8/4.7	-0.7/2.2	1 1/10.1	11.3 7 12.7
ETS carbon price (€/tC02)	35/100	40 / 264	22/158	11/152	14/85
[Non ETS carbon value (€/tC02)]	0 / 0	40 / 264	22/158	11 /152	14/85
[Average Renewables value (€/ MWh)]	34/16	34/15	34/15	56/36	134/46
[Average energy efficiency value (€/ toe)]	181/95	184/604	693/2018	693/2018	793/2285
Implicit carbon price non- ETS (€/tC02)	0 / 0	40 / 255	22/151	11/139	15/84
Energy costs / value added in energy intensive industries (%) (2010: 38.2%)	43.9 / 45.4	44.5 / 59.7	45.6/ 75.2	44.6 / 74.4	46.0 / 73.1

Scenarios with reference settlings (not compatible with 2050 GHG objectives):

Indicator		**"Carbon values" 2030 / 2030**	
	Reference	GHG35	GHG40
Avg. electricity price incr. cmprd to 2010 (%)	31/30 %	31/31 %	35/34%
Average electricity price change compared to ref. (%)	n.a.	0.3 / 0.4 %	3.2/2.8%
HTS carbon price (€/tC02)	35/100	35/100	53/152
[Non ETS carbon value (€/tC02)	0/0	35/100	53/152
[Average Renewables value *(€/* MWh)]	34/16	34/15	34/15
[Average energy efficiency value (6/ toe)]	181/95	181/137	209/111
Implicit carbon price non- ETS (€/tC02)	0/0	35/100	53/152

Energy costs / value added in energy intensive industries (%) (2010: 38.2%)	43.9/45.4	44.0/45.3	45.2/47.6

Source: PRIMES 2014.

It shall be noted that long term projections for e.g. electricity prices and ETS prices but also other indicators are associated with a significant degree of uncertainty, and are sensitive to projected GDP and production levels and the resulting impacts on energy consumption. Electricity price projections, as other energy modelling output, are based on the assumption of a perfectly functioning internal energy market and that prices reflect all actual costs plus a required rate of return (not more and not less) for generation, transmission and distribution and other electricity system costs such as electricity storage [and X and Y],

5.1.4.2. Overall GDP impacts

Based on the modelling approach presented in section 5.1.1, the impact on GDP in 2030 from various scenarios has been assessed. The analysis focuses on the GHG led scenario producing 40% GHG reductions in 2030 based on carbon values in the non-ETS sector [JUSTIFY]. Section 5.2 that assesses the impact of higher targets in the context of an international agreement, assesses also the impact of a higher GHG reduction.

In all scenarios presented in this section, it is assumed that third countries do not take measures beyond the pledges they made at present in the context of the UNFCCC. Some consideration on impacts related to action by third parties, or the impact of conditional targets in case of a global agreement in-line with limiting global climate change below 2°C, are assessed in section 5.2.

In assessing macroeconomic impacts, as well as sector specific impacts and employment impacts in subsequent sub-sections, the assumptions made about carbon pricing throughout the economy are important. In the modelling-setup used, potential negative impacts on GDP from the ambition levels assessed in this Impact assessment are significantly contained and at times even reverted, if carbon pricing is achieving the same cost of GHG emissions throughout the economy, and if the revenues from this carbon pricing would be used to lower labour costs. Such carbon pricing could in principle only be achieved by extending the ETS to cover the entire EU economy or by applying a tax at a level of the current ETS price level to all sectors outside the ETS. The Commission has proposed[102] to amend energy taxation in a manner to incorporate carbon pricing. Section 0 also discusses the impacts of extending the scope of the ETS to other sectors. Moreover it is clear that due to low price elasticity of energy' demand in many sectors that would be subject to such a C02 tax - together with other market failures and imperfections, such a C02 tax would need to be accommodated with policies directed at remedying these issues, as discussion in section xxx.

Table 9 gives an overview of the projected GDP impacts based on the GEM E3 model. As regards the GHG-lead scenario resulting in 40% GHG reductions, it projects loss of between 1% and 0.45% of GDP depending on the approach to carbon pricing in the non-ETS sectors and the use of auctioning in the ETS. Negative impacts are more limited if carbon pricing is applied throughout the economy (i.e. via ETS or carbon tax) and if revenues are used to lower labour costs. This confirms previous assessments[103], that carbon pricing can achieve more positive macro-economic outcomes, if revenues from these carbon pricing tools are used in a manner beneficial for the entire economy, e.g. if tax revenues are used to reduce labour taxation costs, and thus improve competitiveness across the economy.

[102] COM(2011) 169/3, Proposal for a Council Directive amending Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity

[103] See for instance the Impact Assessment accompanying A Roadmap for moving to a competitive low carbon economy in 2050, SEC(2011) 288 final.

Table 9: GEM E-3 projections of GDP impact of a 40% GHG reduction compared to the Reference scenario

Auctioning in ETS	Only Power sector	Only Power sector	Only Power sector	All sectors ETS
Tax in the Non ETS sectors	No	No	Yes	Yes
Recycling method for revenues from carbon pricing	Subsidy for consumers	Labour cost reduction	Labour cost reduction	Labour cost reduction
GDP % change compared to reference				
	-0,45%	-0,40%	-0,21%	-0,10%

Source: GEM E3, JRC, IPTS

The E3MG and E3ME modelling tools were also used to simulate impacts of the scenarios with "enabling setting", compared to the reference scenario (where GHG emissions only reduce by 32% in 2030). With recycling of auctioning used towards lowering labour costs (which is not assumed in reference), impacts on GDP in the scenario led by a 40% GHG target based on carbon values of a higher emission reduction would be limited. Extended auctioning to all sectors in the ETS and introducing taxation in the Non ETS could actually result in a limited positive impact increasing GDP compared with the reference.

Table 10: E3MG projections of GDP impact of a GHG led scenario resulting in 40% GHG reductions in 2030 compared to the Reference scenario

Auctioning in ETS	Only Power sector	All sectors ETS
Tax in the Non ETS sectors	No	Yes
Recycling method for revenues from carbon pricing	Labour cost reduction all sectors	
GDP % change compared to reference		
Gross Domestic Product	0,0%	0,2%

Additional modelling using E3ME model was carried out in order to assess the impact on the GDP and employment of the energy efficiency policies. The differences between scenarios in terms of GDP are small but positive (see Table 11).

Table 11: E3ME projections of GDP impact for 2030 compared to reference of scenarios based on concrete EE policies rather than theoretical carbon values

	GDP (€2005m)	2030 change compared to reference
Reference	15631346	
GHG40EE	15716872	0.55%
GHG40EERES30	15702597	0.46%
GHG45EE RES35	15714010	0.53%

5.1.4.3. Sectoral impacts

The GEM E3 model was also used to assess impacts of a step up to 40% GHG reductions on production of industrial sectors associated with relative high energy needs and exposed to international competition and what the role is of free allocation or auctioning.

Normally, the GEM E3 model assumes that the ETS companies optimise profits by fully taking into account the opportunity cost of freely allocated allowances when setting the prices of the goods they sell. This is also assumed in microeconomic theory a profit optimising strategy. The product price thus includes the carbon price even for those allowances that companies received for free. This modelling set-up is the base case in GEM E3, including in the reference scenario where auctioning is assumed only in the power sector. This modelling set-up is also reflecting allocation systems where the free allocation is fixed for an indefinite period, determined by a one-off historic grandfathering.

But not all industries agree that this behaviour correctly describes what takes place. Some, certainly the energy intensive sectors exposed to outside competition, claim that they do not engage in such type of price-setting, when they receive allowances for free. They claim they see free allocation rather as a compensation for the costs of the introduction of a carbon price on emissions which they do not include in the pricing of their goods. This type of behaviour rather focuses on keeping production volumes and market share high. This behaviour could also reflect a situation where future allocation does depend on production decisions today. Examples can be closure rules that reduce or stop free allocation when production decreases of closes down and rules for capacity expansions and new entrants. Furthermore also if periodic updating of free allocation (on the basis of benchmarks and updated production figures) takes place, production decisions today will impact future allocation. In such systems companies may have an incentive to maintain or even increase production, considering they know that this will be reflected in the future in terms of the amount of free allocated allowances in the next period.

For a discussion to what extent free allocation is at present fixed or flexible based on production in the ETS, see annex xxx.

To assess the impact of auctioning or free allocation in the scenario driven by a 40% GHG reduction target and carbon values, both modelling set-ups reflecting different company behaviours are modelled in GEM E3. On the one hand, it is assumed that companies include opportunity costs of freely allocated allowances in their price setting, and on the other hand it is assumed that companies do not include the opportunity cost of freely allocated allowances.

Table 12 gives the results of the set of modelling runs that assume companies behaviour towards free allocation is to not include opportunity costs in their prices whereas Table 13 gives the results that assume that companies do include opportunity costs. These assumptions are also implemented each time in the Reference. Furthermore for the assessed policy scenarios it is assumed that labour costs are reduced if carbon pricing is generated.

In Table 12 three scenarios are compared to Reference:

- Full auctioning in the ETS, no taxation in the Non ETS.
- Only auctioning for the Power sector, free allocation for other sector in the ETS, no taxation in the Non ETS

	Reference	Scenario 1	Scenario 2	Scenario 3
Auctioning in ETS	Only Power	All sectors	Only Power	Only Power
Free allocation	No	No	Sectors other than Power	Sectors other than Power
Tax in the Non ETS sectors	No	No	No	Yes
Change in 2030 production compared to reference				
Ferrous metals	/	-6,1%	-1,6%	-0,1%
Non ferrous metals	/	0,2%	-0,5%	1,4%
Chemical Products	/	-1,1%	-0,4%	0,8%
Non metallic minerals	/	-4,5%	-0,8%	-0,2%

The sector seeing the largest relative increase in production if allowances are allocated free of charge is the ferrous metals sector with 4.5%, higher production with free allowances (comparing scenario 2 versus 1), followed by the non metallic minerals with an improvement of 3.7% compared to a scenario with no free allowances.

Two effects are at play, first companies receiving free allocation are inclined to increase production compared to auctioning because they do not need to include the cost of the allowance in their price setting and they want to maximise volume, whereas with auctioning this incentive does not exist and they actually will include the cost for an allowances in their price. Furthermore, due to the volume increases in production, also emissions increase in those sectors if no additional action would be taken. In order to meet the target, additional emission reductions in the power sector need to be realised [104], or increased abatement efforts in the industrial sector

[104] In the policy scenarios, the energy mix in the power sector is fixed and based on the power sector energy mix of the PRIMES scenario for a 40% GHG reduction. Additional emission reductions in the power sector need to come from reductions in demand for electricity.

need to be undertaken which actually results in an overall higher carbon price in case of free allocation compared to auctioning (where this incentive to increase production does not exist). Furthermore this increased price generates increased carbon revenues which results in higher revenue recycling and subsequent lower labour costs. But this effect is less important. A sensitivity analysis performed on scenario 2, recycling auctioning revenue to subsidising consumer spending rather than lowering labour costs, only lowers the beneficial impact of free allocation on average for these sectors by 0.045%. Only the Non ferrous metals sector seems negatively affected in scenario 2 with free allocation compared to the situation with auctioning, with higher carbon prices having a higher impact on this sector, potentially also due to increased electricity price impacts.

Overall all sectors benefit in scenario 3 from the increased revenues from taxation in the non FTS sectors, as the modelling set-up assumes that this would result in higher reductions in labour costs and the resulting positive impact on overall cost structure of these sectors.

Table 13 instead gives results of the set of modelling runs that assume companies include the opportunity costs of free allowances in their prices to ensure profit maximisation. 3 scenarios are compared to Reference:

- Only auctioning for the Power sector, free allocation for other sector in the ETS, no taxation in the Non ETS
- Full auctioning in the ETS, no taxation in the Non ETS.
- Full auctioning in the ETS, taxation in the Non ETS

Table 13: Impact of a 40% GHG reduction in 2030 on energy-intensive sectors production assuming companies that receive free allocation, incorporate the opportunity cost in their prices.

	Reference	Scenario 1	Scenario 2	Scenario 3
Auctioning in ETS	Only Power	Only Power	All sectors	All sectors
Free allocation	No	Sectors other than Power	No	No
Tax in the Non ETS sectors	No	No	No	Yes
Change in 2030 production compared to reference				
Ferrous metals	/	-3,3%	-2,8%	-1,9%
Non ferrous metals	/	-0,1%	0,6%	1,8%
Chemical Products	/	-0,6%	-0,1%	0,7%
Non metallic minerals	/	-2,8%	-2,6%	-2,3%

Here the impact of free allocation compared to auctioning (scenario 1 compared to scenario 2) is in the opposite direction of those seen in Table 12, with production actually decreasing in case of free allocation. The reason for this is that in both scenarios, companies incorporate the value of an allowance in their price, and thus price setting is identical,*be it with auctioning or free allocation. Rather the difference in impacts has a macroeconomic reason, with auctioning and subsequent revenue recycling leading to higher economic output (see also section 5.1.4.1), improving output also in the energy intensive industrial sectors. Also in this run, all sectors benefit from increased taxation in the non ETS, lowering all sectors labour costs and improving competitiveness of the energy intensive industrial sectors.

It seems from the above results that if the market situation does not allow sectors to incorporate opportunity costs of free allocation, but rather use the free allocation to maintain and maximise production volumes, then the impact of 40% GHG reductions combined with auctioning on their total production is notably negative, compared to a situation with free allocation. On the other hand if many sectors would behave in this manner, then carbon prices will be somewhat higher in case of free allocation compared to auctioning (which is negative for sectors sensitive to indirect impacts on electricity prices due to increased carbon prices).

Instead if companies do incorporate the cost of free allocation in their price setting, then there is little direct impact on their production from the choice between free allocation and auctioning, and indirectly, through an improved macroeconomic outlook, auctioning might even increase their production volume. Of course this depends to what extent auctioning revenue is recycled in a manner that improves overall economic efficiency.

The above analysis indicates that the impact of auctioning and/or free allocation on industry differs substantially dependent on the behaviour adopted. It is likely that for different industrial sectors and products, different levels of cost pass through exist. A good understanding of cost pass through based on empirical evidence is therefore crucial to elaborate carbon leakage rules that provide adequate safeguards but avoid over-compensation of industry for costs recovered in the market in case of a 40% GHG reduction target.

For a more in-depth assessment of policy design issues regarding free allocation and auctioning and the impact on carbon leakage in a 2030 framework, see section 5.5.

5.1.5. Social impacts

Social impacts analysed in this section focus on employment and distributional effects (including notably affordability of energy for vulnerable customers) Section 5.1.5.1 starts with the macro-economic analysis of employment impacts. Section 5.1.5.2 then looks at more sectoral level detail, focussed on the power sector and impacts of increased energy efficiency measures. Finally, section 5.1.5.3 addresses the findings on affordability of energy, with a focus on vulnerable customers.

5.1.5.1. Macro-economic assessment of employment impacts.

The assessment is based on a number of macro economic modelling tools.

One modelling tool, E3ME, was adapted to look at the impact of a 40% GHG reduction target as well as ambitious energy efficiency and renewables policies. Also the GEM-E3 model tool was used to look at the impact of options achieving a 40% GHG reduction only, but was not used to assess impacts of additional EE and RES policies and targets.

E3ME

The **E3ME model** in adapted form[105] was applied to analyse the impacts on employment of both the GHG target and combinations of EE and RES policies.

This model projects that compared to reference, the scenario led by a 40% GHG reduction in 2030 would create on the aggregate level around 0.7 million additional jobs (645000) and the scenario based on 40% GHG reduction, ambitious explicit EE policies and a 30% RES target would generate 1.25 million additional jobs in a 2030 perspective, compared to the Reference scenario (see Table 14). The selection of these two scenarios is without prejudice to general appreciation of the various scenarios presented in section xxx.

Aggregate employment effects mask greater patterns of structural change at sectoral level because of the restructuring processes taking place. At sectoral level investments in renewable energy power generation capacity and energy-efficient equipment and technologies create jobs in basic manufacturing, engineering and transport equipment, utilities and construction, and their supply chains. On the other hand, extraction industries are negatively affected in the GHG 40% scenarios. This impact is more moderate in the scenario with ambitious energy efficiency and 30% RES, due to higher reductions in oil and gas and less so in coal than in the scenario with moderate EE and RES policies.

[105] In order to be able to reflect impacts of targets other than only GHG reductions, but without losing the benefits of macro-economic modelling across sectors, the E3ME model was adapted. Firstly the power generation mix was treated as exogenous in E3ME and adapted to the results of the PRIMES reference and two 40% GHG reduction scenarios, i.e. one with moderate energy efficiency and renewables policies and one with ambitious energy efficiency and renewables policies achieving 30% RES. Secondly also the increased energy efficiency investments generated by the PRIMES model for the different projections are introduced in E3ME, and matched by a resulting reduction in energy savings in those sectors. Thirdly, the model still optimises GHG reductions across sectors, taking into account that with higher EE and RES penetration, carbon prices and subsequent revenue recycling decreases. The auctioning revenues are assumed to be transferred to private citizens in Reference (only assuming auctioning for the power sector). In the policy scenarios it is assumed that also taxation in the non ETS sectors is introduced, and that this pays for additional investments in EE and RES. Any remaining revenues are transferred to private citizens. In case of a 40% GHG reduction and ambitious EE and 30 % renewables, revenues from auctioning and taxation are not sufficient to cover all the additional investments, and are therefore assumed to be financed by private citizens' capital.

Table 14 Employment impacts in 2030 by sector, E3ME

2030 employment	'000s of persons			% change compared to reference	
	Reference	GHG 40%	GHG 40% + EE + 30% RES	GHG 40%	GHG 40% + EE + 30% RES
Agriculture	9391	9402	9407	0,1%	0,2%
Extraction Industries	500	479	498	-4,2%	-0,4%
Basic manufacturing	14839	14913	14944	0,5%	0,7%
Engineering and transport equipment	15277	15367	15429	0,6%	1,0%
Utilities	2280	2301	2308	0,9%	1,2%
Construction	16599	16708	16890	0,7%	1,8%
Distribution and retail	35314	35348	35452	0,1%	0,4%
Transport	9411	9455	9471	0,5%	0,6%
Communications, publishing and television	20307	20384	20440	0,4%	0,7%
Business services	41048	41225	41293	0,4%	0,6%
Public services	66735	66797	66814	0,1%	0,1%
Total employment	**231701**	**232379**	**232947**	**0,3%**	**0,5%**

Additional modelling using the E3ME model for the scenarios with ambitious EE and RES policies was carried out but now assuming that carbon pricing in the form or auctioning in the ETS for the power sector and taxation in the non ETS is used to lower labour costs. The differences between scenarios in terms of GDP and employment are small but positive (more employment with 31% and even 34% primary energy savings than under reference) and are mainly due to lower carbon prices from EE and RES, which under the modelling assumptions would lead to lower C02 tax revenue and the corresponding lower reduction of labour costs explaining the difference of impacts on employment than presented in Table 14.

Table 15: F.3ME projections of employment impact for 2030 compared to reference of scenarios achieving 40% GHG reductions with additional policies for EE and RES

	Employment (thousands of persons)	2030 change compared to reference
Reference	231861	
GHG40EE	232132	0.12%
GHG40EERES30	232081	0.09%
GHG45EE RES35	232075	0.09%

GEME3

Looking at employment impacts also by applying the GEM E3 model primarily to assess the economic impacts of reducing GHG emissions by 40% (see sections 5.1.4.2 and 5.1.4.3 above) provides a complement to the E3ME as it also reflects the impact from various implementation approaches to carbon pricing and the ETS (see Table 16), but does not assess the impact of more ambitious EE and RES policies.

Negative employment impacts in some sectors are smaller for scenarios with more carbon pricing through taxation in sectors outside the current ETS. With the assumption that the associated revenue is used to lower labour costs (e.g. thorough lower employer's social charges), overall employment effects can be positive compared to reference in case of full auctioning and carbon taxation in the non ETS, gaining in total 430.000 jobs in 2030 perspective.

Sectors typically gaining are those that manufacture equipment. Sectors typically being affected negatively are the metals sectors, whereas employment impacts in other energy intensive industrial sectors are smaller or even positive (primarily due to decreases in labour costs, provided this is what carbon tax revenue would be used for).

The modelling with GEM E3 confirms what other economic literature typically indicate, i.e. that increasing the tax level on resource use and reducing it on e.g. labour could have a beneficial impact on growth and employment. Therefore a tax shift from labour towards CO_2 tax (in the non-ETS sectors) may reduce the cost of the climate policy compared to cases where this shift is not applied, and even result in positive GDP and employment effects on the aggregate level, underlining the importance for Member States to use revenues from such potential C02 taxation in a targeted manner.

Table 16: GEM E-3 projections of employment impacts of a 40% GHG reduction compared to reference

Auctioning in ETS	Only Power sector	Only Power sector	Only Power sector	All sectors ETS
Tax in the Non ETS sectors	No	No	Yes	Yes
Recycling method for revenues from carbon pricing	Subsidy for consumers	Labour cost reduction	Labour cost reduction	Labour cost reduction
2030 Employment change compared to reference				
% change employment	-0,61%	-0,44%	-0,02%	0,20%
Million of jobs				
Million of jobs	-1.33 mio	-0,96	-0,04	0,43
Ferrous metals	-4%	-4%	-3%	-2%
Non ferrous metals	0%	0%	2%	2%
Chemical Products	-1%	-1%	0%	1%.
Non metallic minerals	-3%	-3%	-3%	-2%

Source: GEM E3, JRC, IPTS

5.1.5.2. Sectoral analysis related to employment

In addition to the macro-economic modelling in the previous section, a dedicated employment study was conducted that of selected sectors. It focused on employment impacts of additional investments in the power sector (covering coal, oil, gas, nuclear, wind, solar, biomass)[106] and retrofitting of energy efficiency equipment in buildings (e.g. houses, flats) and non-industrial buildings (e.g. public buildings, offices). This analysis focuses on key sectors involved in the transformation towards lower GHG emissions. It attempts to estimate how many jobs would be created directly by these investments.[107]

Table 18 provides estimates of the employment effects in number of jobs generated with capital investments made that year according to PRIMES data. On this basis, the reference scenario sees investments that are the equivalent of 750.000 jobs per annum. Additional employment in the two policy scenarios analysed over this period is some 219,000 to 304,000 jobs, illustrating the positive impact of both ambitious EE policies and a RES developments at the aggregate level.

The biggest increases in employment result from changes in energy efficiency requirements in the residential and tertiary sector. Employment generated by these investments is 49% and 67% higher than in the Reference. The employment changes due to increased investments in the power generation sector are smaller but positive on the aggregate level, with losses in oil, gas and coal power plants and nuclear power (the latter only in the scenario with ambitious EE measures and a 30% RES target).

It is to be noted that no job estimates are given for operational expenditure, and thus the impact is not assessed of employment due to for instance increased demand for biomass, decreased demand for fossil fuels or

[106] It does not include impact on operational expenditure in the power sector and the resulting job changes.

[107] The methodology applied includes the following steps: 1) A breakdown is made along the value chain of capital investments according to supply sector. For instance, when investing 1 million € in a wind plant, x% goes to engineering, y% to turbine manufacturers, z% to grid connection, etc. 2) For each part of this value chain the resulting labour impact in the supply sector is identified. For instance, a million spend on engineering services generates x man years of work for the engineering firm. 3) Based on (2) and (3) direct jobs generated per million € of capital investment in wind, coal, etc are estimated. 4) Using the capital investment data from PRIMES, total jobs due to capital investment in the power sector and for energy efficiency are estimated. This is done for the Reference and two policy options, i.e. the -40% GHG target with moderate energy efficiency and renewables policies and the one with ambitious energy efficiency and renewables policies achieving 30% RES.

maintenance of power plants (be it fossil fuels or renewables).

Table 17: Jobs associated with investments in the power sector and energy efficiency, 2011-2030

Average annual employment 2011-2030 related to investments	Reference	GHG 40%	GHG 40% + EE + 30% RES	Change compared to Reference			
				GHG 40%		GHG 40% + EE + 30% RES	
	('000)	('000)	('000)	('000)	% change	('000)	% change
Nuclear	46	47	28	1	2%	-18	-40%
Wind	152	170	183	18	12%	31	21%
Solar	69	72	74	3	4 %	5 j	7%
Coal	26	26	24	1	2%	-2	-7%
Oil	2	2	2	-0	-13%	-1	-26%
Gas	31	26	21	-5	-17%	-10	-31%
Biomass	18	21	44	3	16%	26	139%
Total Power Generation Investments	345	365	376	20	6%	32	9%
Residential	295	408	428	113	38%	133	45%
Tertiary	110	196	250	86	78%	140	127%
Total Energy Efficiency Investments	405	604	678	199	49%	273	67%
Total	750	968	1.054	219	29%	304	41%

Under both scenarios employment impacts in the last 5 years up to 2030 are more pronounced with up to 823000 additional jobs compared to reference, mainly due to high investments in energy efficiency.

Table 18: Difference in Jobs compared to reference of investments in the power sector and energy efficiency, 2026-2030

Difference from Reference Average annual employment 2026-2030 related to investments	GHG 40%		GHG 40% + EE + 30% RES	
	('000)	% change	('000)	% change
Nuclear	4	4%	-61	-63%
Wind	51	42%	60	50%
Solar	15	55%	11	40%
Coal	3	29%	-7	-58%
Oil	-0	-50%	-0	-58%
Gas	-12	-44%	-19	-67%
Biomass	8	47%	72	443%
Total Power Generation Investments	69	23%	56	19%
Residential	245	109%	361	160%
Tertiary	182	272%	406	609%
Total Energy Efficiency	427	146%	767	263%
Investments				
Total	496	83%	823	138%

Also other studies underline the job creating potential of certain RES development and EE policies. A study on the economic assessment of low-carbon vehicles[108] concludes that depending on the model used, net jobs

[108] "An economic assessment of low-carbon vehicles" by Cambridge Econometrics and Ricardo-AEA, March 2013,

created in result of manufacturing of fuel-efficient automotive components and from a general boost to the wider economy as a result of decreased spending on imported oil, could be between 356,000 and 443,000 new jobs.

In conclusion, these different analytical tools suggest that there may be a positive net contribution from policies reflecting the various scenarios analysed, on the aggregate level - especially in scenarios with explicit HE measures and renewables targets. Impacts on the sectoral level is expected to differ and the analysis suggest that the negative impact will be most pronounced in extraction industries and most positive in sectors providing solutions to more efficient energy use and renewables development. Negative employment effects can be contained or even reverted in other sectors depending on the approach to carbon pricing, most notably carbon taxation in non-ETS sectors and use of taxation revenue to lower employers' fees.

Whereas the bottom-up energy system analysis and the macro-economic modelling give important information at aggregate and sectoral level, it does not fully capture issues related to skills, job mobility and restructuring across and within sectors. Such issues should be considered in a framework of dedicated social policies.[109]. For a discussion on skills and training, see annex xxx.

5.1.5.3. Affordability of energy

[xxx]

5.2. Indicators / aspirational objectives relating to competitiveness of the energy system and security of supply

On the basis of the introduction to this aspect in Chapter 4, the following advantages and disadvantages of the various options for other targets than those relating to GHG, RES and EE should be considered (for options around what such indicators could be, see end of this section):

Option 1 : No such targets or indicators are set.

The main advantage of this option is that it would not add complexity to the 2030 framework.

The main disadvantage of this option is that if would significantly remove visibility of and importance given to other aspect of security of supply and competitiveness than those addressed by RES and EE targets and policies[110], and that it would not be compatible with the strong emphasis by Parliament and Member States in the European Council on the importance and complexity of these other objectives.

Option 2: Other 2030 targets for other aspects of competitiveness and security of supply are set, and treated in an equal manner as potential targets for GHG, RES and EE.

The main advantage of this approach is that it would fully recognise the complexity of the competitiveness and security of supply objectives, and the fact that progress in this regard cannot be ensured solely through potential targets and measures for GHG, renewables and energy savings. Moreover, it would provide a clear mandate for strong policies in these areas at EU and national level to ensure that the targets are met.

A major disadvantage of this option is that it would add complexity to the framework as such and would significantly complicate interactions and coherence between various energy and climate areas. It would be particularly difficult to ensure that progress towards a broader set of targets is made at the same time due to complex interactions, and difficult policy decisions would arise if progress towards meeting one target works against another. Such trade-offs between competitiveness targets and environmental sustainability targets would be particularly sensitive. Moreover, targets should only be set for areas where concrete policies to achieve them are conceivable, and if it is feasible to capture complex objectives in one or a

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http://www.ricardo-aea.com/cms/assets/MediaRelease/Economic-Assessment-Vehicles-FINAL2.pdf

[109] For instance in the modelling the flexibility regarding mobility of employees between sectors is high, with often only limited differentiation between types of employees (for instance GEM E3 differentiates between skilled and unskilled labour). Neither are there specific limitations regarding the capacity to learn new skills within these employees categories. In reality this transition could be less flexible and there is an important role for skills transformation and training in achieving the transition towards a low carbon competitive economy. Policies to guide this restructuring will be important.

[110] [Explain]

limited set of targets. Due to the international dimension of both competitiveness and security of supply (e.g. price differentials, import diversification), and the heterogeneous approaches and concerns from Member States in relation to these objectives, simple but comprehensive targets at the Eli level, the progress to which could be ensured through concrete EU policies are not easily conceivable.

Option 3: No other such targets are set, but relevant indicators are defined to keep track of progress over time and to provide a knowledge basis for policy action; potentially associated with aspirational objectives in a 2030 perspective.

The main advantage of this approach is that it would recognise the importance of other aspects of competitiveness and security of supply than those addressed by RES and EE targets and policies without setting binding targets that could be difficult to implement and fully integrate with other binding measures. Moreover, by following the development of such indicators over time, policy makers would get a good basis for development and / or adaption of policy direction if need be. In order to ensure that the such policy action is taken on the basis of real developments, aspirational objectives in a given time perspective could be defined with respect to these indicators

The general disadvantage of this option can be deducted from an e contrario assessment of the above-mentioned advantages of options 1) and 2).

Indicators / aspirational objectives that could be considered, in part based on the outcome of the public consultation, are:

- End-price differentials for gas and electricity between the EU and other major economies.
- Level of market integration, through e.g. energy market coupling and level of interconnections between Member States.
- Reliance on indigenous energy resources / degree of energy self-sufficiency in the EU.
- Diversification of energy imports (routes, fuels, countries).
- [Grid stability / continuous and uninterrupted energy supply.]
- [CCS?]

5.3. EU action in the context of increased international climate action

The EU's current GHG target for 2020 is set at 20% reduction compared to 1990 levels, but with a 30% reduction as its conditional offer with a view to a global and comprehensive agreement, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities.

This approach was agreed in order to limit impacts on the EU economy in case our efforts would not be reciprocated by the international community and to provide an incentive to other economies to commit to GHG reductions. At the same time, the conditional target adds an element of uncertainty to the ultimate ambition level for 2020.. In this sense, dual targets (the higher of which is conditional to international climate action), or a single conditional target, works against the long term predictability of the framework, amidst persisting uncertainties whether and when a sufficiently comprehensive international climate agreement will be agreed. At the same time, a dual approach contains the impacts on those sectors of the economy especially hard hit by unilateral climate targets, by not committing to the higher level unless competitors in third countries also face comparable carbon constraints. These considerations are equally valid in a 2030 perspective.

This impact assessment provides information for the political decision if targets and policies for GHG, energy efficiency and renewable energy. If dual GHG targets for 2030 were to be the preferred approach, the fundamental question is at what level these targets should be set. The impact assessment in section 5.1 assesses a range of 35% to 45% of domestic reductions, without assessing what the impact would be of additional action in third countries.

This section assesses what the impact would be of a higher conditional target for the EU, with at the same time sufficient global action to limit global warming to below 2°C.

An eventual level of such a conditional target, for the EU in the context of an international agreement as a fair contribution will depend on many elements of the international agreement, most notably, the extent to which mitigation commitments in the new agreement would collectively be sufficient to stay on track towards the below 2°C objective, and individually ambitious, fair and in accordance with responsibilities and capabilities. This will clearly require action by all parties, comparable reduction targets by countries with similar responsibilities and capabilities as the EU, and considerable emission reduction efforts by emerging economies to enable their emissions to peak before 2030.

To inform negotiations, modelling comparison exercises typically have explored various distributions of global mitigation efforts, how they differ from distributing efforts according to the cost-effective potential, their economic impacts for different regions often expressed as % of GDP, and their relation with past, current and future emission levels or other indicators. Targets differ of course between approaches, with highest targets most often attributed to higher income countries.

The modelling for the Low Carbon Roadmap focussed on what the EU contribution domestically could be for global reductions to be achieved cost efficiently, but does not prejudge if the resulting reductions would represent a fair contribution to global action together with other regions' reductions[111].

In order to simulate potential costs of a conditional target, and without prejudice to any eventual position on what a potential unilateral and a potential conditional target may be, two examples were used based on 35% unilateral and 45% conditional, and 40% unilateral and 50% conditional targets below 1990 levels by 2030[112], For the unconditional target, it is assumed that international offsets are not permitted (see section X for a discussion in this regard).

The GEM E3 model was used to assess the impact of the unilateral and conditional GHG reductions by 2030 compared to 1990. Table 19 gives an overview of the impact on GDP and the production for energy intensive sectors typically deemed to be exposed to international competition.

First the impact of the unilateral GHG reduction in the EU is assessed without additional action in third countries and with no access to international credits both for the 35% GHG reduction and the 40% GHG reduction in the EU.[113]

Second, the impact of a the conditional GHG reduction in the EU is assessed, with other countries also taking action in line with what is needed to achieve the 2°C objective, both for a 45% and a 50% GHG reduction in the EU.

Third, the impact of allowing emission trading between countries is assessed. In this case the EU would achieve 35/40% reductions domestically and acquire a number of international credits to comply with the 45/50% GHG reduction target.

Compared to the unilateral, lower targets scenario, the conditional, higher scenarios (including international climate action) GDP impacts are obviously worse in the absence of international credits, as the differences in marginal abatement cost is not taken advantage of. With the possibility to acquire credits, the negative GDP impact from a the higher conditional target would be smaller but still larger than if the EU would have reduced emissions to -35% or -40% without the others taking action. In that scenario, the additional negative impacts on aggregated EU GDP is in large part driven by the fact that also global GDP would be negatively impacted by the necessary global climate mitigation.

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[111] For example also in the EU climate and energy package, it was recognised that attributing the 2020 targets according to cost efficiency, would not result in a fair treatment amongst EU Member States.

[112] This is a simplified target that is based around a simple linear trajectory, starting in 2020 at a -30% target (the conditional target that the EU put forward in 2009 as its proposal for 2020 in the context of a global agreement) gradually decreasing to reach by 2050 90%, at the higher end of the range from 80% to 95% of reduction targets for developed countries in line with the below 2°C objective in the IPCC's 4th Assessment Report for 2050.

[113] The modelling assumes for there is only auctioning for the power sector in the EU, that any revenues from auctioning is distributed in a lump sum to consumers and that companies fully include opportunity costs of free allowances in their price setting (this latter is also assumed for third countries). As such the results of a scenario with 40% GHG reductions in the EU and no additional action in third countries is very similar to those presented in scenario 1 of Table 13.

[To below will be changed and added to when all runs are finalised but preliminary results indicate to the following]

Impacts on specific industrial sectors vary, but the benefits for sectors subject to global competition from global climate change efforts are big. For a number of sectors analysed, production would be lower in a X scenario with global climate action if no international offsets are permitted. If, to the contrary, international offsets would be permitted, the EU sectors analysed would see significantly higher levels of production in 2030 under a X target coupled with international climate action than in a X scenario without global action, even though in aggregate EU emissions reduce in both scenarios with X in the EU.

This analysis confirms that for the EU's energy intensive industries subject to international competition, production output and relative global market share would be positively impacted
by similar emission constraints being imposed also in third countries if international offsets would be permitted, and that a X% target with international climate action and access to international credits compares positively for these sectors to a X% target with no international climate action and no access to international credits.

Table 19: Impact conditional target on GDP and production of energy-intensive sectors

	35% GHG reduction domestically	45% GHG reduction domestically	45% GHG reduction target of which 35% is achieved domestically	
Other countries	As in reference	Achieve reduction target in line with global action domestically	Achieve reduction target in line with global action, but allowing part of the effort though international carbon markets	
	EU	EU	: EU	Global
GDP (% vs Reference)				
Impact on production energy intensive industries compared to reference				
Ferrous metals				
Non ferrous metals				
Chemical Products				
Non metallic minerals				
	40% GHG reduction domestically	50% GHG reduction domestically	50% GHG reduction target of which 40% is achieved domestically	
Other countries	As in reference	Achieve reduction target in line with global action domestically	Achieve reduction target in line with global action, but allowing part of the effort though international carbon markets	
	EU	EU	EU	Global
GDP (% vs Reference)	-0.4%			
Impact on production energy intensive industries compared to reference				
Ferrous metals	-3.5%			
Non ferrous metals	-0.3%			
Chemical Products	-0.7%			
Non metallic minerals	¿fé.8%			

5.4. Structural measures in the EU ETS

A surplus has built up rapidly in the EU ETS by the end of phase 2. This was primarily due to the economic? crisis resulting in emissions well below the total cap and the inflow of a large amount of international credits, allowed under the ETS directive to enter over the period 2008-2020. Figure 1 gives an overview of the build-up of the surplus up to 2030 under the Reference[114]. At the end of phase 2 the surplus was already over 2 billion allowances and this is projected to continue to grow to over 2.5 billion by 2020, to only gradually reduce afterwards.

[114] Up to 2012, historic data is used. From 2013 GHG emissions are extrapolated based on the Reference projections (see annex Error! Reference source not found.) and adapted to include only intra EU flights in 2012 and international flights from 2013 onwards. Allocation for EU 28 during Phase 3 and Phase 4 is based on data used for the Commission Decision concerning national implementation measures for the transitional free allocation of greenhouse gas emission allowances. Total amount of JI and CDM credits up to 2020 is assumed to be 1600 million credits, while still excluding any inflow of CDM through aviation.

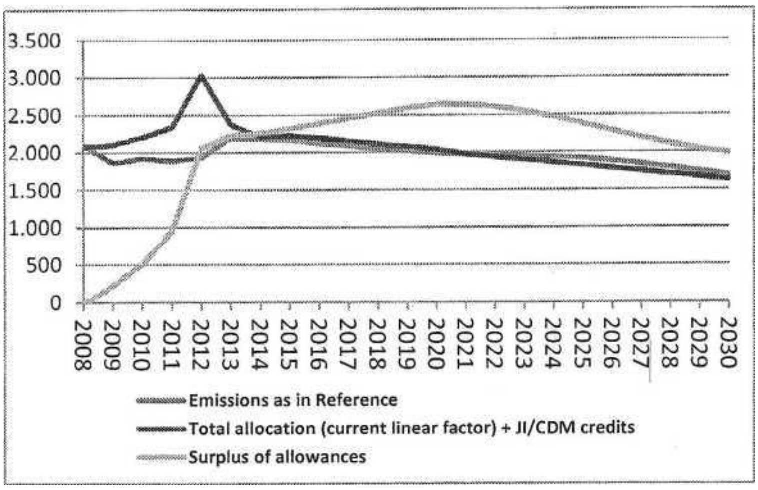


Figure 1: Example of build up surplus in ETS based on Reference emissions profile and existing cap

Based on the outcome of the public consultation launched by the Commission's Carbon Market Report[115], options for structural measures preferred by many stakeholders include:

1. early revision of the linear reduction factor to maintain the long term credibility of the ETS...
2. ...combined with the retirement of allowances to maintain credibility in the short-term
3. a reserve mechanism that would allow for a more dynamic supply of allowances which would not focus on prices but rather on supply / demand imbalances of allowances.

Of these 3 options, options 2 and 3 could be implemented in a shorter time frame and are not necessarily interlinked with the 2030 framework. These are therefore discussed and assessed in a separate impact assessment regarding a structural measure to strengthen the EU ETS. Of the six initially proposed structural measures, three are inherently linked to the 2030 framework as assessed in this impact assessment, notably the revision of the linear reduction factor, the extension of the scope of the EU ETS post 2020 and the use of international credits post 2020, and are therefore further assessed in this section.

5.4.1. *Revision of the annual linear reduction factor*

According the ETS Directive, the ETS cap for stationary sources decreases linearly, with an annual amount equal to 1.74% of the average annual allocation during phase 2 (excluding aviation), referred to as the linear reduction factor[116]. This is equivalent to an annual reduction of around 38 million allowances.

The scenario with 40% GHG reductions and moderate EE and RES policies up to 2030 achieves emission reductions in the ETS of 43% by 2030 compared to 2005. Setting a cap at this 2030 emission level would require a change of the linear reduction factor. A revised linear reduction factor applied from 2021 onwards to all sectors included in the ETS would require a linear reduction factor of 2.2% to be coherent with the 43%. Scenarios resulting in less than 40% GHG reductions compared to 1990 would require a smaller or no increase of the factor.

Figure 2 applies a linear reduction factor of 2.2% starting from 2021 onwards and shows the impact on the surplus using:

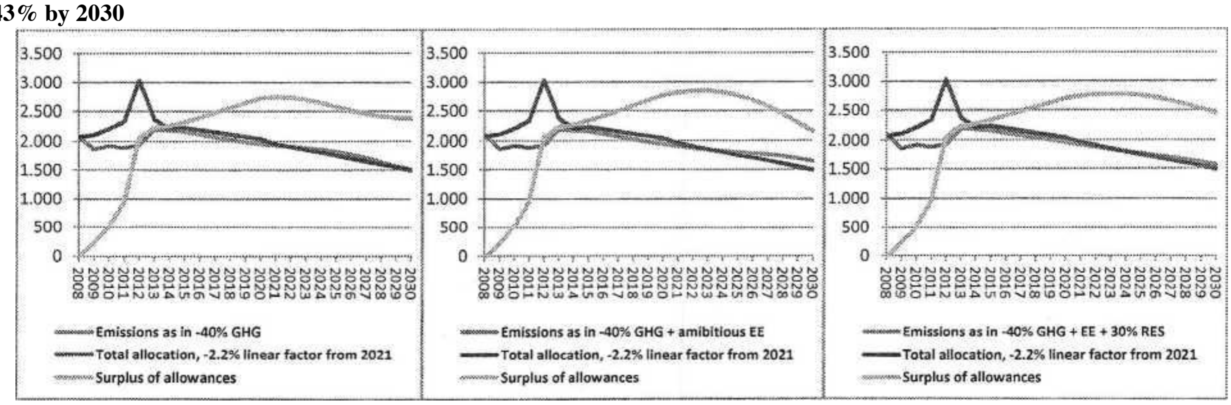
- the GHG 40% projection with moderate energy efficiency and renewables policies
- the GHG 40% projection with ambitious energy efficiency policies
- the GHG 40% projection with ambitious energy efficiency policies and a 30% renewables target

All these scenarios resulting in a 40% GHG emission reductions result in a decline of the surplus after 2020. However this only happens gradually, such that a surplus of around 2 billion allowances or more remains by 2030. This is a level similar to the reference scenario, but under these scenarios of course with lower emissions and a more ambitious cap in 2030. In a 2030 perspective, the lowest remaining surplus results from the

[115] COM(2012) 652 final
[116] To determine 2013 allocation, the linear factor is applied starting from 2010 onwards.

scenario with a strong focus on ambitious EE policies and the highest surplus results from the scenario with a 30% RES target.

Figure 2: Example of possible supply demand pattern ETS based on 40% GHG reduction emissions profiles, ETS cap of 43% by 2030

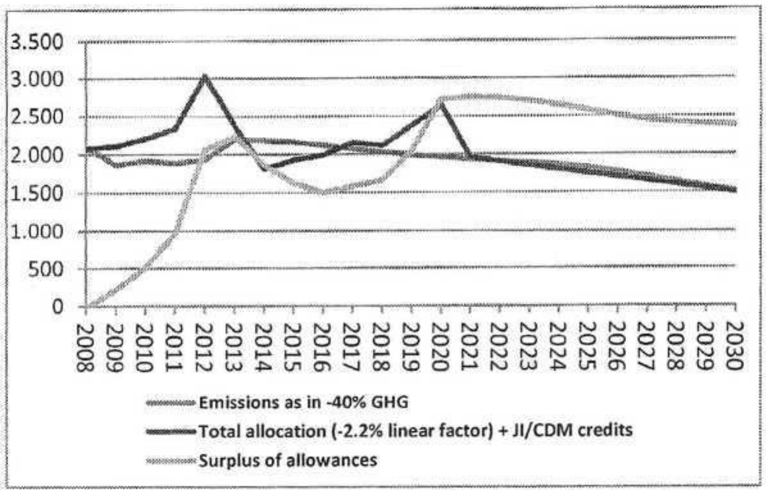


Whereas the gradually decreasing cap after 2020 is in line with an emission profile that gradually consumes the surplus, taking into account the longer term ambitious cap, it should be noted that this still represents a situation where the market would have to continue to operate for more than a decade with rather high surpluses, be it shrinking ones, strongly- driven by longer term considerations with respect to scarcity and costs. If long term considerations are not sufficient to create market certainty, ETS prices may actually be lower, emissions higher and surplus lower than projected in the scenarios with 40% GHG reductions.

The Commissioned proposed to delay the auctioning of 900 million allowances and backload it to the later part of phase 2[117]. Combining a more ambitious linear reduction factor after 2020 with this backloading would still mean early on in phase 3 that the surplus would shrink, only to increase again by 2020 and then to decline gradually again after 2020 (see Figure 3).

Figure 3: Example of possible supply demand pattern ETS based on 40% GHG reduction emissions profile, ETS cap of 43% by 2030 and backloading.

[117] For more information



The pattern of a decrease, an increase and again a more gradual decrease in surplus would seem to be inconsistent with the objective of more market stability. Changing the linear factor changes the cap only gradually, and thus does not affect the surplus much in the short term. As such this measure would in itself not be mitigating the pattern of a decrease and rebound of the surplus due to backloading. One possible way to address this would be measures that produce a more gradual and steady contraction of the surplus. Avoiding a resurgence of the surplus by 2020, after initially reducing it through backloading, and gradually reducing it from 2020 onwards would better address the structural surplus.

Such a pattern would point to the need of a limited adjustment of supply of allowances by 2020 by means of for instance the creation of a market stability reserve or the permanent retirement of some phase 3 allowances. For a more detailed discussion on this matter, see impact assessment regarding a structural measure to strengthen the EU ETS.

40% GHG reductions in 2030 could be achieved also without changing the annual reduction factor (through strong renewables and energy efficiency policies), but such an approach would only increase the surplus significantly, thus not addressing the current surplus in the ETS and undermining the relevance of the ETS in providing incentives for low-carbon investment in the medium to long term.

5.4.2. Extension of the scope of the EU ETS to other sectors

The EU ETS at present includes typically large emitters such as power plants, as well as aviation which is a sector where the amount of operators is relatively limited. Expanding the scope of the ETS to include all energy related emissions, is an option in the further development of the European carbon market recognised by the Carbon Market Report, but still would require addressing a number of administrative challenges. For instance end consumers are typically a very large number in the energy sector, which would make it difficult to regulate them directly through the ETS. However, an upstream approach would be administratively less complex[118]. Such approach could address fuel suppliers, tax warehouse keepers or excise duty points, but would need to take into account different practices in different Member States, which would make implementation on the short term challenging. Also further analysis is required in order to consider if and how any such measures would result in complementary incentives to existing taxation and excise schemes, including the ongoing discussions related to the proposed review of the Energy Taxation Directive; as well as the interaction with already existing measures addressing C02 emissions and energy consumption in sectors such as transport and the housing segment.

An efficient outcome of a potentially enlarged scope *would* require that existing market barriers and imperfections are addressed, such as lack of information, split incentives, financing constraints and low price elasticity of demand, which confirms that the ETS in itself cannot be the only suitable drive for change in these sectors. A price incentive through the ETS could therefore only be considered further if it would be part

[118] Other ETS systems developed include small scale sources. California's cap-and-trade programme will in the future include transport fuels through fuel distributors. The Australian emissions trading system has foreseen to include suppliers of natural gas for heating houses and buildings

of a package of complementary policies, which would require further development of ambitious energy efficiency, renewables and other energy policies. For these reasons, the EU has developed measures such as the Energy Performance of Buildings Directive, the Eco-design and Labelling Directives, CO2&cars and vans regulations and other transport measures, and the Energy Efficiency Directive. These types of regulatory approaches, as well as policies for R&D and innovation will need to continue to overcome such barriers. Without these complementary policies, the lower price elasticity at the demand 'side could lead to unnecessarily high carbon prices if these sectors would be included in the ETS. This complexity of regulatory approach and the need to avoid any elements of double regulation would have to be carefully analysed in any future more detailed assessments in this regard.

Without prejudice to such future more dedicated assessments, if the scope of the ETS would be extended to emissions related to fossil fuel combustion in the residential, services and remaining transport sectors (road, rail and inland navigation) then the projections resulting in 40% GFIG reduction in 2030 as discussed in section xxx show ETS reductions of around 37% compared to 2005 emissions (see Table 20). This target could be achieved by keeping the linear factor at the existing level of 1.74%, but applying it also to all additional sectors included in the ETS.

Table 20: Reductions in 2030 in the ETS, depending on sectoral coverage

2030 reduction vs 2005 for different scenarios	ETS emissions present scope	Sectors to which scope expansion applies	Total emissions ETS after scope expansion
GHG -40%	-43%	-28%	-37%
GHG -40% + EE	-38%	-36%	-37%
GHG 40% + RES 30% + EE	-40%	-36%	-38%

In how far an inclusion of new sectors would affect scarcity and thus price formation, will depend on the overall cap under an enlarged scope, but an extension of the scope in itself will not materialise a rapid change in the surplus, but rather like the change of linear factor for the existing sectors, lead to a more gradual decrease of the surplus.

If an extension of the ETS would be considered appropriate after a future more detailed assessment, it would in a second step have to be decided if auctioning or free allocation would be the suitable approach, while considering the possible impacts of windfall profits and costs for end consumers. For illustrative purposes, Table 2 provides an indication of the potential impact on revenues from the ETS.

Table 21: 2030 ETS auction revenue , depending on sectoral coverage of ETS and degree of auctioning

2030 auctioning revenue (billion €)*	Applied to the power sector and aviation	Applied to the power sector and aviation + extension of scope
Scenario GHG -40%	26	72
Scenario GHG -40% + EE	16	38
Scenario GHG 40% + RES 30% + EE	8	19
‘estimates based on PRIMES-GAINS emission estimates per sector, covering only outgoing flights		

Any potential proposal in this regard would necessitate more detailed assessment of all the relevant impacts.

5.4.2. *Use of international credits*

The amount of international credits that can be used in the ETS for compliance in phase 2 and 3 (2008-2020) is fixed[119]. The total entitlement is now estimated to be around 1.6 billion credits[120]. The default situation is that no additional entitlements are created after 2020.

Domestically, the use of international credits was intended to contain compliance costs and as such also address concerns about carbon leakage. They were also seen as a buffer against short term fluctuations in demand that could not be met through the supply in allowances. In reality, these credit entitlements allowed under the ETS legislation, have been generous. The present inflow of ERU/CERs into the EU ETS for compliance purposes[121] correspond to half of the existing 2 billion surplus.

119

[120] Bloomberg New Energy Finance (2013): "Phase III imports set to a minimum", Carbon markets global analyst reaction.

[121] Other factors behind the increased use notably in 2012 was the uncertainty surrounding the

Table 22: CER/ERU submissions in phase 2 of the ETS for compliance purposes (MtC02e)

Mt CCE-eq.	**2008**	**2009**	**2010**	**2011**	**2012**	**Phase 2**
CER/ERUs	83.5	80.6	137.2	253.7	503.7	1,058.7

Source: Bloomberg New Energy Finance (2013): "2012 compliance: shades of grey revealed".

The use of international credits is intended to deliver reduced compliance costs, transfer sustainable technologies to third countries while engaging them in stronger climate action. For these reasons, the EU decided that the conditional offer of 30% GHG emission reductions by 2020 would allow for an increase in use of credits by up to 50% of the increased effort.

The Clean Development Mechanisms (CDM) and Joint Implementation (JI) are the instruments through which credits have been generated. They are associated with several difficulties. Additionality and baselines are notoriously difficult to establish with serious concerns about transparency of methods used often related to JI. Many projects are therefore contested by many stakeholders. There is a potential for excessive rents and perverse incentives. There are concerns about unequal geographical distribution of projects and human rights. With CDM there is lack of an own contribution to mitigation by the seller. It remains to be seen to what extent the UN review of both Kyoto mechanisms can alleviate these concerns which resulted in restrictions by buying countries. The EU banned credits from afforestation and reforestation projects and later restricted credits from certain industrial gases[122].

Any further use of international credits in a 2030 framework needs to address how many could be used (quantity?) and what type could be used (quality?).

Under business as usual (reference scenario) there is no demand for international credits in the EU ETS (see Figure 1) after 2020, given that it would only add to the already potentially very large surplus of allowances (and credits as allowed up to 2020 in the ETS). This remains true even where a 2030 target is set to deliver a 40% GHG reduction. If overall emissions are to be reduced by 40% by 2030 compared to 1990, then even with a 43% reduction target in the EU ETS compared to 2005, there could still be a surplus in the EU ETS amounting to around 2 billion allowances by 2030. This is reflected in the default situation, whereby no further credits are used for compliance after 2020. Hence limiting the access to international credits is a necessary but in itself, i.e. without other options, suboptimal option to address the ETS surplus.

An unconditional domestic target with no additional access to international credits would create investor certainty towards the level of reduction that will need to be achieved within the EU. Demand shocks in the EU ETS could be contained through the remaining large surplus of allowances, potentially complemented by a mechanism to stabilise the market (see separate impact assessment regarding a structural measure to strengthen the EU ETS.) and the Article 29a mechanism of the ETS Directive avoiding risks of large sustained price increases.

Nevertheless, to facilitate a high level of ambition by 2030 in the rest of the world, the EU could also set a conditional target for 2030. This would be implemented if international conditions are right. A 2030 framework with an unconditional target not allowing for additional large inflows of international credits and a conditional one allowing a large share of additional efforts being met through international credits, could create more certainty on what is really necessary domestically than the current 2020 targets, which did not give industry such certainty. This possibility is further discussed in section X.

A conditional target with demand for international credits offer third countries the potential to participate in the carbon market, creating substantial climate finance flows if matched by similar demand from high income parties within an international agreement.

Post 2020, in light of an ambitious international agreement, it is essential that the EU can guarantee that only high quality credits enter the EU ETS. Both the generation and use of international credits need to contain an

future eligibility of certain ERUs and the phase-out of certain industrial gas credits as eligible credits for compliance after 2012.

[122] For more information, see also Commission Staff Working Document Accompanying the Commission decision on applying use restrictions on international credits (from HFC-23 and N20 projects) pursuant to Article 11 a(9) of Directive 2009/29/EC

element of net mitigation action. An important step will be to move away from project-based mechanisms towards sectoral approaches, certainly in more advanced economies. First steps in this direction have been taken. In the Durban Climate Conference in 2011, the EU secured the establishment of a New Market Mechanism (NMM) and in parallel, the EU continues to work towards a substantially reformed CDM. More economically advanced countries should move away from the CDM towards the implementation of the NMM, while over time, the CDM would increasingly be focussed on LDCs. This is already reflected in EU legislation. From 2013, CDM credits from new projects are only accepted for compliance in the EU ETS if they are from LDCs.

Through EU legislation, it could be ensured that credits entering the EU ETS come from systems which include an element of own contribution or from Parties taking appropriate action in the fight against climate change. EU ETS legislation will ultimately determine what can be used for compliance. If the rules for the implementation of the NMM cannot be agreed through the UNFCCC, the EU has the option to pursue the establishment of such a mechanism bilaterally or in cooperation with other major buyers.

But to create a genuine level playing field, the EU interest lies in promoting the development and implementation of compatible emissions trading systems throughout the world. Linking enables participants in one system to use units from a linked system for compliance purposes. New systems have been established or are being planned in many countries[123] and most systems are open to enter into linking agreements. If systems are compatible in design and similar in ambition, linking can be done without harming investor certainty with respect to the required domestic reductions. Examples how this can be done include linking with Switzerland, where negotiations are well underway.

5.5. Carbon leakage measures in a 2030 framework

Carbon leakage is defined in the ETS directive as an increase in greenhouse gas emissions in third countries where industry would not be subject to comparable carbon constraints, due to the impact of the ETS[124]. An empirical study[125] was recently finalised that explored whether there was evidence of such carbon leakage among the energy intensive industries in the period 2005-2012, i.e. phases 1 and 2 of the EU ETS. A main conclusion of the study was that this was not the case and that carbon leakage was successfully prevented, notably through the provision of free allocation of emission allowances.

There was actually in aggregate considerable surplus of allowances accrued by industry up to 2012[126] translating into considerable potential resources for the involved sectors. The empirical study for instance estimated that the cement, clinker and lime producers participating in the EU ETS have received in the period 2008-2011 160 million allowances beyond their verified emissions. For the pulp, paper and paperboard producers this was estimated to be equivalent to over 57 million allowances for the period 2008-2012.

The use of international credits was initially intended to contain upwards price risks, and as such also address concerns about carbon leakage. But in retrospect, it appears that these credit entitlements may have been too generous, in particular in the light of unexpected developments impacting the ETS, notably the economic crisis. It is expected that the inflow of these international credits has added a number of allowances corresponding to more than half of the expected surplus in the ETS market by 2020.For an analysis of the potential use of international credits in a 2030 framework, see section 5.4.3.

Industry, commenting on the study, pointed out that whereas free allocation indeed has protected the existing production facilities in the EU, it does not protect against what some argue can be called "investment leakage". They claim that investments in the EU are halted because of perceived higher future costs related to climate

[123] E.g. New Zealand, Canada (Quebec), Korea, Australia, Switzerland, Turkey, Mexico and Chile, China, Ukraine, Kazakhstan and Costa Rica.

[124] See recital 24 of the ETS Directive: *[...] an increase in greenhouse gas emissions in third countries where industry would not be subject to comparable carbon constraints (carbon leakage)*.

[125] Carbon Leakage Evidence Project: Factsheets for selected sectors, Ecorys, 23 September 2013. The study produced set of factsheets for a selection of sectors (see annex xxx). The factsheets present historical data and assess the degree to which carbon leakage may have occurred in the sector. They were assembled using publicly available data, draft versions were commented by European industry representatives.

[126] See for instance table 7, Proportionate Impact Assessment Accompanying the proposed Commission Regulation amending Regulation (EU) No 1031/2010 in particular to determine the volumes of greenhouse gas emission allowances to be auctioned in 2013-2020.

policy in the EU than in other regions, resulting in those investments taking place in those other regions, i.e. carbon investment leakage.

This investment leakage affects, according to industrial stakeholders, both the recurrent investments needed to keep installations highly efficient (leading thus to relative reductions in efficiency), as well as negatively impacting investment decisions regarding major new plants, resulting in increased production outside of the EU.

It was not possible in the study to empirically assert whether investment leakage has occurred. Trends of the type described could be due to a number of factors not related to the ETS, and often associated with effects of globalisation in general, such as:

• A maturing European economy, slow population growth and slower GDP growth compared to emerging economies, which create economically more beneficial circumstances for investment in industries outside Europe (Europe experienced a similar period of rapid industrialisation after WWII).

• Lower factor prices including labour, land and energy.

• Lower regulatory burden related to for instance safety, labour and environmental regulation (whereas often political instability, regulatory risk and currency risk are often perceived as higher burdens in those economies).

The empirical study noted that the carbon costs as a share of total costs during the period studied tended to be too small to be the main driver of relocation or investment decisions when compared to, for instance, labour, energy or raw material costs. One conclusion was that energy costs in total, and especially the recent development of unconventional fuels in the US, is starting to play a role in the investment decisions for some sectors.

Regarding the future, section 5.1.4 assesses the situation where indeed carbon constraints are further increased in the EU to achieve a 40% GHG reduction by 2030, whereas in other countries they remain as in reference. Table 12 gives the resulting impact on EU industries, assessed with the GEM E3 model. This analysis seems to indicate that impacts on industrial sectors can be alleviated to some extent if free allocation is continued, while some factors like benchmarks and production data are reviewed periodically. However, it would potentially increase carbon prices in the ETS because industrial sectors with free allocation distributed on the basis of future production levels might be incentivised to increase production in order to obtain more free allocation in following periods, and as such results in additional, more costly GHG reductions elsewhere in the ETS. With the introduction of increased levels of auctioning in the EU ETS after 2020 and up to 2030, impacts of a unilateral increase of the target to 40% are projected to be negative for all those sectors.

Section 5.2 assessed what the impacts on these sectors would be in case of a conditional target beyond the 40% that could only be implemented if other regions also undertake strong climate action. For all four energy intensive industrial sectors[127], it was projected that there would be a strong relative improvement of the competitive position of EU industries, actually resulting in significant production increase in three of the sectors, if accompanied with access to the international carbon market for the additional target beyond 40%. For two of the sectors this was actually even the case if the unconditional target would be fully met domestically, even without access to the international carbon market (see Table 19).

Overall the results seem to indicate that carbon leakage measures are not necessary in case sufficient global action is undertaken, but that some level of free allocation, through periodic review of factors determining free allocation, can be beneficial in a situation that the EU would step up its reduction effort to 40% GHG reductions by 2030 with third countries not undertaking comparable action. If it would be decided to preserve the approach of free allocation through benchmarking up to 2030 to address the risk of carbon leakage, a number of important design features will need to be revisited:

- **A periodic revision of the benchmark values** may be needed to reflect the technological developments which have happened since the benchmark values were first determined in 2011, based on 2006-2008 data. Such a revision could be envisaged to take into account technological developments, which most likely are not taking place at the same pace in all sectors. A reflection would also be needed for which

[127] Ferrous metals, Non ferrous metals, Chemical Products and Non metallic minerals.

products there should be benchmarks, whether the current system of fall-back approaches can be refined, and whether the determination of the benchmark values should continue to be based on the average of 10% best in the EU, or on any other base.

- **Baseline years to be taken into account.** The current free allocation system multiplies benchmark values with production data for certain reference years. There would need to be a reflection whether and when the reference years used for phase 3 free allocations should be reviewed, such that phase 4 free allocation would be based on production data from more recent years. Such a system would provide a closer link between allocation and production levels, but it may also be more complex and lead to less certainty for the installations in the long term. It may be useful to consider to review both benchmarks and production data in combination to provide more clarity at the time decisions are taken and reduce uncertainty as a result of too frequent reviews.

Maximum amount of free allocation. In the current system, the amount of free allocation is calculated bottom-up based on benchmarks and production data, but there is also a top-down maximum amount of allowances allowed. The maximum amount is currently a fixed share of the total cap. Such a cap is crucial as a backstop to ensure also long term environmental integrity of the system and to correct possible misconceptions and/or misapplications of the free allocation system ensuring transparency and equitable burden-sharing among sectors. But it needs to be assessed if the present share of the total decreasing cap should be amended, taking into account different opportunities to reduce emissions for those sectors receiving free allocation and those not. Lessons learned from the first years of phase 3 should be taken into account.

- **Carbon leakage.** Free allocation after 2020 should in principle only be provided to those sectors that are really affected by the risk of carbon leakage. This requires further reflection based on the growing experience with free allocation based on carbon leakage status in phase 3 as well as a review of climate policy efforts undertaken by other major countries. The purpose of free allocation should be to address competitiveness concerns in an accurate manner, while avoiding over allocation and maintaining appropriate incentives for low carbon growth and emission reductions. It needs to be recognised that the real carbon leakage situation of sectors on the present carbon leakage list may differ considerably - some may face much stronger competitive pressure than others. Some might operate in truly global markets, while others might merely be sectors where import and export constitute an important share of production and consumption, but where goods are still subject to significant diversification. Therefore, some reflection may be needed if some form of progressiveness would be useful, recognising that for some sectors within the larger group that can be deemed exposed to a risk of carbon leakage it would make sense to provide for relative more free allocation than for others. Such a division groups can lead to a more accurate picture of the competitiveness situation of sectors, but could increase the complexity of any analysis. Another element which may merit reflection is the relation between the length of validity of the carbon leakage list and the length of the trading period, taking into account both regulatory predictability and developments affecting the competitiveness situation of industrial sectors.

<u>Indirect emissions compensation</u>

Currently, indirect ETS costs in electricity prices, passed on to industrial electricity consumers, can be compensated for the most electro-intensive industries via national subsidies subject to State aid scrutiny. Stakeholders have indicated their worries that this will result in different treatment across Member States for the same sectors, depending on the willingness and ability of Member States to provide state aid. It merits reflection if this approach should be continued and to what extent such support is warranted, which is linked to the quite complex impact of climate policies on electricity prices. If yes, , it needs to be considered if it could be improved to best avoid distortion of intra-EU competition and ensure a level playing field. Furthermore, in case of sufficient global action, also the continuation of these measures may not be necessary

<u>The use of auction revenues for pro-active low-carbon innovation measures</u>

Overall higher levels of free allocation to industry will result in fewer allowances for auctioning. . It could as such reduce the capacity to use auctioning as a distributional tool across Member States even though carbon prices may also actually increase (see section 5.1.4). Auction revenue or other forms of ETS related revenues (such as what is currently done with the so called NER 300) could also be used in a more targeted manner, e.g. towards demonstration and deployment of promising new technologies for the energy intensive industries subject to ETS. Such funding would in principle not directly alleviate carbon leakage, but could in the longer term be crucial to ensure industrial sectors can make a successful transition to low carbon production. A dedicated programme at EU level could be more efficient in creating break-through technologies due to scope and size, than if spread out over 28 Member States.

5.6. Sectors not included in the ETS or Non ETS: Policy options for the Land Sector

The question on extension of the scope of the ETS to include sector at present covered in the Non ETS, in particular fuels for transport and heating, is addressed in the section 5.4.2 on structural measures. The question on distributional aspects of target setting in the non ETS is addressed in section 5.9. A

This section addresses policy design options for (non-energy related) emissions from agriculture, and emissions and removals from Land Use, Land Use Change and Forestry (LULUCF), in short AFOLU (agriculture, forestry and land use).

The problem

While the land sector presents modest mitigation potential in the EU, it does incorporate two important carbon pools: forest biomass and soil organic carbon. The correct handling of these - through land use management approaches for forest and agriculture - is essential in order to a) optimise further removals and b) avoid emissions, where cost-effectively possible.

In section 5.1.2, it is shown that these carbon stocks are overall expected to decline over time under current policies. This is due in part to increased use of biomass for energy purposes. It also gives estimates of further land use changes under policy scenarios with higher greenhouse gas and renewables targets, which have knock-on effects on land use practices within the EU, and can also lead to increased bio-energy import, potentially causing carbon leakage and indirect land use changes. However, these scenarios do not include actions to increase removals and reduce emissions through specific measures.

Moreover, global demand for food, and feed is expected to continue to rise under current trends, thereby affecting the agricultural sector in the EU, and associated greenhouse gas emissions.

The protection, therefore, of these AFOLU carbon pools will be of growing importance in a post-2020 framework.

In contrast with the non-$C0_2$ emissions in the Agriculture sector (which is currently within the scope of the Effort Sharing Decision), the LULUCF sector is not included in the reduction commitment in the current 2020 Climate and Energy package. In the context of the Climate and Energy Package, The Council and the European Parliament have indeed expressed the request that all sectors should contribute to cost-effective emissions reductions.

The current LULUCF legislative framework provides for a step-wise progression to improve data and introduce best practice, as preparation for the inclusion of the sector within the overall 2030 policy framework.

The policy options for 2030

An approach for the integration of the land sector into an EU framework could in principle be based on one of three options:

- Option 1 ("Status Quo"):

  Maintain non-$C0_2$ Agriculture sector emissions in a potential future Effort Sharing Decision, and further develop a LULUCF sector policy approach separately.

- Option 2 ("Effort Sharing"):

  Include the LULUCF sector into a potential future Effort Sharing Decision;

- Option 3 ("Land Sector Pillar"): Merging the LULUCF and Agriculture non-C02 sector emissions into one new and independent pillar of the EU's climate policy

For the pros and cons of a new Effort Sharing Decision in a 2030 perspective, see section 5.9

Comparison of options

Option 1 (Status quo) continues the separate treatment of LULUCF, outside the Effort Sharing Decision (ESD)[128]. However, this "Status Quo", does not imply a no-action scenario, as targets and appropriate measures could be developed separate. Flexibilities with other sectors could be considered. However, the major disadvantage of this option would be that agricultural and LULUCF emissions would be addressed with different policy tools, while they concern the same agricultural activities.

Option 2 (Effort sharing) would increase the number of sectors in the ESD and thus increase flexibility for Member States to achieve a given target. It would also have the advantage, compared to Option 1, that Member States could develop an integrated approach for agriculture and forestry. Certain synergies and trade-offs could potentially be better addressed[129].

However, it needs to be borne in mind that, although specific flexibilities are allowed, the ESD is developed around a linear trajectory with an annual compliance cycle. It will need to be further assessed whether the inclusion in the ESD of LULUCF emissions/removals, which are characterised by potentially large annual fluctuations, long time horizons and uncertainties related to data reliability (unless sophisticated monitoring techniques are used) is compatible with the Effort Sharing Decision[130]. In addition, the cost-effective potential for removals is certainly geographically variable which may make the sharing of effort in the ESD more complicated.

In summary, Option 2 would add flexibility and enable an integrated approach, but would increase complexity and raise methodological issues, including consequences in terms of target setting.

Option 3 (land sector Pillar) would have similar advantages to Option 2. It would enable a more dedicated policy approach that takes into account the specificities of the sector, and can build on and use the Common

[128] The Effort Sharing Decision defines the national GHG reduction targets for the so called Non ETS sector, i.e. those sectors not included in the EU ETS

[129] For instance a decision to move from livestock production on grassland to energy crop production could imply a reduction of methane emissions from livestock and increase renewable energy production, but would also increase emissions from the soil.

[130] DK, FR and HU chose annual compliance for LULUCF sector in CPI.

Agriculture Policy to deliver. In this context, it would need to be considered which instruments (eg. national targets, dedicated EU measures, or national measures financed through rural development policy measures) are most suitable. Assuming that this option would also comprise fixed national targets, it would lack the advantage of flexibility between sectors within the overall ESD, but give an opportunity for a policy approach that would reflect the sector's particularities (permanence, long time cycles, natural variability etc.).

In conclusion, considering the strong linkages between land management and agricultural activity, options 2 or 3 seem to have distinct advantages. Much broader incentives for climate friendly and smart agriculture than today could be designed within a post-2020 Common Agricultural Policy.

Policy monitoring and evaluation

The application of today's accounting rules together with the development of more accurate monitoring and reporting methods - under Decision 529/2013 - should further improve the data and information availability.

The effect that different accounting rules (e.g. flexibilities between different activities; caps on credits and debits; reference levels etc.) could have on the absolute number of credits/debits generated by these two sectors in a post-2020 international framework, will need to be further assessed.

5.7. Implementing a potential RES target

As explained already in section [XJ, the purpose of this impact assessment is not to evaluate in detail the various possible means of meeting a potential renewables target for 2030. Such a detailed evaluation would be earned out in preparation of any future legislative proposals in this regard if there is political agreement on a 2030 renewables target as such.

At this stage some more general considerations concerning practical design suffice, building on the assessment of lessons learned under the 2020 framework and the responses to the public consultation. Three main aspects of implementation would have to be considered:

- The level at which the target should be applied / who should be the obligated entity, where three main options are conceivable: EU level, Member State level through differentiated national targets, or at the level of energy suppliers.
- If the target should be applicable to energy consumption as such, or rather to specific sectors and / or energy carriers such as electricity, heating and cooling or transport.
- If the implementing approach should be based on technical neutrality between various renewables options, or if differentiated approaches for each type of renewable technology should be applied.

On this basis, three main options for implementation of a potential legally binding renewables target for 2030 can be identified:

iv) Continuation of Member State specific targets and support schemes.

v) As option i) but with non-discriminatory treatment of renewables coming from other Member States in national support schemes or strong coordination between Member States, possibly under the condition that there is sufficient transmission capacity between the Member States involved, and

vi) A gradual Europeanization of the approach to ensuring progress towards a 2030 objective.

For all these main options, sub-options can be defined, including

A. Target applicable to all energy consumption, or only subsets of energy consumption (in specific sectors such as transport, or for specific energy carriers such as electricity or heat)

B. Target met in a technology neutral approach, or through specific approaches to specific renewables technologies.

Without pre-empting the outcome of a future more detailed assessment were a legislative proposal to be made, and also considering that some of these aspects would not be decided on the EU level depending on the main option chosen, there are several important trade-offs in choosing between these options and sub-options that policy makers at any level should consider.

First, an EU-Ievel target would avoid setting national targets which potentially could lead to development of renewables where the resources are the most abundant, and thereby in theory improving cost-efficiency at the aggregate EU level in meeting a set objective. At the same time, if Member States do not have specific targets, they would have less incentive to mitigate administrative barriers and' facilitate uptake through grid developments and necessary licensing. Moreover, Member State targets could better ensure a balanced development of renewables across the EU economy and society. An EU level target would also require giving the EU the means to deliver on such a target through concrete policies on the ground, going beyond current levels of harmonisation.

Second, meeting an EU target without national support schemes (which would result from national targets unless Member States decide to combine support schemes across national borders) but with schemes at the EU level would be less distortive to competition and market integration, but would at the same time reduce Member State flexibility to adapt to specific circumstances and decide themselves how finance / support RES developments.

Third, technology neutrality and equal treatment of all renewable options without sector specific targets or support schemes would improve short to medium term cost-efficiency, at least in theory. On the other hand, truly technology neutral approaches would typically lead to excess profits for producers of more cost-competitive renewables; and would not ensure development, deployment and cost-reductions that could be necessary for cost-efficiency in the longer term, in particular if the EU were to agree on more ambitious renewables objectives post 2030 (as suggested by the Roadmap 2050, however not the subject matter of this Impact Assessment). Moreover, the development of innovative, currently more costly RES technologies might be hampered, impacting thereby on longer term industrial leadership of EU companies.

The quantitative assessment of scenarios and options in section 5.1 above and the specific information on system cost and price impacts from various renewables levels is based on the assumption of cost-efficient deployment of renewables in the EU post 2020, on the basis of implementation of the legally binding national RES targets for 2020. Potential future decisions at the EU or national level would have to be based on detailed analysis (including modelling) of the various options. Such analysis focusing less on optimising cost-efficiency at the EU level throughout the period up to 2050 could result in higher system cost and price impacts.

5.8. Implementing a potential energy savings / efficiency target

None of the scenarios / policy options presented and analysed in previous sections will materialise unless there is significant improvement of energy efficiency, driven *inter alia* by public policy, across the EU economy up to 2030 and beyond. Energy efficiency is therefore fundamental for the transition.

All scenarios quantitatively analysed in section 5.1 but the ones driven by a sole GIIG target include explicit or implicit assumptions about such public policies to varying degrees, but the purpose of this impact assessment is not to evaluate in detail the various means of meeting a potential energy efficiency target/objective for 2030. Such assessment should not and cannot be made except as part of the 2014 review of the approach to energy savings in a 2020 perspective. This 2014 review should also consider if energy intensity rather than absolute energy savings could be a more suitable basis for post 2020 objectives in sectors of the economy where energy consumption is strongly correlated with economic activity; provided that implicit or explicit sectoral targets would be considered appropriate and cost-effective. Without prejudice to the 2014 review, Box [X] provides an overview of impacts in this regard.

Box [X]

Indicator		"Carbon values" 2030 / 2050	"Concrete EE measures" 2030 / 2050		
	Reference	GHG40	GHG40EE	GHG40EERES30	GHG45EE RES35
Primary energy consumption compared to (207) projections for 2030 Sector A Sector B Sector C	X				
Energy intensity (primary energy consumption / GDP) Sector A (unit of measure) Sector B (unit of measure) Sector C (unit of measure)					

Source: PRIMES

Irrespective of any potential 2030 targets in this regard, and without prejudice to the 2014 review, it will be important also in a 2030 perspective to continue policies at the EU level ensuring a high level of energy efficiency, especially in areas such as buildings, energy consuming appliances, vehicles etc. to ensure a level playing field and safeguard the internal market for related products. There will be a need to foster governance and the capacity of market actors and policymakers to introduce energy efficiency measures and to improve the financeability and risk profile of energy efficiency investments.

As illustrated in annex X, price elasticity of energy demand is low in many sectors of the economy, in particular in the residential and transport sectors. In industry too, energy-saving measures with short payback times are often not taken up. Energy prices (including the indirect impact from the ETS) will in many situations not be enough to drive the necessary developments in a 2030 perspective, underlining the need for specific policies. A mix of EU level and more flexible Member State approaches in defining and implementing energy efficiency policies (as under the current framework) would safeguard the internal market and undistorted competition on the one hand, and facilitate taking into account national and regional circumstances in a non-distortive manner on the other.

5.9. Differential impacts across member states

To be completed later.

6. COMPARING OPTIONS / CONCLUSIONS

To be completed later.

7 Annexes

7.1. The EU reference scenario 2013

Context, key assumptions and overall framework

The new reference scenario informs about the expected outcome from implementing the already agreed policies in the context of the 2020 package (serving therefore as baseline for this IA). It can therefore enlighten the policy debate on the impacts of an option with no further EU action, while laying the basis for analysing the impacts of additional policy action aimed at in the energy and climate framework for 2030.

The new EU reference scenario modelling, finalised in 2013, was jointly supervised by DGs ENER, CLIMA and MOVE based on EU energy system and C02 emission modelling with PRIMES, transport activity modelling as well as specific modelling related to non-C02 GIIG with GAINS and CAPRI. It involved world energy modelling for determining international fossil fuel prices as well as macro-economic and sectoral modelling - all through 2050. Member States experts had been involved in various stages, starting with replies to an extensive policy questionnaire and encompassing four rounds of commenting on economic, transport activity, energy and non-C02 and LULUCF emission results. The energy modelling is done in five year steps starting with 2015 and based on Eurostat statistics through 2010.

The assumptions related to GDP have been taken from the joint work of DG ECFIN and the Economic Policy Committee. The 2012 Ageing report provided the population and long term GDP growth projections, while the short and medium term GDP growth projections were taken from DG ECFIN. These were then further developed for having the proper inputs for energy and transport modelling (notably value added of the various sectors and subsectors regarding energy intensive activities). The EU economy is assumed to continue growing after having overcome the economic crisis. Average annual GDP growth between 2010 and 2030 is projected at 1.5% pa, decreasing thereafter to 1.4% pa due to demographic change (ageing population). After slight growth over this and the next two decades population is stagnant from 2040 onwards.

EU-28 GDP increases in line with projections of EPC and DG ECFIN, depicting declining growth rates over time. Recovering from the crisis (reflected by only 0.9% pa GDP growth in 2005-2010), GDP is expected to rise 1.5% pa from 2010 to 2020, 1.6% in 2020-30 and 1.4% pa thereafter through 2050.

GDP growth rates vary over time and across Member States, reflecting the crisis and the subdued prospects in some countries affected particularly hard. They also allow for greater economic cohesion with higher growth rates especially in new Member States. For example, GDP development in 2010 to 2015 ranges from significant decreases in Greece to a growth rate of nearly *4%* pa in Estonia. Over the longer term from 2015 to 2030, the EU economy grows at 1.6% pa. The lowest growth in this period would materialise in Germany (0.8% pa, also due to its shrinking population) while economic activity in a couple of Member States would be growing faster than 2% pa (Poland, Estonia, Latvia, Slovakia, Spain and Ireland).

The Reference scenario has been developed in the framework of limited global climate action, especially regarding non-EU regions. It assumes that third countries live up to their Copenhagen/Cancun pledges, but there is no assumption on any further significant climate action in these countries. This is similar for the EU, which in this reference scenario, despite implementing its unconditional GHG reduction target and renewables targets, would not be stepping up efforts in 2020 and beyond.

Fossil fuel import prices are seen increasing, so that the oil price might reach 121 $/barrel in 2030 and 143 $ in 2050 (corresponding to 110 €, all in constant 2010 prices). With 2% inflation (ECB target) this corresponds to 180 $ in 2030 in nominal terms (315 $ in 2050). Gas prices rise stronger in the short term due to increasing demand notably from Asia (China, post-Fukushima Japan), from 38 €(10)/boe in 2010 to 62 €/boe in 2020. After 2030, gas prices decouple somewhat from oil prices, among others due to shale gas exploitation in the US and some other regions; coal prices remain considerably lower by comparison (24 € (10)/boe in 2030 and 31 € in 2050).

Table 23: International fossil fuel price developments in reference

EU fuel import prices	2010	2020	2030	2050
Oil (in $2010 per boe)	80	115	121	143
Oil (in €2010 per boe)	60	89	93	110
Gas (in €2010 per boe)	38	62	65	63
Coal (in €2010 per boe)	16	23	24	31

Source: PROMETHEUS

Technology developments are dealt with in great detail. In each period energy investment is modelled endogenously on the basis of a wide portfolio of different energy technologies, notably for power and heat generation, along with energy demand, cost and price numbers derived simultaneously in the modelling while making sure that grids and interconnector capacity allows for implementing the already agreed policies. The modelling takes also into account the potential need for delivering simultaneously electricity and heat when considering CHP investment options. Technology performance improves over time, the pace depending on the maturity of individual technologies, based on expert judgements including from JRC. Technology learning translates also into cost digression at different rates according to technologies (over 100 different ones for power generation).

The policy framework for the EU can be summarised as achieving the legally binding RES and GHG targets (Renewable Energy Directive, Effort Sharing Decision and the EU Emission Trading System (ETS) Directive with linear decrease of the cap continuing also post 2020) as agreed within the 2020 energy and climate package. Moreover, other policies agreed by spring 2012 are included (such as the C02 from cars / vans regulations, implementation measures of the Eco design directive, energy performance of buildings directive etc.) as well as the Energy Efficiency Directive, for which there had been political agreement in the first half of 2012.

The modelling assumptions include the following elements:

- The Grid expansion follows the latest 10 Year Development Plan from ENTSO-E, without making any judgement on the likelihood of certain projects materialising.
- The 2020 targets on RES and GHG including the sub-targets (RES in transport, ETS cap, Effort Sharing Decision) will be achieved, but there is no assumption on targets for later years. The ETS cap is assumed to continue declining according to the ETS Directive.
- RES subsidies decline after 2020 starting with on shore wind; RES aids for most technologies decline to zero by 2050, except for innovative maritime RES, such as wave and tidal energy. Increasing use of RES co-operation mechanisms will also help to reduce RES costs. Generic policies on facilitating RES penetration (e.g. streamlined authorisation procedures) continue.
- Additional energy efficiency policies are modelled along the lines of the various provisions of the Energy Efficiency Directive reflecting e.g. building insulation or the savings required from utilities and retailers regarding energy consumption at their customers' sites. Similarly, other energy efficiency measures, notably the eco-design regulations have been taken into account influencing energy consumption increasingly over time as obsolete appliances etc. are being removed while new items, subject to eco-design standards, are entering the market.
- ETS prices increase throughout the projection period as the ETS cap is decreasing and the current surplus of allowances is gradually decreasing. Non- ETS carbon values are zero since the Effort Sharing Decision for 2020 turns out to be not binding at the EU level under Reference scenario conditions[72], notably to C02 from cars and energy efficiency policies and taking into account flexible mechanisms among Member States.
- Nuclear investment is endogenous, but non-nuclear Member States remain non-nuclear, except for Poland where some nuclear investment takes place; nuclear in Belgium and Germany is phased out

[72] The reference scenario sees lower GDP growth and stronger increase of oil and gas prices than assumed in the previous exercises before the adoption of the climate/energy package.

according to existing legislation.

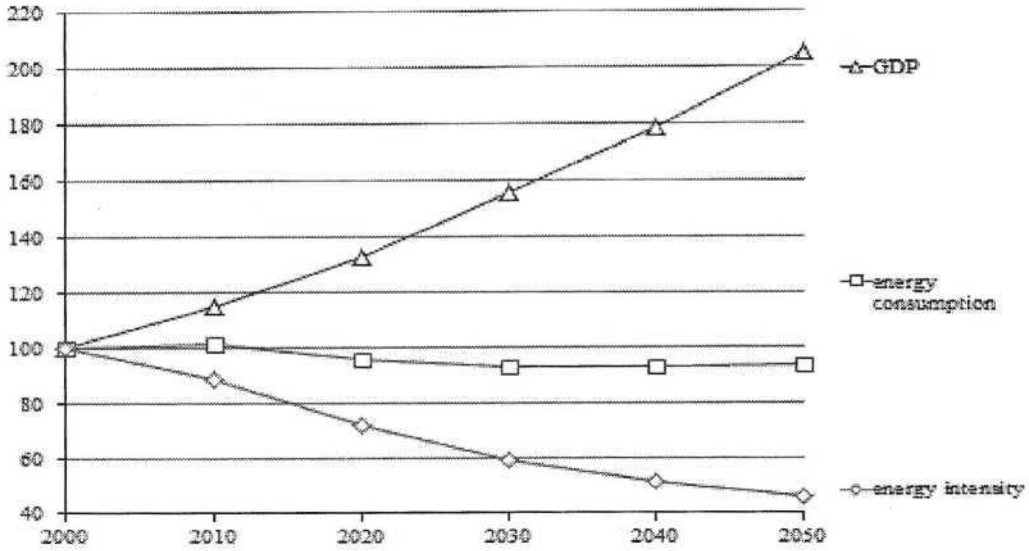
- CCS penetration is driven by ETS prices (apart from funding for demonstration plants); regulatory and acceptance issues that have come to the fore recently have been taken into account, especially regarding storage, as well as the comments from Member States during the consultation, leading to limited CCS uptake. ^
- Energy taxes in € per boe are constant in real terms, i.e. are assumed to rise in line with inflation. All prices and costs have been expressed in euros of 2010.

Key trends on energy consumption and intensity

Under reference scenario conditions, total energy demand in ElJ-28 is expected to decline from current levels. In 2030 the EU would be using 9% less energy than in 2010, with energy consumption remaining flat thereafter.

Given significant economic growth over decades this means an improvement of energy intensity (energy consumption related to GDP) by 33% up to 2030 and by 48% in 2050, when the EU would consume only slightly more than half the energy required per unit of GDP compared with the situation in 2010.

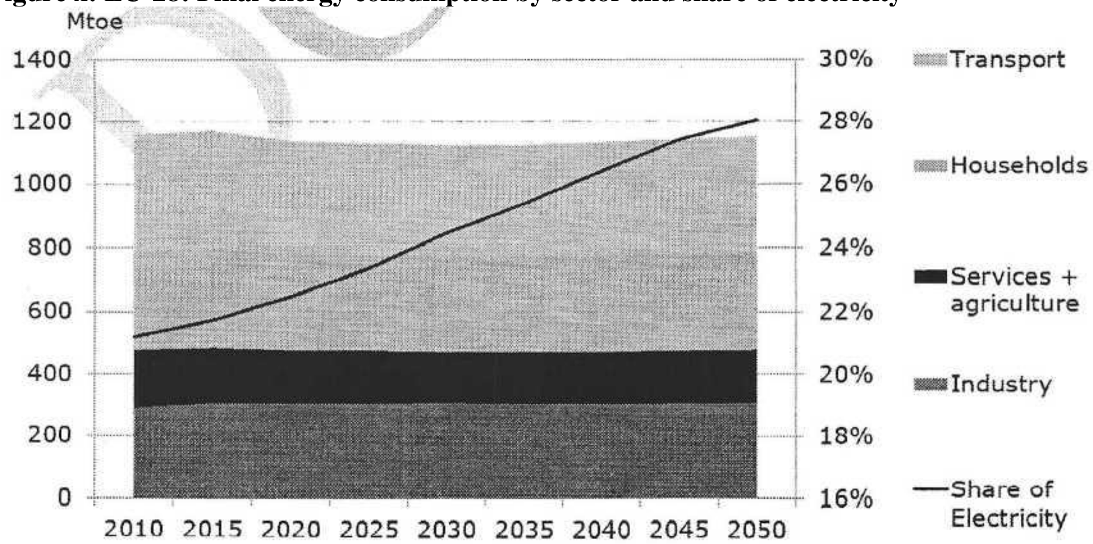
Figure x: EU-28 GDP, energy demand and energy intensity (2000 = 100)



Nevertheless, the Reference scenario would not quite reach the indicative energy savings objective for 2020 of 20% below projections as defined by the European Council of March 2007 (in operational terms this is evaluated against the 2007 Baseline), but would yet achieve almost 17% against this earlier EU projections for 2020. Using the same metric for 2030 would give rise to energy savings of 21% below' these projections made for 2030 in 2007.

Final energy consumption is expected to decline 3% by 2030 and increase again to the 2010 level by 2050. This is mainly driven by significant decreases in households, tertiary and transport up to 2030 where in particular the instruments of the Energy Efficiency Directive (EED) and the C02 from cars regulation exert downward pressure on energy consumption overcompensating rising incomes. After 2030 the effects of these policies aimed at 2020, with some longer term effects, are overruled by the upward pressure from rising income.

Figure x: EU-28: Final energy consumption by sector and share of electricity



Electricity demand rises 12% between 2010 and 2030, increasing further through 2050 (+32% on 2010). Driving forces for this include greater penetration of appliances following economic growth overcompensating effects of eco-design standards on new products, increasing use of heat pumps and electro-mobility. The share of electricity in final energy consumption rises consequently from 21% in 2010 to reach 24% in 2030 and 28% in 2050.

Fuel mix and implied decarbonisation

One salient feature of the Reference is the strong restructuring of the energy supply side by 2030 and even more by 2050 (in terms of primary energy). These changes are driven by strong policy efforts in this decade and a continuation of enabling measures for renewables post 2020, rising fossil fuel prices and the continuation of the ETS linear reduction factor.

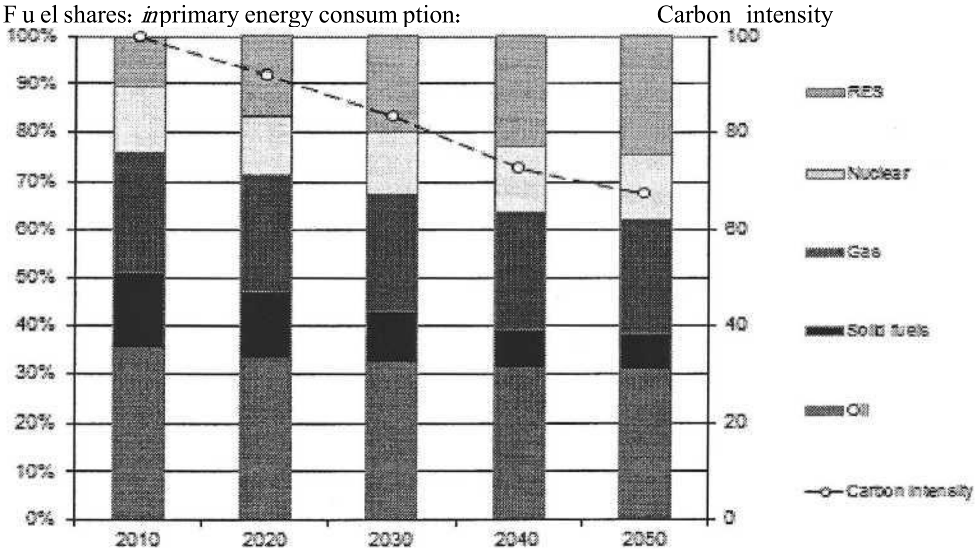
There is pronounced restructuring towards RES to the detriment of all other energy sources.

• Despite losing 3 percentage points (pp) by 2030 and a total of 5 pp by 2050 oil remains the most important energy source through 2050 ;

• Solid fuels are most affected by the policy driven restructuring falling 5 pp by 2030 and a total of 8 pp by 2050, when their share would be less than half of what is was in 2010; the emergence of CCS supported by ETS in the longer term is attenuating somewhat this trend; ,

Figure x: EU-28 Fuel shares in primary' energy consumption, carbon intensity

F u el shares: in primary energy consum ption: Carbon intensity



• RES gain 9 pp from 2010 by 2030 and 14 pp by 2050 making them the third most important primary energy source (after oil and gas) in 2030 and the second most important one (just ahead of gas) in 2050;

Using the concept of RES in gross final energy consumption (according to the RES Directive), the 2020 target might be slightly overachieved (20.9%), reflecting MS comments in the consultation; the RES share would be further rising supported by longer term effects of policies for 2020, technology progress and market trends to reach 24.4% in 2030 and 28.7% in 2050.

The RES target for transport is also expected to be achieved (10.3% in 2020) with a slight further increase of this share to 12.0% in 2030 and 13.9% in 2050. The RES contribution will be most important in electricity consumption accounting for 35.2% in 2020, 42.7% in 2030 and 50.1% in 2050. Also in heating and cooling there would be significant RES penetration reaching 21.5% in 2020, 23.8% in 2030 and 26.6% in 2050.

Biomass plays a key role in these trends. In 2010 the percentage of total primary renewable energy generated by biomass and waste was 70%. This number drops to 62% in 2020 and 56% in 2030, falling slightly below 50% in 2050. The role of wind and solar becomes more important accordingly. In absolute terms, biomass demand is increasing significantly until 2020 and keeps on growing slow-ly until 2050.

Figure x: EU-28: RES share: total and by sector (RES in gross final energy consumption)

Overall, the dominance of fossil fuels in primary energy supplies diminishes with their share falling from 76% in 2010 to 68% in 2030 and 62% in 2050. As a consequence of this fuel switching and some CCS penetration, the carbon intensity of EU energy supplies decreases 17% in 2030 (32 % in 2050) from its 2010 level. Reflecting also energy intensity improvements, energy combustion related C02 emissions decrease 24% below 2010 levels by 2030, and 37% by 2050.

The resulting sectoral trends on energy related C02 are as follows:

- C02emissionsfrompowergeneration are expectedto fall from current levels by 41% in 2030 (71% in 2050) due to strong fuels switching and some CCS penetration;
- Transport related C02 emissions, which increased by 26% between 1990 and 2010, would decrease only 9% between 2010 and 2030, remaining virtually flat thereafter;
- Other sector trends are also declining; they fall in between the strong decrease in power generation and the more limited one in transport. Industry is decreasing by 7% below current levels until 2030 and 18% until 2050, district heating and energy transformation emissions sink by 27% below current levels until 2030 (39% by 2050), residential falling by 21% respectively 29% and the tertiary sector by 36% until 2030 and 45% by 2050.

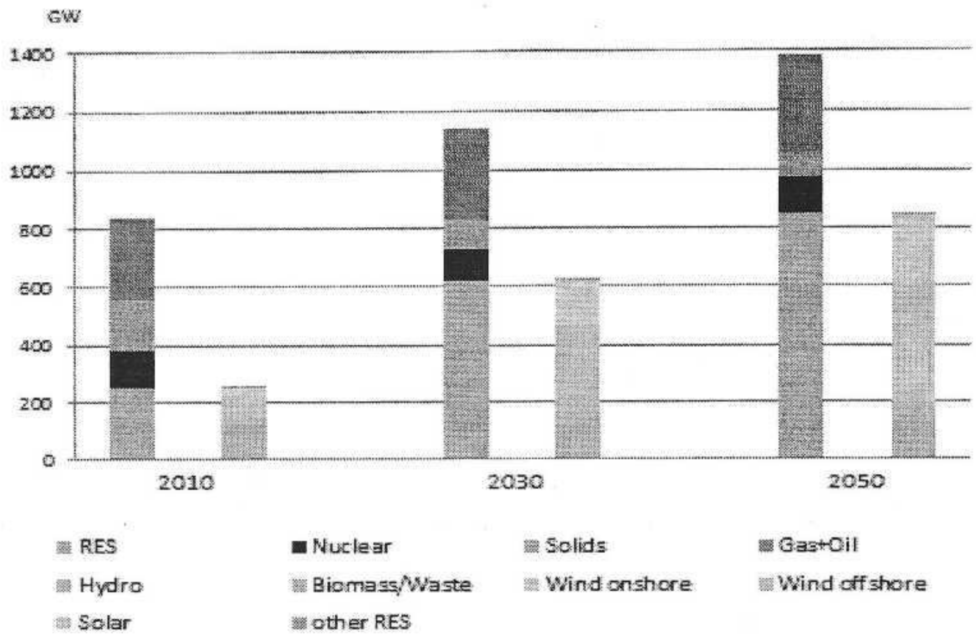
Power generation and capacity requirements

Rising electricity demand, due to its convenient features for a multitude of uses and rising incomes (leading to e.g. more widespread penetration of appliances), together with RES policies, ETS and technological progress bring about a restructuring of electricity generation towards RES to the detriment of mainly solid fuels. RES account for almost 45% of power generation in 2030 and slightly over 50% in 2050. Following phase-out decisions in some Member States the nuclear contribution (in TWh) declines in 2020-25 but returns to the current level by 2050. Similarly, gas based power generation decreases somewhat through 2025 giving way to RES, but comes back to current levels by 2050. The downward trend for solid fuels is present throughout the projection period.

These changes in the structure of power generation have even more profound changes regarding capacity requirements, given that the strongly penetrating RES have lower load factors than e.g. coal and nuclear plants. Consequently capacities grow faster than generation, while the share of RES in capacity is even higher than in generation. Given the key role of gas as a back-up fuel for RES, there is significant growth of gas capacities between 2010 and 2050 whereas generation from gas in 2050 is virtually the same as in 2010.

Net power generation capacities become dominated by RES, which account for 55% of capacity in 2030 and 62% in 2050. The RES capacity of some 850GW in 2050 corresponds to the current total power generation capacity from all energy sources combined.

Figure x: Net power generation capacity (with further breakdown of RES capacities in right columns)



The expansion of RHS capacities throughout the projection period is mainly driven by onshore and off-shore wind as well as solar. Tidal and wave energies penetrate in the long run in some countries having good potentials, such as France, Ireland, Portugal and UK.

Following these changes in generation structure and despite growing electricity production, power generation would further decarbonise. The share of RTS and nuclear combined in gross electricity generation would increase from currently 49% to reach 58% in 2020, 66% in 2030 and 73% in 2050. In addition, CCS would make some inroads in the long run with a timid share of less than 1% until 2030 increasing however to 7% by 2050.

Energy prices, system costs and investments

Energy prices are increasing significantly until 2020 and show somewhat diverging trends afterwards, largely related to significantly increasing world fossil fuel prices in the context of significant energy system restructuring:

- Diesel prices for private transport users increase 20 % from 2010 to 2020 and rise thereafter almost 4% per decade up to 2050; mainly driven by increasing oil import prices.
- Oil and gas prices for heating increase by 38% respectively 47% from 2010 to 2020. Heating oil prices continue to rise significantly thereafter (over 5% per decade up to 2050), while gas prices for households remain more or less at 2020 levels, mainly driven by the trends in oil and gas import prices, which see a decoupling of both prices only in the longer term.
- Average electricity prices for end users rise more strongly by 2020, by 31%, assuming in the modelling that incurred costs (including some profit margin) are fully recovered via prices. This reflects a set of different factors: Gas and coal import prices rise by 62% and 41% respectively over the current decade; power generation investment increases significantly; old capital stock (for generation, transmission and distribution) is being replaced generally with more efficient and less carbon intensive power plants; RES targets are achieved implying lower load factors (more generation capacity for a given amount of electricity generation) and the need for back-up capacity; grid investments increase significantly to support greater market integration and RES penetration. Moreover, electricity savings (from policies and higher prices) mean lower sales levels diminishing thereby the basis for sharing out the fixed cost elements, which dominate total electricity costs, thereby increasing the cost per unit of electricity delivery. ETS allowance expenditures contribute only a marginal part, given that carbon prices are very low until 2020 with the projected carbon prices becoming important for electricity prices only in the longer run. Electricity prices for industry increase less than for other sectors: 22% between 2010 and 2020. After 2020 electricity prices are flat - actually even marginally decreasing, reaping thereby the benefits from fuel input savings (e.g. from RES and

energy efficiency, which reduce fossil fuel input). Prices for industry decrease significantly, so that total industrial electricity price increase 2010 to 2030 is limited to 10%. /

Affordability and competitiveness effects related to energy are ultimately not a matter of prices, but are determined by cost, i.e. the product of prices and consumption levels; notably energy efficiency policies lead to a reduction of consumption thereby alleviating adverse price effects. Total energy system costs related to GDP, Which stood at 12.8% in 2010 peak in 2020 at 14.9% as a consequence of heavy energy investment, falling thereafter to 14.2% in 2030 and back to 2010 levels by 2050 (12.6%) thanks to fuel cost savings in later years.

Table x gives the overview of total energy system costs over time for all Member States. It shows they are comparably higher in lower income Member States, confirming that lower income Member States are also the most energy intensive EU economies[73]. Inefficiencies and obsolete infrastructure is an important reason as well as different economic structure with a relatively lower share of GDP in services and relatively larger share of household spending for meeting basic heating and cooling needs.

Table x: Energy system costs in relation to GDP per Member State

	201 0	2020	2030	2040	Change to 2030 from 2010
EU28	12,76%	14,91%	14,17%	12,55%	1.41
BE	13.47%	16.46%	15,92%	14,08%	2.45
BG	25,45%	30,55%	31,08%	31,79%	5.63
CZ	19,72%	21,58%	20,22%	18,78%	0.49
DK	10,75%	11,46%	10,85%	10,24%	0.10
DE	12,67%	14,60%	14,08%	13,11%	1.41
EE	20,26%	22,12%	20,81%	20,09%	0.55
IE	10,47%	11,63%	10,09%	9,03%	-0.38
EL	12,65%	16,88%	16,18%	15,30%	3.53
ES	12,25%	14,55%	13,32%	12,03%	1.06
FR	11,08%	12,75%	11,72%	10,15%	0.63
HR	19,57%	22,44%	22,22%	21,20%	2.65
IT	12,33%	14,87%	14,47%	12,72%	2.14
CY	16,03%	17,86%	18,16%	15,50%	2.13

[73] Eurostat: in 2011 the 10 most energy inefficient Member States were EU12, of which 8 had an energy intensity of GDP at least twice the EU average.

LV	25,60%	27,97%	26,72%	26,86%	1.12
LT	22,16%	24,09%	23,63%	21,13%	1.47
LU	11,84%	12,66%	11,45%	9,86%	-0.39
HU	22,24%	25,98%	26,29%	25,24%	4.06
MT	13,38%	14,26%	14,17%	13,10%	0.79
NL	12,19%	14,78%	14,16%	12,49%	1.98
AT	12,22%	14,07%	13,61%	12,18%	1.39
PL	21,08%	22,75%	23,41%	22,19%	2.33
PT	15,95%	19,71%	18,61%	17,08%	2.66
RO	18,82%	22,48%	23,31%	23,80%	4.49
SI	17,80%	21,48%	21,21%	20,42%	3.41
SK	19,78%	21,50%	20,50%	18,67%	0.72
FI	15,46%	17,62%	17,77%	16,45%	2.31
SE	13,72%	13,98%	12,17%	10,65%	-1.55
UK	10,81%	12,92%	12,05%	9,68%	1.24

Heavy energy investment is undertaken both on the supply and demand sides, notably for electricity supply and for more efficient energy using equipment as well as building insulation. Energy-related investments (excluding transport) are 47% higher in the decade 2021-30 compared to the decade 2001-10, which was marked by rather low investments; these investments in the next decade are however 21% lower than those during this decade to 2020, where strong efforts are needed for implementing the 2020 targets and policies. Transport-related investments are projected exceed those in 2001-10 by 31%, while they are expected to be 20% higher than such investment in the current decade.

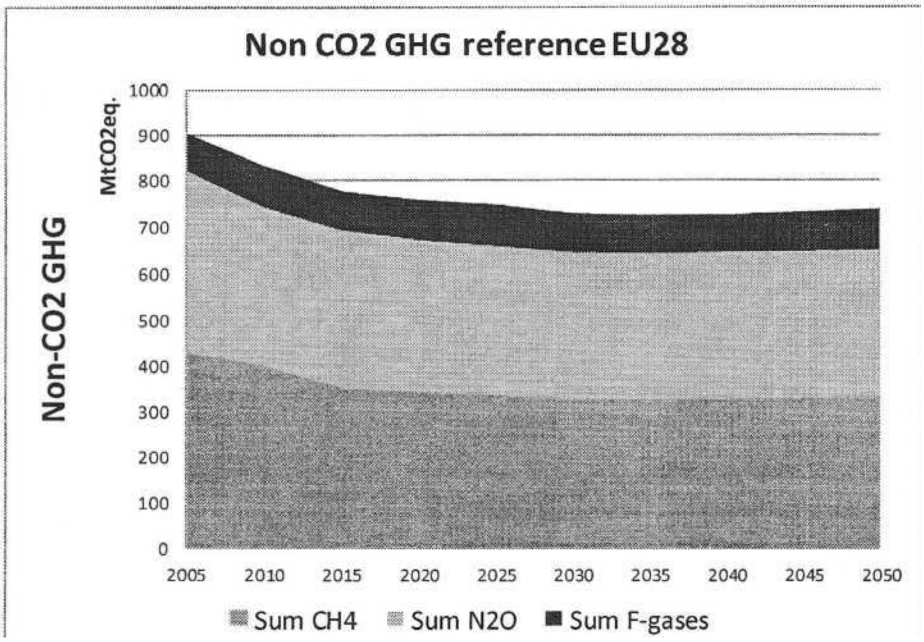
Such heavy investment that continues beyond 2030 leads to greater importance of capital expenditure (largely creating income in the EU) versus operational expenditure, notably related to fossil fuel imports.

Drivers of GHG emission trends beyond energy related CO2

Around 5% of current total EU GHG emissions excluding LULUCF are non-energy (combustion) related C02 emissions. They stem mainly from industrial processes in the metals, minerals and chemicals sectors and are mostly covered by the EU ETS; the remainder of C02 from non-energy combustion sources stems from fugitive emissions in energy sectors (close to 10% of such emissions) while less than 5% of them are from solvents and waste. Having decreased significantly between 1990 and 2010, non-energy related C02 emissions might increase in the next 10-15 years, due to expected recovery of economic growth and limited remaining cheap mitigation options. With increasing ETS allowance prices after 2025, they return in 2030 to the current level. Thereafter there might be considerable CCS penetration due to sufficiently high ETS allowance prices, which combined with lower fugitive emissions from lower fossil fuel production would lead to falling total non-energy related C02 emissions, down 63% in 2050 compared with 2010.

CH4, N20 and F-Gases, often summarised as non-C02 emissions, account currently for 17% of total EU GHG emissions excluding LULUCF. They have decreased significantly between 1990 and 2010. They are expected to further decrease by 12% below 2010 levels in 2030 (or 19% compared to 2005) and stagnate later on. CH4 emissions are projected to decrease above average (19% due to declining trends in fossil fuel production, improvements in gas distribution and waste management) and N20 emissions fall below average (4%) until 2030, both remaining flat thereafter. F-Gases would reduce by 8% between 2010 and 2030, largely driven by EU and Member State's policies (i.e. the F-gas regulation and mobile air conditioning directive); F-gases would increase somewhat between 2030 and 2050 in line with economic developments.

Figure x: Non-C02 GHG emissions by gas in the EU28



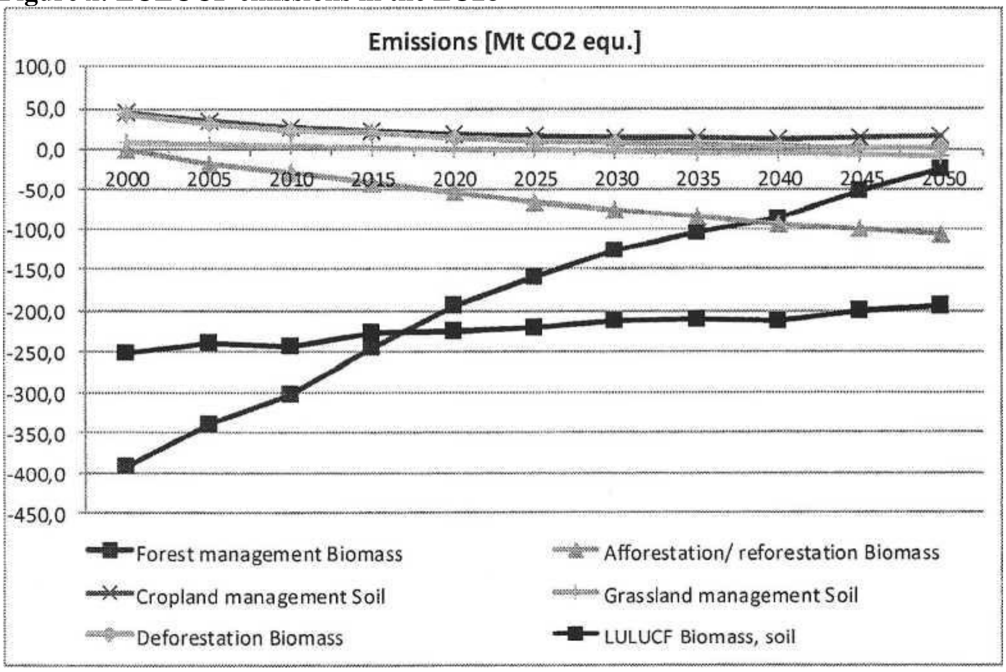
The sectoral non-C02 emission trends and their drivers vary more strongly:

- Since 2013 more than 80% of industry sector non-C02 emissions are covered by the EU ETS (\on-C02 emissions of nitric and adipic acid production. PFC emissions from aluminium production). The resulting price incentive and (previous) national legislation leads to sectoral emission reductions of 55% between 2010 and 2030, making full use of existing cheap mitigation options, while for the period after 2030 slight increases at low level are projected in line with economic trends.
- A similar decrease of 55% between 2010 and 2030 is expected for the waste sector, strongly driven by environmental legislation, such as the full effects of the Landfill directive and improvements in waste management. Also an increasing amount of CH4 is recovered and utilised, thereby impacting on these trends towards lower emissions. After 2030, however, a moderate increase is projected, reflecting trends in economic development.
- The agricultural sector is responsible for more than half of all non-C02 emissions. While the agricultural non-C02 emissions have reduced by 23% between 1990 and 2011, they are projected to roughly stabilize at current levels as a result of different trends which compensate each other, such as decreasing herd sizes but increasing milk yields and increased use of more efficient mineral fertilisers. These trends are impacted by the EU common agricultural policy, e.g. the decoupling of direct support from production, abolishment of milk quota and cross-compliance with environmental laws, such as the nitrate directive.
- CH4 and N20 emissions from the energy sectors are expected to decrease by 28% from current levels in 2030, and further 13% between 2030 and 2050. In the absence of specific mitigation policies, this reflects mainly trends in energy activity, in particular the reduced production of coal and natural gas in the EU.
- Emissions from air conditioning and refrigeration decrease by 13% until 2030, also thanks to existing legislation (i.e. mobile air conditioning), but are projected to slightly increase after 2030.
- Emissions from the wastewater sector and remaining other sectors are projected to increase moderately in line with economic development trends.

LULUCF emissions and removals

The carbon sink composed of land use, land use change and forestry in the EU 28 is expected to decrease somewhat over time. The LULUCF sink for 2000 to 2010 is estimated to be around 250 Mt C02eq including harvested wood products (see LULUCF biomass, soil in the figure). The sink is expected to decline to around 200 Mt C02eq in 2030. This result comes from several opposing trends. In forestry, afforestation is increasing resulting in an increasing sink over time. Deforestation is declining resulting in a decreasing source. The forest management sink, however, decreases over the time horizon. The main driving force is the expected increase in timber demand especially but not exclusively for energy purposes. Whereas total timber demand increases by more than 15% between 2005 and 2030 timber demand for energy purposes would increase by more than 40%. The harvested wood products stock however increases from around 10SiMt C02eq. in 2005 to 60 Mt in 2030. Cropland emissions are expected to decline over time whereas grassland emissions remain more or less stable mainly as a result of the expected conversion of land from other purposes to grassland.

Figure x: LULUCF emissions in the EU28



7.2. State of affairs and main lessons learnt from the 2020 framework Summary

1. The 20% GHG emissions reduction target and dedicated policies

1. The EU has achieved substantial GHG emission reductions and is on track to meet and even exceed the 20% target

2. The EU ETS has produced an EU-wide carbon price signal to achieve emission reductions cost-effectively and a European carbon market which complements the completion of the internal energy market. The inclusion of aviation as a further step towards a global carbon market has led to criticisms from third countries.

3. The Effort Sharing Decision ensures that non-ETS sectors contribute their target share in a flexible way. The EU is on track to meet the -10% target below 2005 levels, however 13 Member States need to make additional efforts to meet their respective national 2020 targets or make use of the flexibility mechanisms.

4. The ETS has adapted flexibly to the crisis but has and will continue (in the foreseeable future) to have a large surplus of emissions allowance, largely as a result of the sustained economic recession and a large inflow of international credits

5. The surplus has resulted in an ETS price signal too weak to significantly affect the price of fossil fuelled power generation, which if unaddressed will have a long lasting effect on the ability of the ETS to provide an incentive to invest in low carbon energy technologies such as renewables. In combination with today's high gas to coal price ratio, it can lead to carbon lock-in.

6. The low ETS price has also increased the need for public funding to achieve longer term emission reductions. However, while a (higher) carbon price is an important driver, it alone may not be enough to provide sufficient incentives for developing innovative low carbon technologies and related infrastructures.

7. The current impact of the ETS price on power prices is marginal. Its influence on demand side energy savings is therefore limited. However, at substantially higher levels of the ETS price, the impact on powder prices and on electricity savings could be considerable.

8. Free allocation to energy intensive sectors and along with low carbon prices have resulted in a very low risk of carbon leakage at present. State aid for electricity intensive industries can be an effective way of preventing indirect impacts but has given rise to concerns by some stakeholders regarding distortions of competition across Member States.

9. A number of EU policies, high fossil fuel prices and reduced demand due to the crisis have contributed to GHG emission reductions. Well-designed, specific, energy savings measures addressing non-price barriers such as split incentives, high private discount rates, limited access to finance or imperfect information are complementary to price signals. The C02 and cars regulation is a good example of such effective complementary regulation.

10. The low ETS carbon prices and corresponding auctioning revenues, the overachievement of the effort sharing targets at the overall EU level combined with access to international credits on prices of emission allocation transfers between Member States reduce related redistribution effects envisaged in the climate and energy package.

11. Regulatory uncertainty about the way forward and concerns about a lack of effectiveness of the ETS have reduced the confidence of carbon market participants and are in some cases already leading to a fragmented approach to decarbonisation within the EU which would be contrary to the internal energy market.

12. The obligation of the amended Fuel Quality Directive for all fuel suppliers to reduce the life cycle greenhouse gas emissions from their supply of road fuels by 6% in 2020 has proven to be complex to implement but has the benefit that it will apply equally to importers and domestic producers of fuels.

13. The pledges under the Copenhagen Accord and Cancún decisions have led to a variety of national policies and measures, including carbon markets. However, the existing pledges are not delivering sufficient reductions by 2020 and no new comprehensive international climate agreement has been achieved yet that ensures that the global community as such is on track to keep global warming below 2°C.

2. The 20% renewable energy target and implementing measures

1. The renewable target has contributed to good progress in penetration of renewable energy in the EU energy mix

2. The EU has made good progress towards the 2020 target, but not all Member States are likely to meet their respective targets without additional efforts

3. The efforts to promote a range of renewable energy technologies have significantly reduced the costs of these technologies

4. The 2020 renewable target is expected to contribute to significant reductions in GHG emissions.

5. Between 1990 and 2011, renewable energy production in the EU is likely to have contributed to decreased import dependence, having grown by 90 mtoe per year during that period. Renewables production also helps to reduce fuel costs.

6. Renewable energy production in the EU has created or maintained somewhere between
800,0 and 1.2 million jobs by 2011

7. Increasing renewable energy in the power generation mix has contributed to reduced wholesale power prices but its support mechanisms have contributed to increased retail prices.

8. While the financing costs of renewables remain high, in markets in which predictable long-term policies are in place, the business case is strong and there are many circumstances in which renewables can be competitive

9. Though essential to ensure uptake and long-term development, support for renewables alongside an ETS, notably for renewable electricity, has the potential to drive down the carbon price and in turn reduce the incentive for investments in renewables.

10. One important challenge is the integration of more variable renewable power generation in the electricity grid. It is clear that greater market integration of renewables is necessary, together with adaptation and modernisation of the electricity grid and market functioning to adapt to a system of sustainable electricity production.

11. Renewable electricity generation (with low marginal costs) also poses new challenges for the operation of traditional "energy only" electricity markets

12. Support schemes for renewable energy need to be fit for purpose and efficient. The costs of developing renewable energy have been unnecessarily increased in some cases by poorly designed support schemes.

13. While the promotion of conventional biofuels has been successful in terms of quantities produced, it has been a costly way to achieve GHG emission reductions and there are increasing concerns on their sustainability; certainty about the long term perspectives of advanced sustainable biofuels is necessary to ensure deployment, as biofuels are important for energy security, rural employment and renewable energy uptake in the transport sector.

3. The energy efficiency target and implementing measures

1. Significant progress has been made towards meeting the 20% energy efficiency target

2. Going forward, the Energy Efficiency Directive will help to ensure progress, but it is doubtful that the 2020 target will be met with current policies (even if the gap is projected to be now only 3 percentage points vs 11 percentage points projected in 2010).

3. Challenges in maintaining progress in energy efficiency include ensuring proper implementation and mobilising funds

4. The 2020 target for energy efficiency has been instrumental in ensuring progress, although a relative target for some sectors might better reflect the structural dynamics of the ELF economy

5. Energy efficiency measures are expected to contribute to some reductions in GHG emissions by 2020, in particular in the non-ETS sectors.

6. Some energy efficiency measures, notably those impacting electricity consumption, have the potential to drive down the carbon price and to make the achievement of GHG emissions reductions more costly than they would otherwise be. However, the current surplus of allowances in the ETS is largely driven by other factors...

7. ... on the other hand, if cost-effective energy efficiency opportunities are not exploited, a higher carbon price is needed to deliver the same level of emissions reductions...

8. Specific efficiency measures are also necessary to correct certain market and behavioural failures which a carbon price alone will not correct

9. Energy efficiency measures can positively contribute to energy security and competitiveness

1. The EU has achieved substantial GHG emission reductions and is on track to meet and even exceed the 20% target

In 2011, EU 28 emissions in the scope of the climate and energy package (including international aviation) were 16.9 % below the 1990 level, and 2012 emissions are estimated to have fallen by 18% below the 1990 level. Excluding international aviation (Kyoto Protocol scope), the EU 28 reduced emissions in 2011 by 18.3% below the 1990 level[74].As illustrated by the new reference scenario, over-achievement of the overall GHG target of 20% even seems possible at the EU level (see Annex [X]). National GHG projections submitted under the Monitoring Mechanism Decision in 2013, quality checked and aggregated by the

[74] For further details, see the Report on PROGRESS TOWARDS ACHIEVING THE KYOTO AND EU 2020 OBJECTIVES (COM(2013)698).

European Environmental Agency, also point in this direction[75].

2. *The EU ETS has produced an EU-wide carbon price signal to achieve emission reductions cost-effectively and a European carbon market which complements the completion of the internal energy market. The inclusion of aviation as a further step towards a global carbon market has led to criticisms from third countries.*

The 20% GHG reduction target for 2020 is in part implemented via the EU Emissions Trading System (EU ETS). The 2020 cap for the sectors covered by the ETS, reflecting a 21% decrease of electricity and industry ETS emissions below 2005 levels is expected to be met. This is illustrated by the new reference scenario, which also takes full account of the temporal flexibilities in achievement of the cap (banking and use of banked allowances).

The ETS has produced an EU-wide, uniform, carbon price signal that influences daily operational and strategic investment decisions of large industrial installations and in the power sector. It covers and creates a level European playing field for more than 10,000 installations and nearly 50% of all EU GHG emissions. The new institutional framework with auctioning and EU-wide harmonised benchmarks for free allocation has been in place since 2013 and constitutes a significant improvement compared to the previous trading periods that still had national based allocation plans.

Since 2012, aviation has also been included in the EU ETS. Unlike the cap on the number of emission allowances for fixed installations (which decreases yearly), that for aviation is fixed at 5% below a 2004-2006 average emission level baseline. The legislation applies also to incoming and outgoing international flights in the EU. This resulted in criticism from third countries opposing the inclusion of flights of foreign operators originating from their countries into the EU ETS. To provide negotiation time for the adoption of an internationally agreed solution by the ICAO (International Civil Aviation Organisation) General Assembly in autumn 2013, international flights into and out of Europe in 2012 were temporarily exempted from enforcement. The EU legislation is designed to be amended in the light of a global agreement.

3. *The Effort Sharing Decision ensures that non-ETS sectors contribute their target share in a flexible way. The EU is on track to meet the -10% target below 2005 levels, however 13 Member States need to make additional efforts to meet their respective national 2020 targets or make use of the flexibility mechanisms.*

The Effort Sharing Decision (ESD) sets national targets for GHG emissions in the sectors not covered by the EU ETS. National targets for 2020 are distributed between Member States according to economic capacity. Some need to reduce emissions compared to 2005 while others are permitted a limited growth in emissions. In addition, a trajectory of corresponding absolute emission limits is defined for each Member States for the years 2013 to 2019.

The combined target aims to achieve a 10% emission reduction at the EU level in 2020 compared to 2005. In aggregate, the EU is on track to achieve the 10% reduction target, but significant differences exist between Member States. 13 Member States need to make additional efforts to meet their respective national 2020 targets under the ESD, or make use of the flexibility mechanisms foreseen therein[76].

The ESD enables Member States to meet their targets for each of the years 2013-20 flexibly, be it through the acquisition of international credits or through trade with Member States outperforming their targets. This should enable reductions at least cost. Given the temporal flexibilities in achievement of the target trajectory, given that the ESD has been in force for only a few months and given also that 2013 emission limits can be met by most Member States, to date trade between Member States has not yet occurred. The importance of the foreseen flexibilities was also highlighted in several responses to the stakeholder consultation.

4. *The ETS has adapted flexibly to the crisis but has and will continue (in the foreseeable future) to have a large surplus of emissions allowance, largely as a result of the sustained economic recession and a large*

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[75] COM(2013)698 and EEA: Trends and projections in Europe 2013 - Tracking progress towards Europe's climate and energy targets until 2020.

[76] According to national projections submitted under the Monitoring Mechanism Decision in 2013, quality checked and aggregated by the European Environmental Agency. For further details see COM(2013)698.

inflow of international credits

The deep and protracted macro-economic crisis has significantly reduced demand for allowances. The ETS has adapted flexibly to changed economic circumstances and lowered compliance cost for sectors covered by the scheme. However, as a result of this reduced demand in combination with the accelerated inflow of international credits and what in some cases has been an over-allocation of allowances by Member States for phase 2 covering the period 2008 to 2012, an imbalance between supply and demand has resulted in a surplus of around 2 billion allowances building up since 2008[77].

While from 2014 onwards the rapid build-up of the surplus is expected to come to an end, the overall surplus is not expected to decline significantly during phase 3. The magnitude of the surplus by 2020 will depend significantly on longer term energy developments, such as the penetration of renewable energy and on-going efforts to increase energy efficiency, as well as on the speed of economic recovery.

While the use of international credits has been part of a cost effective solution to emission reductions and a first step towards a global carbon market, it has also contributed to uncertainty on what effort is required domestically, as well as having contributed to the surplus of allowances in the ETS. Furthermore, EU industry and governments via the Clean Development Mechanism have indirectly supported technological modernisation in competing sectors, especially in emerging economies such as China, India and Brazil.

5. The surplus has resulted in an ETS price signal too weak to significantly affect the price of fossil fuelled power generation, which if unaddressed will have a long lasting effect on the ability of the ETS to provide an incentive to invest in low carbon energy technologies such as renewables. In combination with today's high gas to coal price ratio, it can lead to carbon lock-in.

When the three 2020 targets were agreed, the expectation was that there would be a positive impact from the GHG target and in particular from the ETS on both energy efficiency and renewables by increasing notably the price of electricity generation based on fossil fuels and the resulting price signal to energy consumers and a comparative advantage for generators of electricity from renewable energy sources.

Indeed, by creating an incentive for companies to invest in technologies that cut emissions as well as by increasing notably the price of electricity generation based on fossil fuels, the ETS is meant to be a key driver of investments in low carbon technologies[78]. The market price of allowances - the ‘carbon price’ - creates a greater incentive the higher it is[79].

But the recent level of the ETS price has been too low to produce such incentives. The combination of an increasing supply of allowances and international credits on the one hand, and low demand on the other, has been reflected in the observed ETS price evolution since 2008. From a high of just short of 30 €/t C02 in 2008, the ETS price reached a historic low of 3 €/t C02 in May 2013, slightly increasing to around 5 €/t C02 since then.

According to many companies included in the ETS, the ETS price at current levels has become increasingly less important for investment decisions[80]. And this is in spite of the fact that the ETS emission cap decreases to around -21% by 2020 compared to 2005 and continues to decrease at the same pace after 2020, in principle giving a legal guarantee that major low- carbon investments will be needed.

The low carbon price has been one of the driving factors, along with falling coal prices and a correspondingly increasing gas to coal price ratio, for the recent growth in the consumption and imports of coal witnessed in the EU, alongside falling consumption of natural gas[81]. This provides one illustration of how the EU ETS is at current low' prices not incentivising switching away from the more polluting forms of power generation.

6. The low ETS price has also increased the need for public funding to achieve longer term emission reductions. However, while a (higher) carbon price is an important driver, it alone may not be enough to provide sufficient incentives for developing innovative low carbon technologies and related infrastructures.

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[77] Carbon Market Report COM(2012) 652 and SWD(2012) 234.

[78] European Commission, 2012, the State of the EU Carbon Market in 2012

[79] European Commission, 2013, EU ETS Factsheet 2013

[80] Conclusion from survey conducted in 2012 by Thomson Reuters Point Carbon of 363 EU ETS operators.

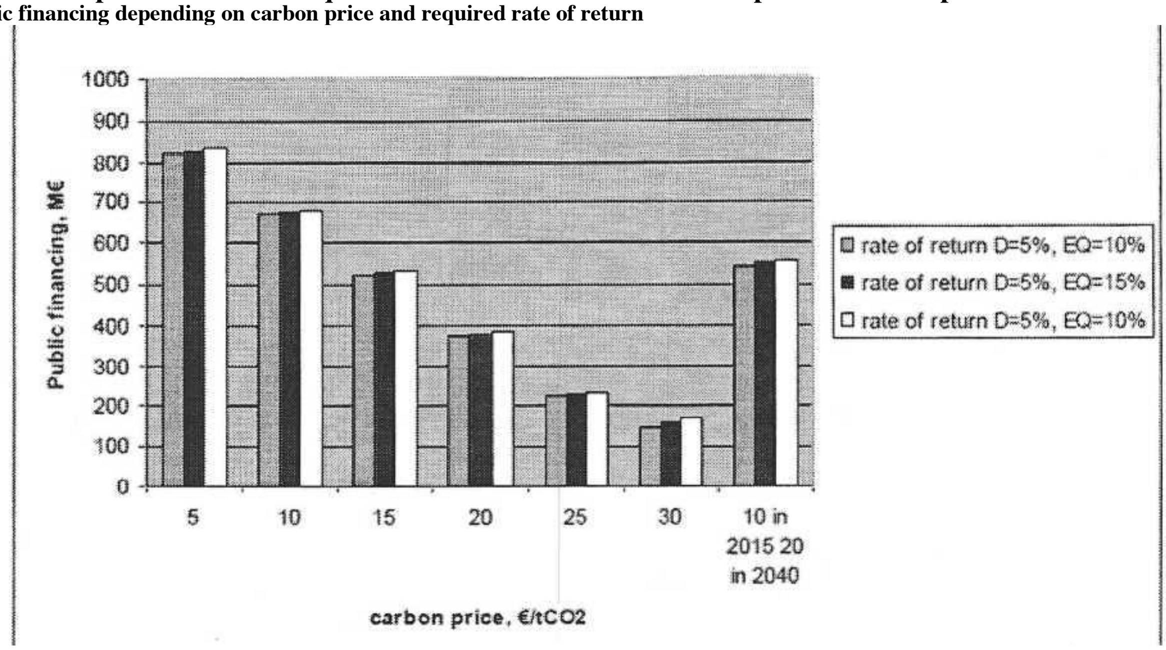
[81] Annual natural gas consumption in 2012 was 4% lower than in 2011. In contrast, EU consumption of coal has remained relatively stable over 2012, while imports of hard coal went up by approximately 8% in 2012 compared to 2011.

A low carbon price does not only negatively affect low carbon investments, it also increases the need for public support for low carbon technology development necessary to achieve emissions reductions.

Taking the example of carbon capture and storage (CCS), the lower the carbon price, the higher the public funding required to install CCS in a new pulverised coal plant. At 5 €/t C02 and the current stage of technology development, more than €800 million of public finances would be required to install CCS in a coal plant, while this amount falls to less than €200 million for a carbon price of 30 €/t C02[82].

[82] See

Figure 1 - Upfront subsidies required to install CCS in a new build pulverised coal plant
Public financing depending on carbon price and required rate of return



(D=debt taken on to finance die project: EQ-equity part financing the project)

Source: PROPORTIONATE IMPACT ASSESSMENT accompanying the document Commission Regulation (EU) No of XXX amending Regulation (EU) No 1031/2010 in particular to determine the volumes of greenhouse gas emission allowances to be auctioned in 2013-2020

Also, an increasing value of ETS allowances would directly benefit a limited number of available investments in low carbon projects as of the 300 million allowances from the EU- wide new entrants reserve for phase 3 that are available to stimulate the construction and operation of large-scale demonstration CCS projects as well as innovative renewable energy technologies (NER300 programme), 100 million allowances are to be monetised by the end of 2013. This means that every €1 increase (or avoided drop) in the carbon price in 2013 will lead to a €100 million increase in revenue available for these types of projects[83].

Irrespective of the level of the carbon price, some commentators have argued that carbon pricing by itself is insufficient to drive investment in research and development of new technologies[84], while others have reflected that while the carbon price can contribute to the financial viability of a low-carbon project, uncertainty about the future carbon price may complicate decision-making particularly for financing of projects[85]. Empirical studies found some impacts of the EU ETS on innovation, however with limited scope[86].

In addition, the ETS price is only one element in the economic decision to invest or not in low carbon technologies. The optimal investment solution is always specific to the demand and supply situation of the investor and the expectations he or she has about the evolution of

[83] See
[84] See "The case for carbon pricing", Grantham Research Institute, 2011
[85] Climate Policy Initiative, 2011, Carbon pricing for low-carbon investment
[86] E.g. Rogge K.S., Schneider, M. Hoffmann, V.H. (2011): The innovation impact of the EU Emission Trading System — Findings of company case studies in the German power sector. Ecological Economics, Vol. 70, pp 513-523; Calel, R., Dechezlepretre, A. (2012): Environmental Policy and Directed Technological Change: Evidence from the European carbon market.

electricity, fuel and carbon prices as well as other operational costs, demand levels and profiles, the behaviour of competitors and the stability of the regulatory and market framework.

One survey[87] revealed not only that the ETS alone may not be sufficient to drive low-carbon investments, but also that there are a variety of other factors that companies consider more important or as important as the ETS for investment choices. For instance, power generators reported that access to fuel and public perception that affects the permitting process are important factors for investment decisions, and power technology companies reported that technology-specific policies such as feed-in tariffs, where they exist, are the most important factors for sales and R&D investments.

7. The current impact of the ETS price on power prices is marginal. Its influence on demand side energy savings is therefore limited. However, at substantially higher levels of the ETS price, the impact on power prices and on electricity savings could be considerable.

The impact of carbon prices on power prices has typically been measured by considering the C02 transfer factor for power supplied by combustion plants. The transfer factor is defined as the increase in the annual average power wholesale price associated with a C02 cost of 1 €/ton C02, i.e. the transfer factor is measured as €/MWh per €/ton C02.

The average transfer factor in a thermal power system is the average of the marginal C02 cost for all hours during the year. In a thermal system with a mix of different technologies and fossil fuels, it has been estimated that the average transfer factor lies between the transfer factor for gas power generation (0.4 tC02/MWh) and coal power generation (0.8-0.9 tC02/MWh)[88].

However, if the share of renewable electricity generation increases or the system has a high share of older, less efficient, coal generation facilities, the average transfer factor may be outside this range. For Combined Cycle Gas Turbine (CCGT's) plants for example, which are expected to be the thermal power plant of choice in the future to act as back-up for renewable energy power plants, the transfer factor can be even lower than 0.4 tC02/MWh.

In the recent Impact Assessment (IA) on backloading, an average C02 emissions factor from power production in the EU of 0.465 tC02/MWh is used. This was also the C02 emissions factor used in the IA for the state aid measures in the ETS and in the 1A relating to the 2010 carbon leakage decision. Making the simplifying assumption of full cost pass through, it would mean that a 1 Euro increase in the carbon price would translate into an increase in the electricity price of € 0.465/MWh.

The cost of electricity for EU industry as an end-user in 2012 was between € 94/MWh and € 226/MWh with an average of around € 137/MWh[89]. Thus assuming a transfer factor of 0.465 tC02/MWh, a 65 increase in the carbon price would lead to a €2.3/MWh increase in electricity prices, amounting to 1.7% of €137/MWh, which must be considered insignificant in relative terms, not least given the conservative assumption of full cost pass-through. The relative impact on wholesale prices would however of course be greater.

On this basis, it is clear that the ETS at present price levels only has a marginal impact on wholesale electricity prices. The impact from the ETS is dwarfed by the fluctuations and modest upward trend of wholesale prices noticed over the last three years (largely driven by other factors than the ETS), let alone changes in end-user prices over the same period. In addition, there is some evidence that short term price elasticity of electricity demand and hence the short term effects of price changes on energy savings are limited (see point 9).

However, even if energy demand is deemed relatively price inelastic in the short term, it cannot be concluded that any price increases will not have an impact on behaviour. Significantly higher carbon and/or energy prices could change the price elasticity of demand observed, providing much increased incentives for consumers to invest in more energy efficient products.

It should also be highlighted that C02 transfer factors vary considerably between Member States, and can be quite considerably higher than the EU average. As an example, estimated transfer factors for the power

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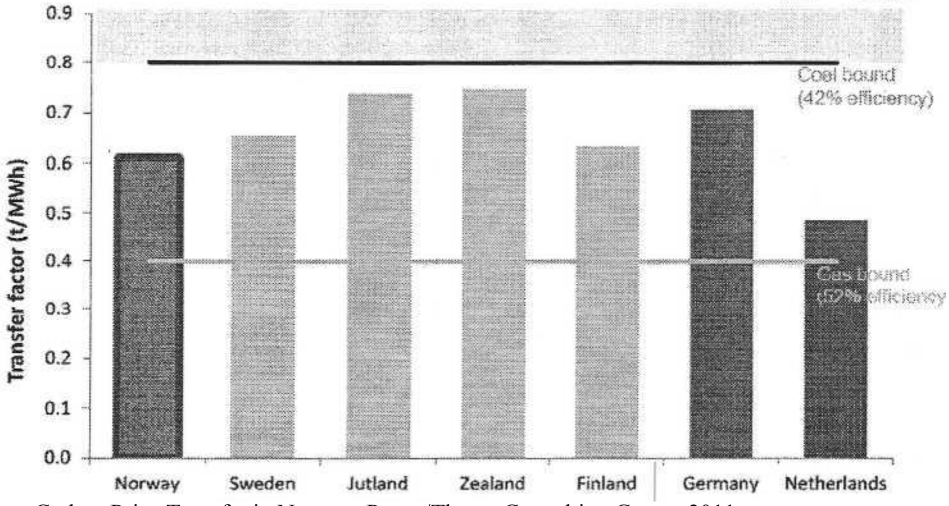
[87] ISI Fraunhofer, 201 ¡„Relative Importance of Different Climate Policy Elements for Corporate Climate Innovation. Activities: Findings for the Power Sector

[88] Poyry and Thema consulting group, 2011, Carbon Price Transfer in Norway. The Effect of the EU-ETS on Norwegian Power Prices, Poyry and Thema consulting group

[89] Eurostat numbers for the second semester of 2012 for the middle industrial consumption band (Ic: 500 MWh < Consumption < 2 000 MWh). The average is a simple, non weighted, mean average.

market areas in North West Europe (Nordics, Germany and the Netherlands) are illustrated in figure 2 below[90] .

Figure 2 - Estimated C02 transfer factors for Norway and power markets in NWE



Source: Carbon Price Transfer in Norway, Poyry/Thcma Consulting Group. 2011.

All transfer factors in the figure above lie between the typical emission factors for gas (0.4 tC02/MWh) and coal generation (0.8-0.9 tC02/MWh), shown by the horizontal lines in the figure. The highest transfer factor in this group is in Denmark (Zealand = 0.76 tC02/MWh), which has the highest share of coal power generation, and the lowest transfer factor is in the Netherlands (= 0.5 tC02/MWh), with the highest share of gas pow'er generation.

Note that the estimated transfer factor for Norway (=0.6 tC02/MWh - also shown in figure 2) appears to be high given that Norwegian power generation is almost 100% based on renewables and as such, practically C02 free. This is because of the high interconnectivity of the Norwegian market with neighbouring, Nordic markets, which have substantial thermal power generation. There is thus a spill-over effect of the carbon intensity of power generation on neighbouring, interconnected markets, and the more interconnected the markets, the greater the convergence in national transfer factors from C02 into electricity prices (as well as electricity prices themselves)[91].

But even with a transfer cost at the low end of these estimates, it would not take a very high carbon price before the impacts on the costs of power generation become substantial. An analysis undertaken by Frontier Economics for Business Europe[92] assuming a (rather low) transfer factor of 0.3 tC02/MWh for a CCGT plant, a relatively high ETS price of €50/t of C02 would amount to around 20% of the total costs of gas-fired generation, and a more modest level of €20/t of C02 would still equate to around 9% of total costs (see figure below)[93].

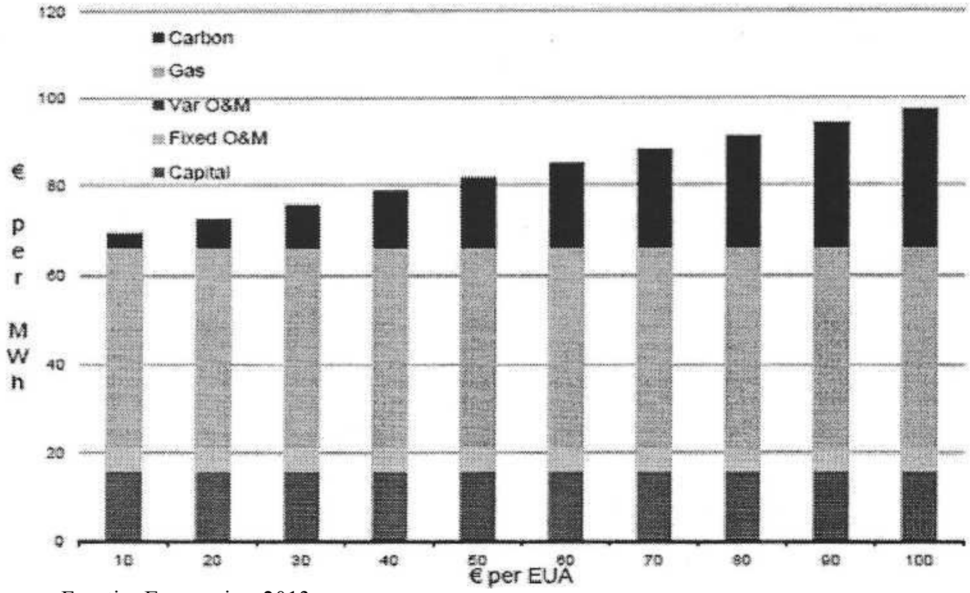
[90] Poyry and Thema consulting group, 2011, Carbon Price Transfer in Norway. The Effect of the EU-ETS on Norwegian Power Prices

[91] Poyry and Thema consulting group, 2011, Carbon Price Transfer in Norway. The Effect of the EU-ETS on Norwegian Power Prices

[92] Frontier Economics report prepared for Business Europe, May 2013, Lessons leamt from the current energy and climate framework

[93] The calculation assumes a gas price of €26 per MWh (thermal). Other assumptions are a plant efficiency of 58% and cost of capital of 8% (real, weighted average cost of capital consisting of debt and equity).

Figure 3 - Impact of carbon prices on cost of gas-fired generation.



Source: Frontier Economics, 2013.

For such transfer factors to have an impact on consumers however, the degree to which such costs are passed through to either household or industrial consumers must be assessed. As long as price regulation persists in parts of the EU as it still does today, and as long as the completion of the internal energy market continues to be further delayed, consumers in a number of Member States will continue to be artificially insulated from such cost increases and the incentive effect of the ETS dampened.

8. Free allocation to energy intensive sectors and along with low carbon prices have resulted in a very low risk of carbon leakage at present. State aid for electricity intensive industries can be an effective way of preventing indirect impacts but has given rise to concerns by some stakeholders regarding distortions of competition across Member States.

See Annex [X] (carbon leakage assessment).

9. A number of EU policies, high fossil fuel prices and reduced demand due to the crisis have contributed to GHG emission reductions. Well-designed, specific, energy savings measures addressing non-price barriers such as split incentives, high private discount rates, limited access to finance or imperfect information are complementary to price signals. The C02 and cars regulation is a good example of such effective complementary regulation.

It is not possible to say how much of the total EU GHG emissions reductions is directly attributable to the ETS. GHG emissions have also decreased due to the impact of the economic crisis and high fossil fuel prices, which have given additional incentives for fuel efficiency. Emissions reductions have also been achieved through the other policies implemented in the Climate and Energy Package[94] and related EU law, notably energy efficiency measures such as the eco design framework setting minimum energy efficiency standards for a range of domestic and industrial appliances and the fossil fuel displacement generated by strong growth in the use of renewable energy.

Further reductions in particular in non-ETS sectors have been generated by other supporting national and sectoral EU policies and range for the EU from policies that regulate C02 emissions and improve energy

[94] This includes: Directive 2009/28/EC on the promotion of the use of energy from renewable sources (which divides the 20% renewables target by 2020 into targets per Member State); Decision No406/'2009/EC on the effort of Member States to reduce GHG emissions (which defines targets per Member State for sectors not included in the ETS. Together with the emissions cap in the ETS directive this results in a 20% GHG reduction in 2020 compared to 1990); Regulation (EC) No 443/2009 on emission performance standards for new passenger cars (which regulates average levels of C02 emissions of newly sold cars in the EU); Directive 2009/30/EC (Fuel Quality Directive) to reduce the carbon content of fuels sold in the EU over their life cycle; Directive 2009/31/EC on the geological storage of carbon dioxide to create an enabling framework for carbon capture and storage.

efficiency for cars and vans, to the Regulation on certain fluorinated greenhouse gases and Mobile Air-Conditioning Systems Directive to specific waste, environmental and agricultural policies.

Supporting the logic of a combination of carbon pricing as a broad-brushed tool and complementary EU energy efficiency policy measures, the IEA[95] argues that carbon pricing does not address several market and behavioural failures such as split incentives, high private discount rates, limited access to finance or imperfect information in areas such as appliance electricity use, road fuel consumption and building heating and cooling energy use and considers that policies which address such failures can therefore be considered complementary to carbon pricing.

Low price elasticity of energy demand[96] in the EU is an oft-cited reason for a possible ineffectiveness of carbon (or energy) prices to address certain energy efficiency barriers[97], with some evidence that price elasticities of residential energy demand in the short term are generally low, with some variations by country and region. The high price needed to achieve changes in residential energy demand only by price changes would lead to challenges on other issues, i.e. distributive effects, economic impacts, equity issues[98]. Such low elasticities can be explained as follows: with regard to heating, while residential consumers can switch between several sources, in reality switching is deemed too costly an investment, even in the long term[99]. Moreover, many residential energy users are faced with financial constraints that limit the possibility to make upfront energy saving investments even if such investments would pay back in a relatively limited period of time.

On the other hand, several studies for the transport and building sectors indicate that in the long term energy demand can be rather elastic, with price elasticities being significantly higher than in the short term[100]. Other studies have found that the combined impact of information and price instruments increases effectiveness most[101].

Such evidence provides some support for an EU approach which combines instruments to achieve GHG emission reductions via improvements in energy efficiency, in particular in non-ETS sectors. However, given that certain specific measures reducing energy demand also impact on quantity-based carbon pricing instruments such as the EU-ETS, care has to be taken to take account of these interactions when designing the measure[102].

Another way in which the EU ETS can have an effect on energy efficiency is via auctioning revenues used to fund energy efficiency measures. One example is Germany, which has earmarked ETS auctioning revenues to be deposited into a "Special Energy and Climate Fund", which will serve the purpose of financing various environmental and energy efficiency policies[103]. The French government has also announced recently that all the proceeds from ETS auctioning will finance the renovation of at least 500,000 homes per year, with a scope to achieve the EU energy efficiency objectives[104]. The carbon price plays an important part, as it will determine how much funds become available for such measures.

10. The low ETS carbon prices and corresponding auctioning revenues, and the impact on prices of emission allocation transfers between Member States of the overachievement of the effort sharing targets at the overall

[95] IEA, 2011, Summing up the parts: Combining Policy Instruments for Least-Cost Climate Mitigation Strategies

[96] The extent to which a change in final energy prices will lead to a change in energy consumption is measured by the price elasticity of energy demand. The higher the elasticity, the more energy users will react to changes in price.

[97] IEA, 2009, Gadgets and Gigawatts: Policies for Energy Efficient Electronics

[98] McKinsey Global Institute, 2007, Curbing Global Energy DemandGrowth: The Energy Productivity Opportunity, McKinsey Global Institute, San Francisco; IEA, 2011, Summing upthe parts:CombiningPolicy Instrumentsfor Least-Cost Climate Mitigation Strategies

[99] McKinsey Global Institute, 2007, Curbing Global Energy Demand Growth: The Energy Productivity Opportunity, McKinsey Global Institute, San Francisco.

[100] E.g. P. Gcilenkirchen, K. Geurs (PBL); FI.P. van Essen, A. Schroten, B. Boon (CE Delft): Effecten van prijsbeleid in verkeer en vervoer. Bilthoven ; Delft : Planbureau voor de Leefomgeving (PBL); CE Delft, 2010; Reinhard Madlener, Ronald Bernstein, Miguel Ángel Alva González (2011) Econometric Estimation of Energy Demand Elasticities. E.ON Energy Research Center Series. Volume 3, Issue 8, October 2011.

[101] See e.g. Scholl, G. et al. (2010): Policies to promote sustainable consumption, Natural Resources Forum, Vol. 34, pp 39-50

[102] IEA, 2011, Summing up the parts: Combining Policy Instruments for Least-Cost Climate Mitigation Strategies

[103] European Parliament, 2013, Energy Efficiency and the ETS,.

[104] European Parliament, 2013, Energy Efficiency and the ETS,.

EU level combined with access to international credits reduce related redistribution effects envisaged in the climate and energy package.

See the detailed analysis of distributional effects under lower carbon prices as assumed in the Climate and Energy Package in the Member State results analysis of options beyond 20% GHG emission reductions[105]. The now projected overachievement of the Effort Sharing Decision at EU level in reference highlights the salience of this issue.

11. Regulatory uncertainty about the way forward and concerns about a lack of effectiveness of the ETS have reduced the confidence of carbon market participants and are in some cases already leading to a fragmented approach to decarbonisation within the EU which would be contrary to the internal energy market.

Some Member States concerned about the evolution of the ETS have taken, or are considering taking national measures, such as carbon price floors or taxes for carbon intensive fuels in ETS sectors. There is a concern that the regulatory uncertainty about the way forward with the ETS is increasing the risk of policy fragmentation, in turn threatening the Single Market, with national and sectoral policies undermining the role of the ETS and the level playing field it has created.

12. The obligation of the amended Fuel Quality Directive for all fuel suppliers to reduce the life cycle greenhouse gas emissions from their supply of road fuels by 6% in 2020 has proven to be complex to implement but has the benefit that it will apply equally to importers and domestic producers of fuels

The Fuel Quality Directive (FQD), as amended in 2009 as part of the Climate and Energy package, introduced an obligation for fuel suppliers to reduce the life cycle greenhouse gas emissions from their supply of fuels used in road (and non-road mobile machinery) by 6% in 2020 from a 2010 baseline. The FQD target is expected to be met by substituting fossil fuels with a) lower GHG intensity fuels including sustainable biofuels. Liquefied Petroleum Gas (LPG) and methane (Compressed Natural Gas, Liquid Natural Gas and bio-methane), b) with electricity and hydrogen, and c) by reducing upstream emissions of fossil fuels in and outside of the EU.

While the methodology for calculating the greenhouse gas emissions for biofuels was included in the FQD at the time of adoption, the methodology to be used by suppliers for calculating the lifecycle greenhouse gas intensity of fossil fuels was left to be developed through comitology. The methodological challenge is to ensure fuel suppliers can calculate life cycle emissions, incorporating an adequate level of accuracy but balancing the associated administrative burden,: The development and evaluation of such a methodology is complex.

In this context, a draft implementing measure harmonising the method for calculating greenhouse gas emissions from fossil fuels and electricity in road vehicles was submitted to the Fuel Quality Committee of the Member States on 4 October 2011. The Committee vote on the implementing measure held on 23 February 2012 resulted in a "no opinion", given that a number of Member States claimed to be unable to finalise their position in the absence of an assessment of the economic impacts of the proposed measures. In accordance with the relevant comitology procedure, an impact assessment considering a number of options was finalised in August 2013, and will be followed by anew Commission proposal to the Council.

Other major economies are reviewing proposals for or have/ has adopted similar legislation: The states of California and Oregon in the USA and the province of British Columbia in Canada have adopted legislation for reducing life cycle greenhouse gas emissions from transport fuels; commonly known as Low Carbon Fuel Standards (LCFS). In addition the governors of the state of Washington and eleven other north-eastern states have either directed their respective departments to evaluate and develop a similar LCFS or have joined to evaluate and develop one standard for their region. The latter includes the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New York, New Hampshire, New Jersey, Pennsylvania, Rhode Island and Vermont.

[105] SWD (2012)5

One benefit of such a policy is that it will apply equally to importers and domestic producers of fuels.

13. The pledges under the Copenhagen Accord and Cancún decisions have led to a variety of national policies and measures, including carbon markets. However, the existing pledges are not delivering sufficient reductions by 2020 and no new comprehensive international climate agreement has been achieved yet that ensures that the global community as such is on track to keep global warming below 2°C.

More than 110 countries, accounting for 85% of global emissions and including all major economies in the global community have formally pledged to take action to mitigate climate change in the context of the UNFCCC.

The EU ETS is at present the largest functioning carbonmarket, butothers are being implemented and developed. For example, Australia adopted its Carbon PricingMechanism legislation; China is pushing ahead with the design of its seven emissions trading pilots which could begin in late 2013; South Korea is developing its trading scheme.

Major economies have enhanced their fuel economy standards (in US, China, Japan, and India is considering new policies) and some countries undertaken significant reforms of their tax and subsidies to improve their energy security (Iran, Indonesia, South Africa, India). Over 100 countries have renewable energy policies, and especially fast-growing economies are developing support schemes to enable investments in renewable energy (ex: Philippines, China and Chile).

But the existing pledges are not delivering sufficient reductions by 2020 to be on track to prevent a dangerous 2° C rise of temperature. At the UN Climate conference in Durban in 2011, the need to act collectively, and with greater urgency and ambition was recognised. All parties agreed to negotiate by 2015 a global climate regime applicable to all after 2020 and agreed to enhance mitigation efforts to close the pre-2020 mitigation gap.

2. The 20% renewable energy target and implementing measures

1. The renewable target has contributed to good progress in penetration of renewable energy in the EU energy mix

By 2011, renewable energy represented 12.7 % of the EU's gross final energy consumption. The key instrument for achieving this progress has been the Renewable Energy Directive[106] and the national measures implementing it. The share of renewable energy has increased in every Member State since 2005. By 2010, 20 Member States had already exceeded the indicative 2011/2012 targets.

Member States have also progressed towards meeting the 10% by 2020 renewable energy target in transport. In 2010, renewable energy use in the transport sector was 4.7% of the energy consumed in that sector (above 95% of which was biofuel - amounting to 4.5%), only marginally falling short of the planned 2010 EU share of renewable energy in transport (of 4.9%).

The Directive established national legally binding targets which have provided the incentives to national governments to undertake a range of measures to improve the uptake of renewable energy. These include improvements to national planning and equipment/installation authorisation processes and electricity grid operations (connection regimes etc.), some of which are explicitly required by the Directive. Financial support has also been used by Member States to increase uptake, compensating for the various market failures that result in suboptimal levels of renewable energy.

2. The EU has made good progress towards the 2020 target, but not all Member States are likely to meet their respective targets without additional efforts

The progress to date means that the EU has met its interim target. However, as the trajectory grows steeper, more efforts will still be needed from Member States in order to reach it[107]. In addition, not all Member States are on track to meet their respective targets, and recent evolutions such as for instance retroactive changes to support schemes is causing concern as to whether the overall EU target will be met.

3. The efforts to promote a range of renewable energy technologies have significantly reduced the costs

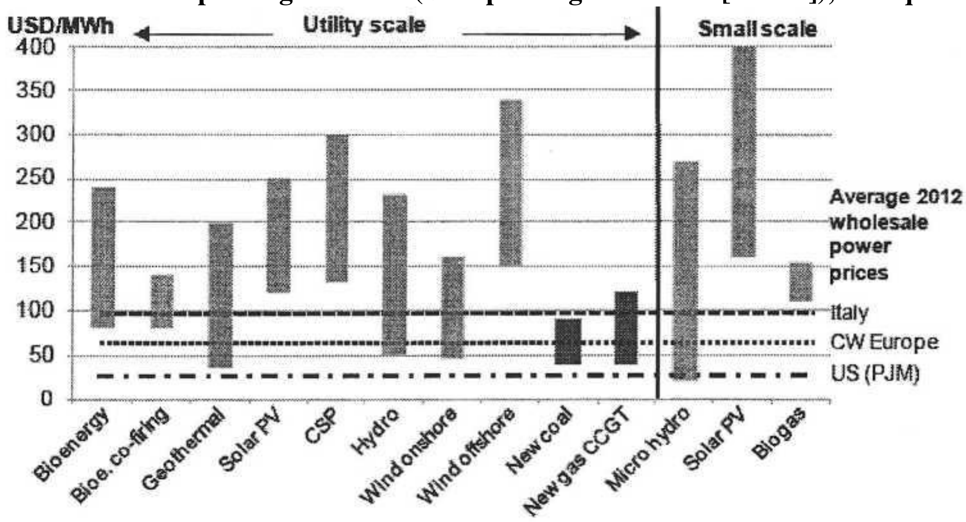
[106] Directive 28/2009/EC.
[107] See the Commission Renewables Progress Report.

of these technologies

Some renewable technologies in certain markets are already competing with state of the art fossil-fuelled power generation, even at low levels of the ETS price[108].

Figure 4 below shows the latest IEA estimations of the levelised costs[109] of power generation in the OECD.

Figure 4 - Levelised costs of power generation (USD per megawatt hour [/MWh]), first quarter 2013



Notes: MWh = megawatt hour; CCGT = combined cycle gasification turbine. Costs are indicative and ranges reflect differences m resources, local conditions and! the choice of sub-technology. Wholesale power prices are expressed as the annual average of daily traded, day-ahead base-bad power prices. €W Europe refers to annual average of power prices in France, Germany, Austria and Switzerland. United States (US] PJM refers to the regional transmission organisation covering parts of 13 states in the mid Atlantic and mid-west portion of the United States.

Source: IEA, 2013, Medium Term Market report on Renewable Energy

Within the cost ranges for different technologies shown in the chart, OECD Europe is included, taking into account the prevailing carbon price in the first quarter of 2013, which has been very low. And yet, it can be seen that at the lowest end of the range, a number of RES technologies (geothermal, hydro and onshore wind, for instance) are in some cases already competing with new coal and gas power generation, even at very low carbon price levels.

At the other end of the scale, those renewable technologies which would clearly need a strong carbon price signal to compete without additional support include solar PY (in particular small scale) and offshore wind.

However, the costs of decentralised solar PV systems are becoming lower than retail electricity prices that system owners would otherwise pay in places such as Spain, Italy, southern Germany, southern California, Australia and Denmark[110].

And according to the latest data on Germany, solar PV currently receives a feed-in tariff equivalent to only 137 $/MWh (102 €/MWh)[111]. For countries further south in Europe with more sunlight the costs could be even lower.

4. The 2020 renewable target is expected to contribute to significant reductions in GHG emissions.

Just as it is not possible to say exactly how much the ETS has contributed to reductions in GHG emissions,

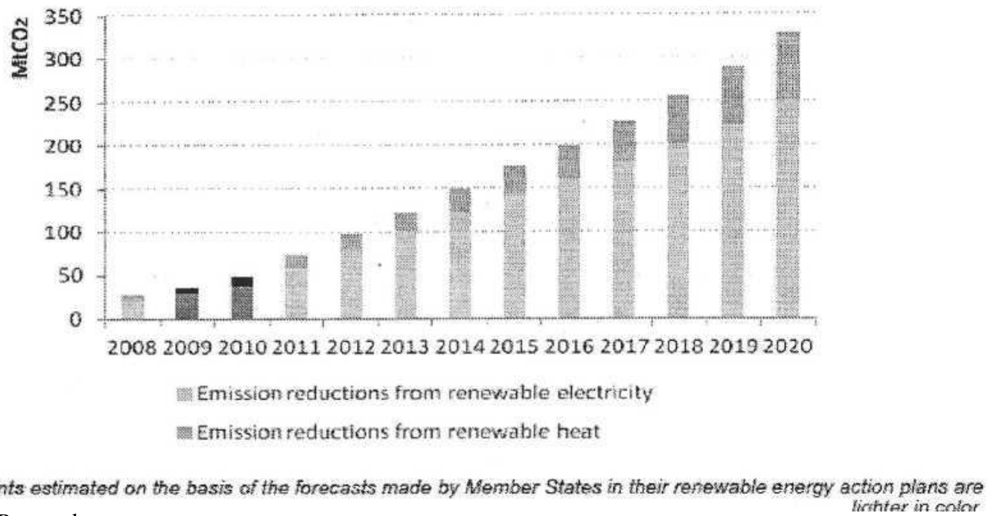
[108] See IEA, 2013, Medium Term Market report on Renewable Energy.
[109] The levelised cost approach is a financial model used for the analysis of generation costs. It focuses on estimating the average levelised costs of generating electricity over the entire operating life of the power plants for a given technology, taking into account main cost components, namely capital costs, fiiel costs and operations and maintenance (O&M) costs. This analytical framework is flexible and allows specific cost factors (e.g. contingency, decommissioning, carbon prices) to be considered. The LCOE is equal to the present value of the sum of discounted direct costs divided by the total production of the generating unit (IEA).
[110] See IEA, 2013, Medium Term Market report on Renewable Energy.
[111] Http://www.bundesnetzagentur.de/

attributing exact reductions to specific renewable policies is not possible. The extent of the effect also depends on the extent to which renewable policies impact more the ETS or the non ETS sectors.

However, in general renewable energy substitutes other forms of energy, including fossil fuels with considerable greenhouse gas emissions. Model runs done by the IPCC indicate that each GJ of additional renewable energy leads to a reduction in primary energy of 400 kg/GJ of CO_2 (average for all forms of renewable energy)[112].

Estimates have been carried out of how much the 2020 renewable target is expected to contribute to overall emission reductions by 2020. Over the period between 2008 and 2020, Member States' renewable energy development programmes are expected to reduce gross emissions by 2 GtC02[113], with over 80% of this amount from the electricity sector (Figure 5). This would represent 40% of the 5 GtC02 reduction effort required from the ETS sectors between 2008 and 2020. as established when the Climate & Energy package was drawn up or almost half (-9.3%) of the total GIIG emissions reductions required, which is considerable[114].

Figure 5 - Annual C02 emissions reductions caused by the RES Directive



Source: CDC Climate Research

The cost of reducing GHG emissions through specific renewables measures can be substantially different than the marginal short term cost of reducing emissions required to reach the cap in the ETS sector (reflected by the ETS price) but at the same time is delivering additional benefits beyond GHG reductions, and can improve long-term cost efficiency by encouraging the development of new technologies.

5. Between 1990 and 2011, renewable energy production in the EU is likely to have contributed to decreased import dependence, having grown by 90 mtoe per year during that period. Renewables production also helps to reduce fuel costs.

Much increased renewable energy consumption in the EG has been achieved through developments in EIJ renewable energy production, which has the potential to contribute to lower energy import dependence and, therefore, a lower energy import bill.

EU production in renewable energy has increased significantly in recent years (by 231% between 1990 and 2011). At the same time, the production of non-renewable energy sources has fallen (by -27%).

Over the same period (1990 to 201:1), the EU's net energy imports increased by 24%. Without the contribution of (increasing) domestically produced renewable energy, the EU's net energy imports would have possibly increased by more. While the exact contribution of renewables to reduced import dependency cannot precisely be estimated, it should be noted that 90 Mtoe is the difference between renewable energy produced domestically in the EU in 2011 and 1990. Increased renewable energy production may also have reduced energy demand, and will to some extent also have displaced production of domestic non-renewable

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112 IPCC - Special report on renewable energy (2012)

113 This estimate, calculated by CDC Climate Research, was obtained by multiplying the additional amounts of renewable energy provided for in national action plans for 2008 and for the period between 2011 and 2020 by the emission factor of alternative energies used by Member States in their report to the Commission.

114 "Energy Efficiency, Renewable Energy and C02 Allowances in Europe: A Need for Coordination", Climate Brief, no. 18, CDC Climat Research, September 2012

sources.

Altogether, the avoided costs of imported fuel saved thanks to the use of renewable energy are estimated to amount to around €30 billion in the EU in 2010 compared to an external trade deficit in energy products that year of €304 billion[115]. This estimate applies rather cautious assumptions and should be considered as a low estimate.

Looking forward, it is expected that the avoided fuel costs will rise in the coming years due to increasing production of renewable energy in the EU and a projected increase in EU fossil import prices[116].

6. *Renewable energy production in the EU has created or maintained somewhere between 800.0 and 1.2 million jobs by 2011*

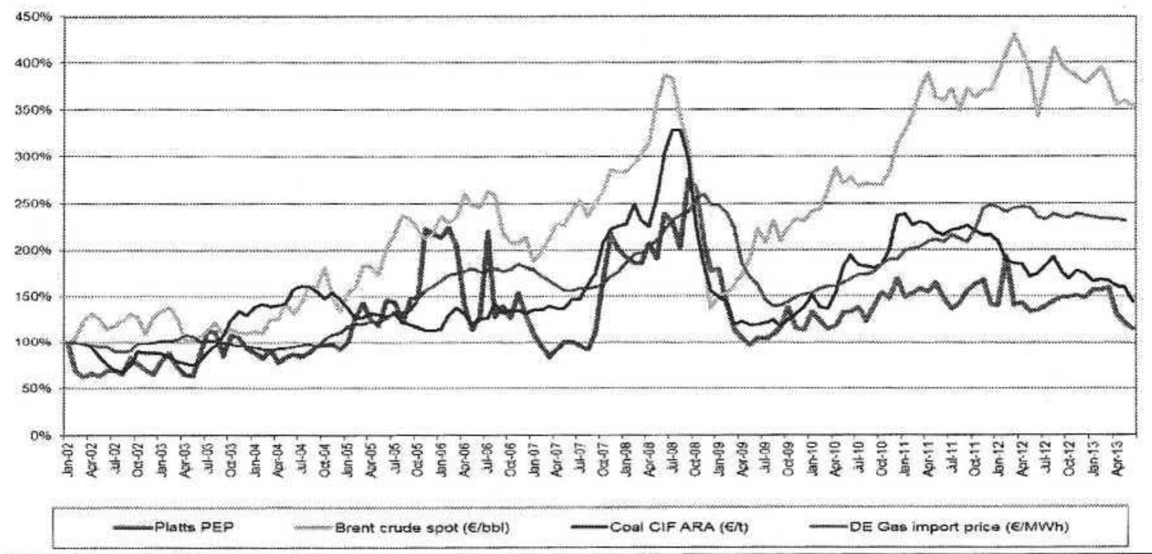
According to a report[117] commissioned by the European Commission, energy supply sectors in the EU in 2010 employed 2,413,500 persons. Of that amount, it is estimated that the renewable energy sector directly employed between 320,000 and 440,000 workers. Including indirect jobs, it is estimated that the renewable energy sector sustained between 800,000 and 920000 workers in 2010. This compares to an estimate of 1.2 million jobs in 2011 in an earlier report for the European Commission[118].

7. *Increasing renewable energy in the power generation mix has contributed to reduced wholesale power prices but its support mechanisms have contributed to increased retail prices*.

The increasing deployment of renewable energy sources - mainly solar and wind power generation - has had a beneficial impact on the operational costs of power generation costs, further weakening the link between power prices and fossil fuels.

As the figure below shows, parallel to increases in the share of renewable energy in power generation, wholesale power prices have risen less than the prices of oil and gas, and until recently coal, suggesting that the increased share of renewable electricity may have contributed to lessening increases in prices.

Figure 6 - Comparison of European wholesale power, oil, gas and coal prices. January 2002-100%



Sources: Platts, BAFA, ENTSO-E.

Platts PEP: Pan European Power Index (in €/MWh), Coal CIF ARA: Principal coal import price benchmark in North Western Europe (in €/Mt)

DE gas border import price is the average price of natural gas on the German border (in €/MWh)

In some markets where hydro generation is significant, the combination of rainy weather and high levels of hydro generation can result in very cheap wholesale power prices, as could be observed most recently in Spain

115 Report on economic aspects of energy and climate policies, 2013, European Commission, DG ECFIN

116 Report on economic aspects of energy and climate policies, 2013, European Commission, DG ECFIN

117 Employment Effects of selected scenarios from the Energy roadmap 2050, COWI, Forthcoming.

118 Eurobserver and Commission Communication "Towards a job-rich recovery" COM(2012) 173 final"

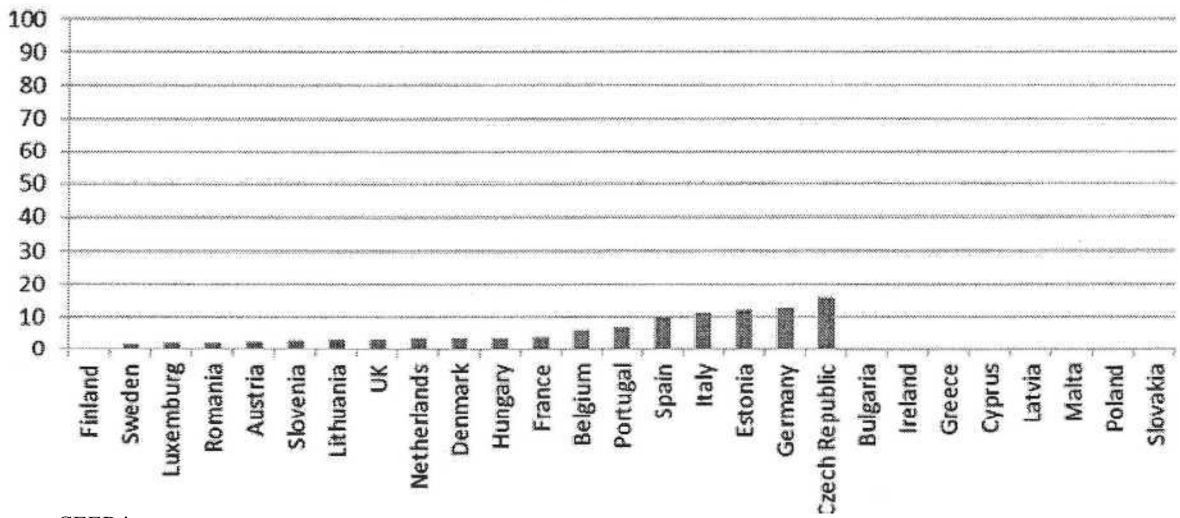
during March-April 2013 or in the Nordic market in the summer of 2012[119].

Increasing share of wind and solar power generation can also contribute to the reduction in the difference between the baseload and peakload period prices, especially when the peak of the variable power generation coincides with peak power demand hours. In many markets, the daily average peakload price is less than the daily baseload average price on many trading days for this reason.

While there has been a positive impact on wholesale prices from renewable energy, the costs of the renewables support mechanisms that have been put in place throughout the EU have typically been passed through to final consumers, as an additional component of the power price.

Renewable surcharges as a proportion of final household electricity prices vary significantly in the EU, as can be seen in the figure below. The 2011 average for the 18 Member States for which data is available is 5.6%. it ranged from representing only 0.2% (Finland) to 15.9% (Czech Republic) of final household electricity prices. Member States with a relatively low burden of renewables surcharges relative to final electricity price (less than 5%) include also Sweden, the UK, France and Romania. On the other hand, in Member States such as Germany, Spain, Italy and Estonia, renewable surcharges represent between 10% and 12.7% of the final household electricity price[120].

Figure 7 - Renewable surcharges as a proportion of household electricity price, 2011, in %



Source: CEER.'

8. *While the financing costs of renewables remain high, in markets in which predictable long-term policies are in place, the business case is strong and there are many circumstances in which renewables can be competitive*

In recent years, both high fossil fuel prices and a supportive regulatory framework have provided support for low-carbon technology investments.

On the other hand, higher investment rates have tended to penalise more heavily capital- intensive, low-carbon technologies such as nuclear, renewables or coal with CC(S) due to their high upfront investment costs, and comparatively favour fossil-fuel technologies with higher operating costs but relatively lower investment costs, especially gas CCGT[121].

Recent estimates of long-term and current discount rates currently employed for low-carbon power generation

[119] See second quarter 2013 issue of the Quarterly Report on European Electricity Markets, European Commission.

[120] Data from the Council Of European Energy Regulators, 2012 Report on Renewable Energy Support in Europe

lj9 1EA-NEA "Projected costs of generating electricity", 2010 range from 9.1% - 9.6% for onshore wind, 10 to 11% for nuclear and 10 to 15% for CCS[122] which reflect the risks still associated with such investments.

At a recent IEA workshop specifically on RES financing[123], it was concluded that technology risk is no longer seen as the main barrier to investment in renewable energy technologies; it is rather policy uncertainty which is perceived by developers and investors as the main risk that they are unable to manage, and that markets in which predictable long-term policies are in place, the business case is strong and there are many circumstances in which renewables can be competitive.

Market design is also highlighted as important, and markets based on competition over long-term contracts is one way to ensure sustained investment in capital-intensive low-carbon technologies[124].

A number of the IEA's reflections on RES financing in a selection of EU countries are as follows:

- France: In 2012, onshore wind and biomass energy remained economically attractive. Onshore wind is competitive with newly built natural gas power plants in many locations, though it remains more expensive than wholesale power prices.
- Germany: feed-in tariffs for onshore wind and bioenergy are broadly in line with new- build gas and coal plants, an indicator of competitiveness for these renewable options. Still, changes in coal and gas prices as well as proposed changes to incentive schemes may alter this picture over the medium term.
- Italy: Despite some attractive project economics, the availability and cost of finance for renewable deployment may remain a significant constraint in Italy over the medium term. The challenging macroeconomic situation has resulted in finance becoming increasingly scarce and more expensive in general.
- Spain: In 2011, wholesale electricity prices increased, reaching on average EUR 50/MWh. However, they decreased in 2012, averaging EUR 47/MWh. With a LCOE over EUR 80/MWh, this situation does not make new wind projects economically attractive lor investors. Some solar PV projects for self-consumption can still be attractive over the medium term taking into account increasing retail electricity prices, but this may depend on the adoption of net metering. Still, financing is expected to remain a major challenge to the deployment of renewables over the next few years.

2. Though essential to ensure uptake and long-term development, support for renewables alongside an ETS, notably for renewable electricity, has the potential to drive down the carbon price and in turn reduce the incentive for investments in renewables.

Measures to promote renewable energy (and energy efficiency) can lower the carbon price by weakening the demand for emission allowances in the ETS. Furthermore, at very low levels of the carbon price, short term emission reductions can be carried out cheaply via the purchase of allowances. And any extra measures taken to reduce emissions further, be they investments in renewable energy, energy efficiency measures in transport or housing, will in relative terms be more costly. With a low carbon price, investments in such measures are therefore difficult to justify for delivering short term emissions reductions.

Specifically with regard to the promotion of renewable power generation (RES-E), such concerns have been raised by industry representatives[125] which are critical of the combination of such measures with a volume cap on C02 emissions. They consider that via such a combination, renewable power has no incremental impact on emissions reduction, and that, instead, overall carbon avoidance costs are increased by building expensive RES-E technologies, while at the same time other low cost avoidance options within the conventional power generation or industrial sectors are not used since those market participants only receive the weak EU ETS price signal diluted by the impact of RES-E promotion.

It should be highlighted that the impact of the achievement of the 20% renewables target on the ETS and

[122] "Technology supply curves for low-carbon power generation", Poyry, June 2013

[123] Conclusions of workshop which took place on the 9th of April 2013, organised by the IEA Renewable Energy Working Party and with the participation of members of its Renewable Industry Advisory Board and an audience of 140 senior decision makers from the key players worldwide.

[124] Conclusions of workshop which took place on the 9th of April 2013, organised by the IEA Renewable Energy Working Party and with the participation of members of its Renewable Industry Advisory Board and an audience of 140 senior decision makers from the key players worldwide.

[125] See e.g. Lessons learnt from the current energy and climate framework, Frontier Economics report prepared for Business Europe, May 2013

carbon prices was anticipated and taken into account in the design of the climate and energy package[126].

Taking the emissions reduction benefits of renewables in isolation, it could be considered that even if, historically, support for renewables has achieved costly C02 reductions relative to the carbon price, in due course, falling technology costs will contribute to progressively cheaper renewables options. Whether they become a relatively cheap means to decarbonise compared to the carbon price will depend on both the evolution of the costs of renewables and that of the carbon price.

In addition, such arguments also fail to consider another crucial aspect of the longer term perspective of GHG reductions, that of providing investor certainty via policy stability. For instance, without the EU's renewable energy policy, there would have likely been less investment in certain renewable technologies such as solar PV, as the technology risk and the sunk costs would have been too considerable. In this regard, the Renewable Energy Directive has removed the first mover disadvantage by forcing the EU collectively to support the development of renewable energy technologies, ensuring that renewable energy does not only develop in some Member States and with little effort sharing.

3. One important challenge is the integration of more variable renewable power generation in the electricity grid. It is clear that greater market integration of renewables is necessary, together with adaptation and modernisation of the electricity grid and market functioning to adapt to a system of sustainable electricity production.

A key challenge of the increasing penetration of renewable energy in the power grid is its integration into the EU's energy system. This constitutes a particular challenge in the case of wind and solar power as these have inherently different characteristics from conventional sources (e.g. in terms of cost structure, availability and size) and do not always fit into existing market structures and network infrastructures.

One sign of the need for increased flexibility in the integration of renewable energy in the power grid, is the occurrence of negative pricing on European power markets at times of high levels of renewable powered generation[127]. Negative prices occur when, despite excess supply of electricity, utilities with inflexible generation capacity prefer to pay to sell the generated power, rather than ramp down or close their power stations. Flexibility to adjust both supply and demand for electricity, from demand side response (smart grids), flexible generation capacity, more interconnections and energy storage will help in solving this problem.

4. Renewable electricity generation (with low marginal costs) also poses new challenges for the operation of traditional "energy only" electricity markets

The low (close to zero) marginal cost of variable renewable electricity has a similar impact to that of low marginal cost nuclear power production, and also poses challenges for long term market design, as wind and solar may face the dilemma that they have high up-front investment costs, but on sunny and windy days the power price will approach zero, thus not reflecting the long-term cost of electricity production.

Some stakeholders argue that the rapid deployment of variable sources of renewable generation (rising from 2.2% in 2005 to 7% in 2011) has affected the "energy only" electricity markets' ability to provide adequate revenue streams for appropriate investments and has to a varying extent displaced flexible generation capacities (gas power).

In this context, the question arises how the necessary investment for system flexibility and back-up capacity can be maintained. The capacity mechanisms considered by some Member States as alternatives to market-based resource allocation could distort the internal market for electricity.

Moreover, large-scale electricity generation from renewable sources of energy far from consumption centres - as planned by many Member States - poses challenges in terms of electricity transport. With a grid network designed for a different distribution of power generation and consumption, this can create congestion within some Member States, sometimes also with consequences for neighbouring countries.

The implementation of Trans-European Energy Infrastructure Guidelines will help to remedy this in the long

[126] SEC(2008) 85

[127] Recent examples in Germany include: on the 16th of June 2013, on a Sunday afternoon, when the combined share of wind and solar assured more than 60% of power generation, reaching an all-time high in the country. This resulted in several hours of negative power prices (falling below -100 €/MWh in Germany and Belgium); on the 24th of March 2013, for the first time in the German EPEX market history, there were four hours of negative hourly prices during the afternoon hours, a phenomenon which has only occurred during night hours in the past. This was also the result of the simultaneously high level of wind and solar power generation that day.

term. Decentralised and smaller scale renewables generation can also help to mitigate the problem. However, system operators' fears for grid stability are likely to increase in the short term if the development of wind and solar electricity generation continues more rapidly than grid modernisation and expansion.

In this context, it is clear that adequate, integrated smart and reliable energy networks are prerequisites for secure energy supplies to households and business alike, in a 2020 perspective and beyond.

5. Support schemes for renewable energy need to be fit for purpose and efficient. The costs of developing renewable energy have been unnecessarily increased in some cases by poorly designed support schemes.

The support schemes implemented by Member States have triggered strong growth that has contributed to bringing down costs of different technologies (as reported above). The broad approach to renewable energy technologies have led to the development of a range of technologies, including those that initially were much too expensive to be cost competitive.

However, the rigidity of some support schemes means that support levels have adapted only slowly to cost decreases or have not adapted to surges of installation capacity, which has resulted in strong growth and significant cost increases with resulting impacts on end-user prices of electricity or, in some instances, on Member States' public budgets. In this context, it is important to avoid overcompensation, to improve cost efficiency and to gradually adjust supports schemes in order to allow for renewable generators to respond to short term price signals and avoid subsidy dependence.

To avoid distortions to the internal energy market it is also important to improve the consistency of different national support measures and to enhance the use of the cooperation mechanisms between Member States. The national character of Member, States support schemes has resulted in less cost-efficient deployment of new renewables capacity and from many perspectives work against market integration. With a future share of renewables in EU electricity generation expected to be around 35% in 2020 and 43% in 2030 also in the absence of new' policies (EU reference scenario), a national approach to renewables support (such as feed-in tariffs related to production capacity on national territory rather than consumption) effectively cuts off a substantial part of the electricity market from further integration.

6. While the promotion of conventional biofuels has been successful in terms of quantities produced, it has been a costly way to achieve GHG emission reductions and there are increasing concerns on their sustainability; certainty about the long term perspectives of advanced sustainable biofuels is necessary to ensure deployment, as biofuels can be important for energy security, rural employment and renewable energy uptake in the transport sector.

In the transport sector, Member States have generally been successful in promoting the consumption of conventional biofuels produced from agricultural crops, while the development of alternative sources of renewable energy in transport such as advanced biofuels from waste, residues and algae is still in its infancy.

Biofuels were promoted in the beginning of the last decade, in a world of increasing fossil fuel prices and low agricultural prices (the EU had a set-aside policy to limit overproduction). A 10% target for renewable energy in transport, predominantly from biofuels, was politically agreed as part of the renewable energy Directive and fuel quality Directive negotiations.

However, as food prices increased and in some cases spiked, biofuels became increasingly unpopular and the debate became highly polarised. The public debate on the benefits of biofuels was heated, and progress in science, while still yielding different results, lead to increasing concerns with regards to the sustainability of conventional biofuels. The truth about the benefits and impacts of biofuels is as complex as the relationships between ecosystems and climate for the entire agricultural and forestry sectors. A lesson to be learnt is that policy stability can be more important than ambitious but controversial targets.

It is due to concerns about the indirect land use change impacts associated with crop based biofuels that the Commission proposed amendments to the Renewable Energy and Fuel Quality Directives in October 2012. Through limiting the incentives to food and feed based biofuels to current consumption levels and increasing them for advanced biofuels, the EU expects to improve the greenhouse gas emissions savings provided by the biofuels consumed in 2020.

Certainty about the long term perspectives of advanced biofuels is necessary to ensure deployment, and rapid adoption of the proposal will help. In this context, the Commission believes that only the consumption of advanced biofuels should be incentivised post 2020.

Some stakeholders have raised the concern that a specific target for renewables in the transport sector reduces Member State flexibility in meeting their overall target, and that it could lead to more costly attainment of the 20% target as such. On the other hand, such a target has direct impacts on the consumption of fossil fuel based transport fuels, and the EU's import dependence of oil.

3. The energy' efficiency target and implementing measures

1. *Significant progress has been made towards meeting the 20% energy efficiency target*

Member States committed to achieving the 20% European energy efficiency target at the March 2007 European Council[128] but the target was legally defined and quantified as the "Union's 2020 energy consumption of no more than 1,474 Mtoe of primary energy or no more than 1,078 Mtoe of final energy" in the new Energy Efficiency Directive (EED)[129]. It is an EU objective and Member States have to set themselves national indicative targets and implement a number of policy measures following a set of European Directives and Regulations.

After years of growth, EU-27 primary energy consumption peaked in 2006 at 1,706 Mtoe and has been decreasing since then to reach 1,583 Mtoe in 2011.

This shift in trend is partly due to the economic crisis and partly due to the effectiveness of existing policies such as the Energy; Performance in Buildings Directive (EPBD)[130], the Ecodesign and Energy Labelling Directives[131] and their implementing regulations, and the Regulations setting emissions performance standards for new passenger cars and for light commercial vehicles[132] regulations. It is also due to the reduced energy intensity of the EU economy, which was at 144 toe/MEUR in 2011, down from 171 in 2000 and 165 in 2005.

2. *Going forward, the Energy Efficiency Directive will help to ensure progress, but it is doubtful that the 2020 target will be met with current policies (even if the gap is projected to be now only 3 percentage points vs 11 percentage points projected in 2010).*

The outlook for meeting the 2020 energy efficiency target was rather negative in 2011 but the adoption of the Energy Efficiency Directive (EED) in 2012 and other measures - including implementation of measures contained in the Transport White Paper, and further strengthening of the adopted Ecodesign and Labelling measures - have helped provide a more positive outlook.

Still the Commission's preliminary analysis based on energy modelling and indicative national energy efficiency targets submitted by Member States suggests that with current policies, primary energy consumption may be around 17% lower in 2020 compared to projections. There are however some grounds for expecting that a smaller gap between the target and the outcome (than 3 percentage points) is possible given that neither the modelling nor the targets submitted by Member States in 2013 assume a very ambitious application of the provisions included in the Energy Efficiency Directive and the other relevant legislation. On the other hand, unambitious implementation could also lead to a higher gap.

Following the adoption of the EED, the Commission is required to assess, by 30 June 2014, the progress made towards the 2020 target and, if necessary, to accompany this assessment with proposals for further measures.

3. *Challenges in maintaining progress in energy efficiency include ensuring proper implementation and mobilising funds*

A major challenge in ensuring progress so far has been to ensure proper implementation of EU initiatives at the Member State level. Delays and incompleteness of national measures implementing EU directives (e.g. some provisions of the EPBD) risk undermining agreed objectives.

Another major challenge has been to mobilise the funds needed to ensure continued progress. Constrained public budgets have accentuated the importance of leveraging public funds with private investment, in particular in the building sector. The question therefore arises how to effectively leverage public money with private investment.

The complete and timely implementation of EU legislation at the national level - in particular the transposition

[128] 7224/1/07, REV 1.

[129] Directive 2012/27/EU. With the accession of Croatia the target was revised to " 1 483 Mtoe primary energy or no more than 1 086 Mtoe of final energy" in Directive 2013/12/EU

[130] Directive 2010/31/EU

[131] Directives 2009/125/EC and 2010/30/EU

[132] Regulations 443/2009 and 510/2011

and enforcement of the provisions of the EED and EPBD, the Market surveillance mechanisms under the Energy Labelling and Ecodesign Directives, the implementation of the measures in the Transport White paper and the smart metering roll-out and smart grid deployment with the resulting demand response - coupled with higher use of cohesion funds and innovative financing mechanisms, will provide the necessary instruments for this change.

In addition, due to the long-lasting impact of energy efficiency measures, the current approach of looking only as far as the 2020 horizon may need to be reconsidered.

4. *The 2020 target for energy efficiency has been instrumental in ensuring progress, although a relative target for some sectors might better reflect the structural dynamics of the EU economy*

The Commission's experience so far is that a quantified target for energy efficiency has provided political momentum, guidance for investors and a clear mandate for the Commission to come forward with proposals to ensure progress, such as the EED.

However, an absolute consumption target (as specified by the EED) does not explicitly take changes of economic activity over time into account. While an absolute target for 2020 better ensures meeting a certain ambition level, a relative target (such as energy consumption relative to GDP, e.g. energy intensity) would better reflect the structural dynamics of the EU economy. A "mixed" target could also be an option (absolute for those sectors where energy consumption is less dependent on economic activity, such as buildings, and relative for those sectors, such as industry, where these two elements are more closely correlated).

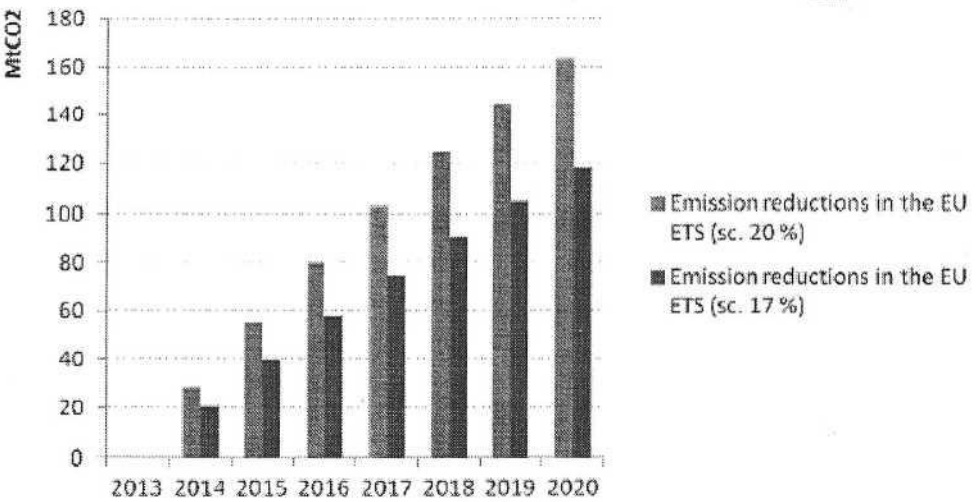
5. *Energy efficiency measures are expected to contribute to some reductions in GHG emissions by 2020, in particular in the non-ETS sectors.*

Measures to achieve the 20% energy efficiency target in 2020 are intended to be complementary to, as well as to provide support for the greenhouse gas reduction target, in particular in non- ETS sectors[151].

The Impact Assessment of the Energy Efficiency Directive concludes that achieving the 20% energy saving target will result by 2020 in GHG emission reductions compared to a 2009 (PRIMES) baseline ranging from -10% in the case of the Baltics to -21% in the case of Mediterranean Member States (with the Nordic countries, Central and Eastern Europe and Western Europe all registering GHG emission reductions within that range).

According to estimates[152], the additional binding measures in the EED and the Transport White paper would correspond to around 500 MtC02 emissions' reduction by 2020 (see Figure 7 below), which represents 10% of the 5 GtC02 emission reduction target envisaged by the Climate & Energy Package. This corresponds to about a quarter of the possible impact of the renewables target on consumption (of 2 GtC02 corresponding to 40% of the reduction target). The extent of additional emission reductions depend on the extent of the incidence of the efficiency measures in ETS or non-ETS sectors.

Figure 7 - EED and Transport White paper annual reduction impact on C02 emissions



Source: "Energy Efficiency, Renewable Energy and C02 Allowances in Europe: A Need for Coordination", Climate Brief, no. 18, CDC Climate Research, September 2012.

6. Some energy' efficiency measures, notably those impacting electricity consumption, have the potential to drive down the carbon price and to make the achievement of GHG emissions reductions more costly than they would otherwise be. However, the current surplus of allowances in the ETS is largely driven by other factors.

Measures to promote energy efficiency (and renewable energy) can lower the carbon price by weakening the demand for emission allowances in the ETS. Furthermore, at very low levels of the carbon price, short term emission reductions can be carried out cheaply via the purchase of allowances. And any extra measures taken to reduce emissions further, be they investments in renewable energy, energy efficiency measures in transport or housing, will in

[1]IA EED, SEC/2011/779

[1] "Energy Efficiency, Renewable Energy and C02 Allowances in Europe: A Need for Coordination", Climate Brief, no. 18, CDC Climate Research, September 2012.

relative terms be more costly. With a low carbon price, investments in such measures are therefore difficult to justify for delivering short term emissions reductions.

The authors of an EP study on energy efficiency and the ETS[133] highlight that covering the same activities by two instruments can amount to double regulation, thereby blurring the carbon market signal, and making the achievement of GHG emissions reductions more costly than they would otherwise be "whilst under the ETS, firms can optimise their investment over the longer term - they have a choice between investing and buying allowances — under the EED they are forced to apply technological solutions to comply with the regulation. This may be in conflict with the optimising investment over the longer term".

Modelling exercises carried out in preparation of the Commission's EED were not conclusive regarding possible impacts on the price of ETS allowances[134,4]. In terms of additional costs to the total energy system, these were projected to rise by between 2.6% and 4.7% compared to the reference scenario in a 2020 perspective. In the longer term, these investments will reduce system costs due to the corresponding reduction in fuel costs. Electricity price increases in the short term directly resulting from increasing energy efficiency (due to the need to finance the fixed costs of energy efficiency measures) were however projected to be negligible. In conclusion, the additional costs of achieving the overall 20% target through the set of measures proposed were considered to be proportionately small.

This said, in the EED, the Commission committed itself to monitor the impact of the new energy efficiency measures on Directive 2003/87/EC establishing the EU’s emissions trading directive (ETS) in order to maintain the incentives in the emissions trading system rewarding low carbon investments.

There is thus recognition in the EED itself that energy efficiency measures could have some impacts on the ETS price. According to the report prepared for the European Parliament on interactions between the EU energy efficiency policy and the ETS[135], the impact very much depends both on the market fundamentals and the market expectations, the latter being "particularly important in the EU ETS as opposed to other markets as it is a market created by governments. As a result, the market tends to react very strongly on actual or perceived government policy changes".

Thus the authors explain some of the sudden and significant changes of the ETS price which have been witnessed in the past (such as a 20% fall in June 2011) as resulting from market perceptions of how willing politicians and regulators are to intervene in the market, rather than to the real effect of interventions.

They however conclude that the ETS price is only to a limited extent affected by actual or potential interactions between the EU energy efficiency policy, including the EED, and ETS. The EU ETS covers around 40% of GE1G emissions (mainly electricity production and consumption and energy intensive industry) while EU and Member State policies directed at energy efficiency in principle aim to a significant extent at the other 60%, i.e. the ‘effort sharing’ sectors buildings, land transport and small industry. Hence, the interactions between the ETS and energy efficiency measures can be limited.

[133] Energy Efficiency and the ETS, European Parliament, 2013

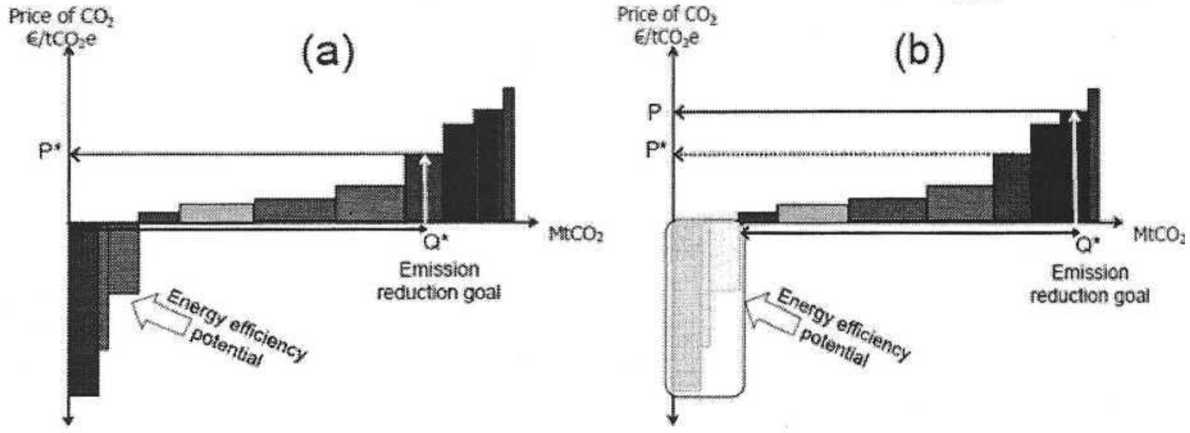
[134] The E3ME model run projects a drop to zero of the ETS price in 2020 whereas the PRIMES scenarios project a much lower impact (a reduction from €16.5/t to €14.2/t in 2020). This lower ETS price impact until 2020 in PRIMES is explained among other things by a higher share of modelled measures with GHG reductions materialising in non-ETS sectors, and the assumption of full market foresight and an unlimited ETS banking flexibility until 2050.

[135] Energy Efficiency and the ETS, European Parliament, 2013

7. ... on the other hand, if cost-effective energy efficiency opportunities are not exploited, a higher carbon price is needed to deliver the same level of emissions reductions...

On the other hand, the IEA[136] argue that if cost-effective energy efficiency opportunities are not exploited, a higher carbon price is needed to deliver the same level of emissions reductions, increasing the cost of the policy response (in figure 8 below, the carbon price required is increased from P* to P if energy efficiency is left untapped).

Figure 8 - Ignoring energy efficiency potential can lead to higher carbon price



Source: IE.A, 201 1

The IEA considers that even if technology deployment policies increase costs in the short-term, their purpose is to deliver significant reductions in the cost of new technologies over the coming decades, with the goal of significantly lowering the long-term cost of achieving deep emissions reductions.

8. Specific efficiency measures are also necessary to correct certain market and behavioural failures which a carbon price alone will not correct

(See point 9 of section 1 on the GHG target).

9. Energy efficiency measures can positively contribute to energy security and competitiveness

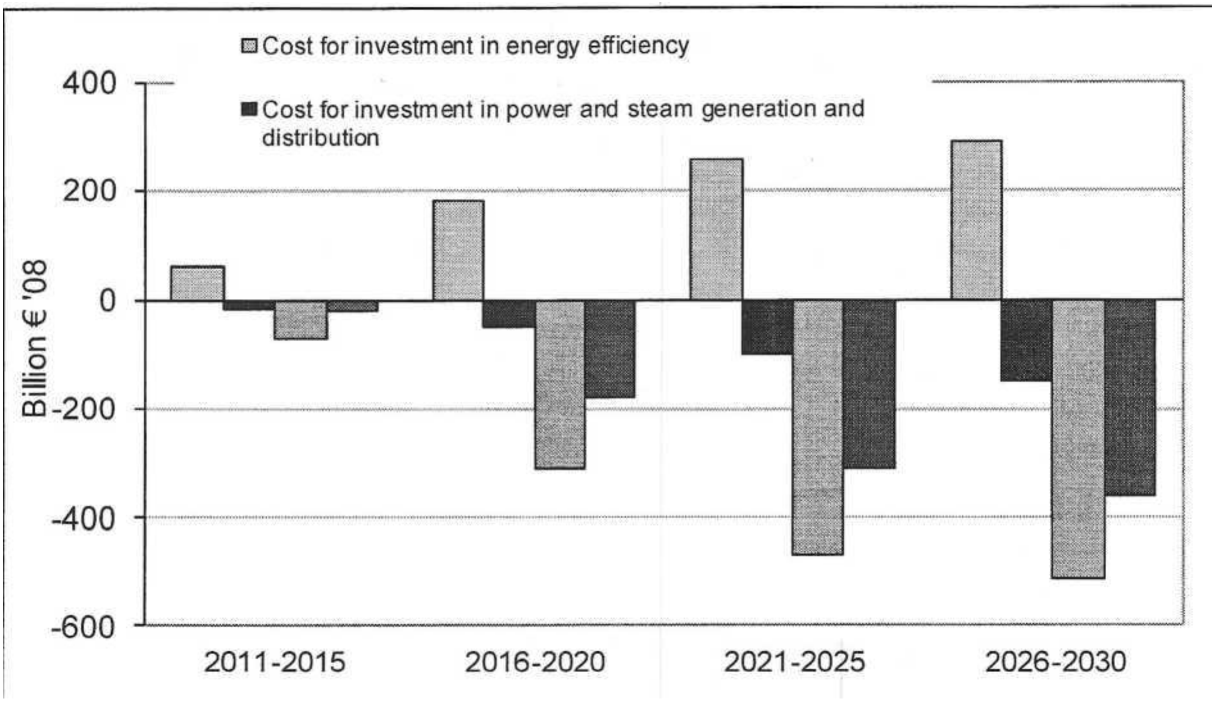
An evaluation of the impact of the Energy Efficiency Directive[137] revealed that increased costs due to investments in energy efficiency of €24 billion annually would be offset by reduced costs in terms of investments in energy generation and distribution amounting to an average of €6 billion annually and reduced fuel expenditure amounting to an average of about €38 billion annually as a result of lower demand. Given the large amount of imported fuels, this also reduces the import bill for fossil fuels and related energy security issues considerably.

The overall effect on the GDP compared to a baseline scenario would be a gain of €34 billion and employment is projected to increase by 400,000 jobs. These figures will need to be validated by ex-post assessments once the policy framework is mature enough.

136 Summing up the parts: Combining Policy Instruments for Least-Cost Climate Mitigation Strategies, IEA, 2011

137 Non-paper of the Services of the European Commission on the Energy Efficiency Directive, Informal Energy Council, 19-20 April 2012. The estimates were performed using the E3ME and PRIMES models.

Figure 9 Estimates of direct and avoided costs linked to the implementation of the Energy Efficiency Directive



7.3. Summary report on the analysis of the debate on the green paper "A 2030 framework for climate and energy policies"

On 27 March 2013, the European Commission adopted a Green Paper on "A 2030 framework for climate and energy policies" [138].

This document launched a public consultation that lasted until 2 July 2013, allowing Member States, other EU institutions and stakeholders to express their views. The aim of the Green Paper was to provide impetus to the on-going debate and to consult stakeholders in order to obtain evidence and insights to support the development of the 2030 framework for energy and climate policies.

The Green Paper begins with an overview of the current framework for climate and energy policies and what has been achieved, followed by an outline of the issues where stakeholder input is sought. The experience and views of stakeholders arc important in the following five areas: lessons learned from the current framework; targets; other policy instruments; competiveness; and the different capacity of Member States and consumer groups to contribute to the transition towards a competitive, secure and sustainable low carbon energy system and economy. The 2030 framework must draw on the lessons learned from the current framework, backed up where possible with sound evidence, and identify where improvements can be made. The 22 questions of the green paper revolved accordingly around five main themes:

- Which lessons from the 2020 framework and the present state of the EU energy system are most important when designing policies for 2030?
- Which targets for 2030 would be most effective in driving the objectives of climate and energy policy?
- Arc changes necessary to policy instruments and how they interact with one another, including between the EU and national levels?
- Which elements of the framework for climate and energy policies could be strengthened to better promote competitiveness and security of supply?
- How should the new framework ensure an equitable distribution of effort among Member States?

The replies to this consultation will be an essential part of the Impact Assessment for the Commission's preparations for more concrete proposals for the 2030 framework by the end 2013.

7.3.1. *Process and quantitative results of the Public Consultation Process of*

the public consultation

The public consultation lasted from 27 March 2013 until 2 July 2013. A dedicated web page including the link to the Green Paper was created.

The consultation process took place in parallel with discussions with other EU institutions and public events organised during this period through various forums. The following general groups responded to the consultation: Member States, national parliaments, citizens, companies, various stakeholder groups, and representatives of civil society such as nongovernmental organisations, trade unions, and business and consumer organisations.

The Commission participated in a number of events to promote the consultation process. In addition, a High-Level Stakeholder Conference was organised on 19 June 2013 in Brussels, with Commissioners Oettinger and Hedegaard present. The results of all events at which the Green Paper and its follow-up actions were discussed were taken into consideration in preparing this report.

[138] COM/2013/0169 final

Fig. 1 Stakeholders profiles - Based on 557 replies

Box 2: High Level Stakeholder Conference: A 2030 framework for Climate & Energy Policies

The Commission organised a full-day high-level conference to share opinions on the 2030 climate and energy framework with the stakeholder community.

Welcome and introductory speeches were given by DG ENER and DG CLIM the Irish Government and by the Chair of the EP Committee on industry, Research and Energy of the European Parliament.

This report summarises the responses to the Green Paper. It is available, on the web page[139] of the Green Paper, together with the contributions received.

Methodology

A thorough analysis of the contributions was carried out, using an approach which allowed for a precise evaluation of the opinions of contributors, as described below.

The analysis was carried out separately on each of the five main priority areas of the Green Paper and its respective questions. All contributions were analysed in a large matrix

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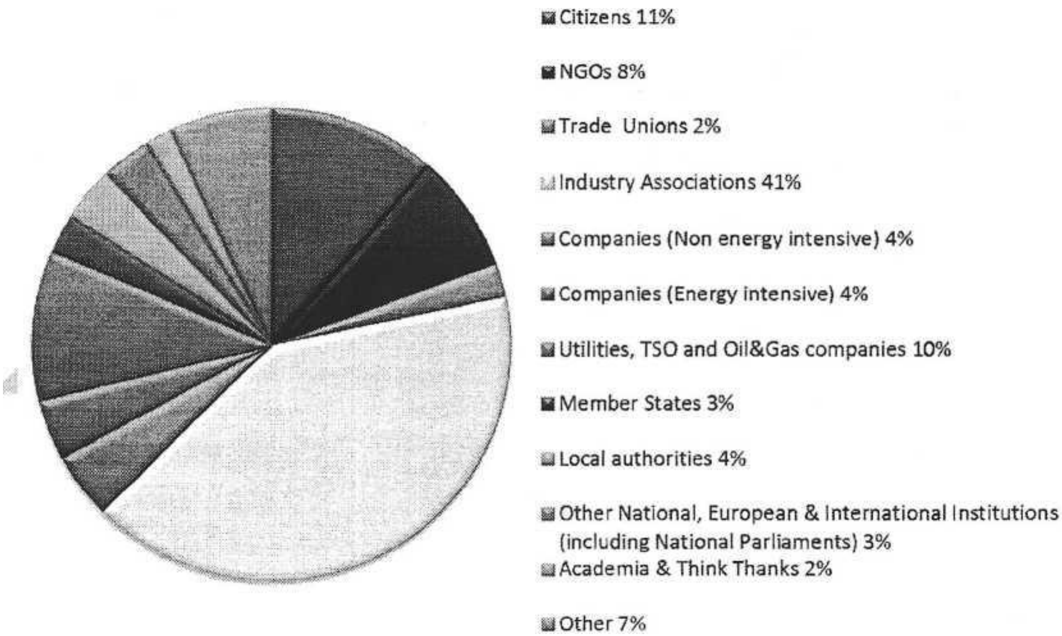
subdivided into these priority areas, and in turn, each question was analysed separately. Each contribution was compared with the Green Paper text, noting positive or negative comments. New ideas, which emerged and could help the Commission for further policy design, were specifically highlighted. For clarity, this report has been structured following the outline of the Green Paper.

Quantitative results of the consultation

In total 557 responses were received. The consultation registered a strong participation from industry associations and private companies, with 41 % of overall replies from Industry Associations. 10% of replies came from energy utilities, transmission system operators and oil and gas companies, and another 8% from other private companies, with a balanced representation between energy intensive and non-energy intensive companies.

The consultation also registered a strong participation from civil society: 8% of overall replies came from NGOs, mostly European environmental organizations, whereas trade unions accounted for 2% of replies. Private citizens represented 11% of the received replies.

A number of public authorities have also responded to the consultation. 15 Member States have submitted official statements[140]. Along with Member State contributions, several national parliaments have reacted to the Green Paper. Several regional and local authorities have also responded, representing a significant share of overall respondents (7% of the total). Other national, European and international institutions and public agencies represented 3.5% of total replies.



140 This analysis considers as Member States official replies statements expressed either by central Governments or sent by single national Ministries. Some Member States also underlined that their submission may not fully reflect the final position of their Government.

Fig. 1 Stakeholders profiles - Based on 557 replies

Geographical distribution

Regarding the geographical distribution of replies, European umbrella associations and institutions represent the highest share of responses (26% of all replies).

At the Member State level, stakeholders from the biggest Member States are generally well represented: Germany (12%), United Kingdom (8%), France (4%), Spain (4%), Italy (4%), Poland (4%).

A relatively strong participation can be noted from Austria (6%), Belgium (4%) and the Nordic countries (Finland, Denmark and Sweden accounted for more than 9% of overall replies) whereas Norway represents the highest participation among non-European countries (2 % of overall replies).

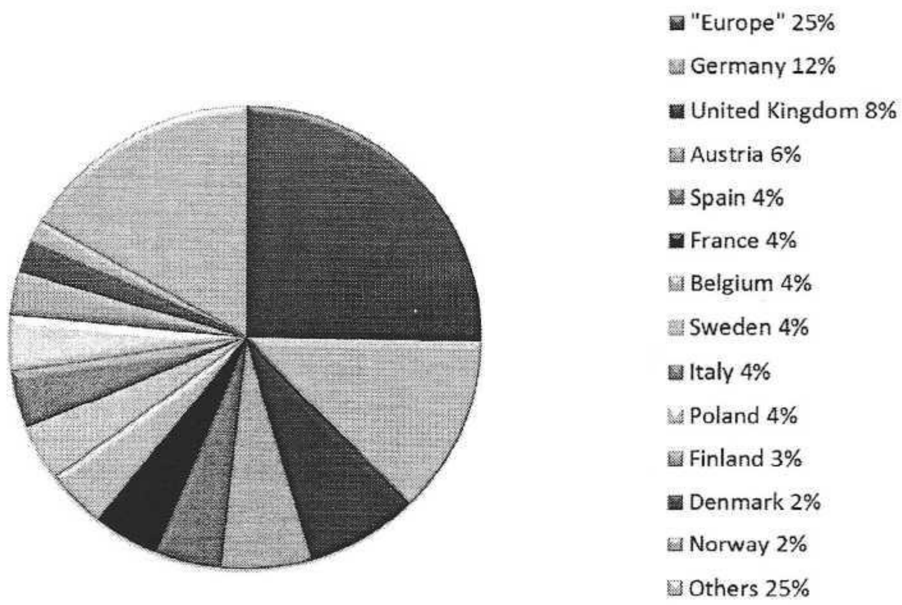


Fig.2 Stakeholders geographical distribution -Based on 557 replies

7.3.2. Qualitative assessment of the consultation and main findings

From the public consultation responses a number of general conclusions can be drawn.

Stability, predictability and coherence

Stakeholders are asking the EU to provide direction on what policies will follow the 2020 agenda for climate and energy. The definition of a new framework should reduce uncertainty among investors, governments and citizens, further contributing towards growth and jobs in Europe while promoting sustainability, competitiveness and security of supply. It is frequently pointed out that the EU needs to continue working on its longer term climate objectives with a coherent set of instruments and needs to secure greater commitment from other major emitters.

More Europe

Throughout the consultation, there was a strong support for the development of a common European energy policy. National energy and climate policies are often seen as fragmenting the market and thus creating unfavourable conditions for companies and investors, whereas common EU policies have the potential to create a level playing field for companies and investors alike. The EU Emissions Trading Scheme (ETS) and EU legislation on the Internal Energy Market are seen as two central aspects for future EU climate and energy polices. From the consultation there clearly emerges the role of a renewed *EU energy infrastructure to coordinate and optimise network development on a continental scale*. An integrated European infrastructure is perceived as a fundamental tool to ensure that European citizens and businesses have access to affordable energy.

Decarbonisation efforts and the ETS should remain at the centre of EU energy and climate policy

There is a very broad consensus that climate change should remain at the core of EU policies and the need for a 2030 greenhouse gas (GHG) emissions reduction target is widely accepted. Almost all stakeholders agree that this target should remain central in the 2030 framework. Most stakeholders also have the opinion that the ETS should remain the major instrument for the transition to a low carbon economy and in particular to reach the GHG emissions reduction target. Some stakeholders also bring up the importance of strengthening the Effort Sharing Decision[141]. Many stakeholders agree that additional policies and instruments can be utilized to reduce emissions for non-ETS sectors, such as EU-wide product performance standards for cars and appliances, or policy to lower emissions of existing buildings, via increased energy efficiency. Overall, stakeholders note that in order to decarbonize in the most cost-efficient way, a balance between EU wide instruments and flexibility provided to Member States needs to be reached.

More focus on competitiveness and security of supply

Stakeholders clearly emphasised the need for climate and energy policy to continue to take into account the three common goals of security of supply, competitiveness and sustainability. Many Member States and stakeholders stress that EU climate and energy policy should give greater consideration to the consequences of the on-going economic crisis and international developments, in particular their potential adverse effects on competitiveness. As Europe has

[141] The Effort Sharing Decision establishes binding annual GHG emission targets for Member States for the period 2013-2020. These targets concern emissions from sectors not included in the EU Emissions Trading System (EU ETS), such as transport (except aviation), buildings, agriculture and waste

a prominent industrial base and needs to strengthen it, the energy system transition should avoid adverse impacts on competitiveness, especially since energy remains an important cost factor for energy intensive industries. At the same time, climate and energy policies could also give a boost to economic growth by helping retain Europe's leadership position in low- carbon industries such as renewables and efficient equipment providers and by limiting energy costs via increased energy efficiency and reduced dependence on imported fuels.

Adopt a cost-effective approach

From the consultation replies a general concern emerges about the increasing cost of some climate and energy policies, in particular related to the support of renewables from Member States and stakeholders alike. There is a general consensus that many public support schemes have to be revised in order to be more in line with changing costs of deploying renewables. Many contributions also suggest that public support schemes should be revised in order to establish a more technology neutral approach.

Security of energy supply

Many stakeholders agree that Europe should further diversify its energy supply sources and routes, though there is no consensus on the sources with some stakeholders focusing on shale gas, while others note that focus should be on indigenous renewables resources and energy efficiency. The ELI needs to take a strong, effective and equitable position on the international stage to secure the energy it needs, while promoting free and transparent energy markets and contributing to greater security and sustainability in energy production and use worldwide. Some stakeholders see climate and energy policy as key in support the development of local renewable resources that would increase the security of supply by reducing dependence on imported fossil fuels.

The Internal Energy Market

The benefits of the internal energy market were broadly recognised. The completion of the internal market for energy is seen as a key strategy for minimising the cost of energy and securing supply. To tackle Europe's energy and climate challenges and to ensure affordable and secure energy supplies to households and businesses, the EU should ensure the competitive, integrated and liquid functioning of the internal energy market, in order to provide a solid backbone for electricity and gas flowing where it is needed. The vast majority of stakeholders also stress that its completion through a *higher rate of interconnections,* including smarter infrastructures, should be a crucial aspect for EU climate and energy policies. Infrastructures fully integrated in the energy system will reduce the costs of making the low-carbon shift in particular through integrating renewable energy sources (RES), through economies of scale for individual Member States, in addition to improving security of supply and helping to stabilise consumer prices by ensuring the distribution of electricity and gas throughout Europe.

Innovation

To support European climate and energy policies, there is a common vision among stakeholders that the EU's energy technology and innovation policy needs to deliver on reducing costs rapidly and speeding up the introduction of new sustainable technologies to the market. There is a need to accelerate developments in cutting-edge technology and innovation, as well as speeding up market deployment. A greater focus on innovation is seen as essential to ensure the flexibility and security of the European energy system and to further develop a portfolio of cost-effective and sustainable energy options.

On the basis of this summary of the main messages emerging from the consultation, the following chapters focus on the detailed stakeholder views for the specific issues raised by the Green Paper.

7.3.2. *Which lessons from the 2020 framework and the present state of the EU energy system are most important when designing policies for 2030?*

The various stakeholders draw different conclusions on the lessons learned from the 2020 framework. There is an overall agreement that a clear framework going forward is needed to give clarity to the economic actors but nonetheless there are divergent views of changes that need to be implemented based on past experience.

Competitiveness

From the consultation it emerges that many stakeholders, including *Member States,* ask for increased focus on competitiveness due to the economic crisis and changing international circumstances such as shale gas development in the USA. *Industrial organizations, energy intensive representatives* and *oil* and *gas companies* as well as some *citizens* agree that there is need for better coordination of the three energy policy objectives: security of supply, competitiveness and sustainability to ensure that all are given equal attention.

Many *business organizations* and *energy> intensive companies* point out that the EU has not been successful in securing an ambitious international climate agreement, which should be a priority in the 2030 framework as unilateral actions would hurt European competitiveness and would lead to export of jobs and growth abroad. Many of these entities also underline the importance of ensuring competitively priced energy in the EU. In part due to the fact that the EU represents a decreasing part of global emissions and energy consumption, several *Member States* note that it is crucial to secure comparable international commitments on reducing emissions.

NGOs, part of the academia and many *non-energy intensive companies* emphasize that the 2020 framework, with clear commitments, led to green growth and job creation in Europe. *NGOs* point out that the renewable energy sector has been resilient to the recession. Some *non-energy intensive companies* also argue that progress was made in international commitments that would not have occurred without European leadership.

GHG target and the ETS

There is an overall consensus among stakeholders that the ETS should remain the central instrument of the 2030 framework, as it is market driven and the cost-efficient way to lower emissions, although a number of stakeholders have emphasized the limits of the current design of the ETS. The ETS is seen as a technology neutral EU instrument that should give a credible signal for reducing emissions.

Many stakeholders note that the ETS has had difficulties in giving a strong and clear price signal. In line with this view, several *think tanks* argue that GHG reductions have been mostly driven by the economic crisis and RES support schemes. *NGOs* insist that the 2020 framework should have been more ambitious for both the ETS and the non-ETS sectors. They, together with many *trade unions*, call for the cancellation of international credits under the ETS and the Effort Sharing Decision (governing the non-ETS sectors) to instead focus on domestic action. Even with a robust ETS, *companies* and *organisations in the renewables sector* note that additional support will be needed to get pre-commercial technologies to the market.

On the other hand, *industrial organizations and energy intensive industries* argue that the ETS is functioning properly and the current low prices are the result of lower demand resulting from the economic crisis, the growth in RES and use of international offsets. *Utilities* stress that while the ETS has not been flexible in responding to changing circumstances, it did create a liquid market for carbon.

Renewable Energy

Several stakeholders note that the large deployment of RES has been costly and, in some cases, has led to market distortions. Many stakeholders also bring up that insufficient interconnections and grid reinforcement hindered RES integration.

The *energy intensive representatives*, *power sector representatives,* some *utilities* and part of *academia,* argue that the RES support schemes have distorted the energy market and led to issues with integrating the intermittent RES in the market. In their opinion, a technology specific approach to RES is too costly as more cost-efficient technologies to reduce carbon emissions from the energy sector get displaced. In addition, many of these actors argue that RES policies undermine the effectiveness of the ETS by depressing the carbon prices.

From a different perspective, some *industrial organizations as well as some think tanks* acknowledge that Europe has become a leader in low-carbon technologies. *Renewable energy* and *non-energy> intensive companies* and *NGOs* point that legally binding targets have been successful in bringing the costs of renewable technologies down and in overcoming administrative, economic and market barriers. They nonetheless recognize there has been overcompensation in many national support schemes and ask for this to be resolved through adapting the support schemes as technologies become more mature.

Energy Efficiency

As regards energy efficiency, a variety of stakeholders, including *industrial representatives* and *NGOs,* note that the 2020 framework did not manage to reduce energy consumption and GHG emissions in the building sector despite the large potential.

Several stakeholders, including *NGOs, green* and *non-intensive industries* and *trade unions* highlight the positive impact of energy efficiency in terms of security of supply, competitiveness and growth. These nonetheless point that its non-binding nature has reduced the chance to meet the energy savings target.

Some *Member States* note that the Energy Efficiency Directive[142] was established only in 2012 and that progress made will be assessed during the 2014 revision. From their

perspective, it would be therefore be premature to set new targets before that date, a view shared by some *utilities* as well. Several *Member States* point out that there are some good policies related to energy efficiency such as a wider use of EU-wide performance standards that could help unlock energy efficiency potential.

Industrial organizations and *energy intensive companies* stress that what they consider an overlap between ETS and some energy efficiency policies is costly for industries and should be removed. For non-ETS sectors, they propose a bottom up approach in determining potential energy efficiency commitments.

Fragmentation and overlapping policies

General business organizations and *energy intensive companies* as well as *utilities* note that what they consider being overlapping targets for energy efficiency, RES and GHG has distorted the effectiveness of the policies, put additional administrative burden on businesses and increased costs. A large part of these stakeholders note that a single approach for the climate framework based on a single target is needed.

NGOs typically argue that there is a certain lack of coherence due to overlooking the interactions between the different policies; however they note that a three-target approach is good as they complement each other and ensure broader progress in the energy sector. Some *non-energy' intensive companies* add that a proper

[142] Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.

impact assessment of interactions between overlapping policies could make them more coherent.

Many *industrial stakeholders* also note that national policies on RES support and energy efficiency measures need to be harmonized. *Renewable energy companies* support convergence of RES support schemes but argue that Member States should retain some control to adapt the instruments based on national circumstances. *Industrial stakeholders* warn that national initiatives such as the introduction of national carbon tax could further distort market signals and hinder integration. On the other hand, *Member States* stress that it would be crucial for them to retain the flexibility of achieving their reduction targets outside the ETS in order to better adapt their policies to national circumstances.

7.3.3. *Targets for 2030*

Which targets for 2030 would be most effective in driving the objectives of climate and energy policy? At what level should they apply (EU, Member States, or sectoral), and to what extent should they be legally binding?

With few exceptions, there is a consensus that a GHG emission reduction target should be set within the 2030 framework. As far as other targets are concerned positions voiced by stakeholders followed two main lines of thought. Some stakeholders ask for a revised approach to 2030, in particular with regards to target-setting for RES and energy efficiency. On the other hand, others stress the importance of setting clear targets in all areas of the long term framework in order to ensure a stable investment environment in the energy sector, foster competitiveness in low carbon industries and keep the lead in the international negotiations.

Box 3: Main positions on targets among Member States having responded to the consultation[163]

All Member States that participated in the consultation are in favour of a *GIIG reduction target for 2030*. Some Member States make such support conditional to a thorough analysis of impacts. Denmark, France, the United Kingdom and Spain are favourable to a binding target of 40%; Poland argues that the decision to adopt an objective for 2030 should be taken no earlier than in 2015; the Czech Republic would accept a more ambitious objective only in the case of a global agreement; Romania considers a 2030 target should be seen in the context of real climate action by third countries; Lithuania makes such support conditional to a thorough analysis of impacts and states that such a target should consider efforts by other major economies; Finland and the United Kingdom propose a dual emissions' reduction target for 2030 in the context of global negotiations with the UK proposing a 50% target in case of satisfactory international agreement; Cyprus supports less binding targets; Malta agrees with a GHG target in line with the 2050 roadmap, but also notes that international negotiations outcome should be considered.

On Renewables, Denmark is in favour of a 2030 target; Lithuania supports an RES target, set following a thorough assessment of impacts on industry sectors and individual Member States; Austria is strongly in favour provided the system security and social dimension is taken into account; Finland calls for an indicative or moderately binding target; France calls for a renewables target to be fixed at a later stage based on a partial harmonisation of support schemes and reflection on how to integrate renewables in the system; Portugal is open to a target, subject to more use of cooperation mechanisms; Estonia is ready to support a renewable target if the EU-level action provides substantial added value, following a cost-benefit analysis; Romania advocates a renewables' target set by the Member States; Malta proposes a RES investment target tied to GDP per capita; the United Kingdom and the Czech Republic are explicitly against setting targets for renewables.

On *Energy> Efficiency*, Denmark and Portugal are in favour of a 2030 target; Estonia is ready to ¡support energy efficiency targets if the EU-level action provides substantial added value; Lithuania j envisages a target for energy efficiency related to energy intensity subject to a thorough impact assessment; France is open to a European target as a complimentary addition and to be fixed at a later stage with a new' definition of energy intensity; Finland is favourable to an indicative EU energy efficiency target; Romania would be open to an overall aspirational target; Malta does not explicitly address energy efficiency, but say that Member States should have flexibility to decide on the mix of how to reduce GHG emissions; Austria and Cyprus would prefer to postpone discussions I on energy' efficiency until after 2014; the United Kingdom and the Czech Republic are explicitly against a mandatory energy efficiency target.

Other targets-. Portugal advocates an intermediate target as regards the physical implementation of an Internal Energy Market (target for minimum interconnections between Member States) whereas Spain is proposing a binding interconnection target (10%). Romania advocates that targets should pursue also the objectives of security of supply and competitiveness. Lithuania asks for appropriate EU indicators for energy infrastructures' development, research and experimental development.

Greenhouse Gas Target

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Whereas *Member States* are divided on the target approach (as illustrated in Box 3.), there is a general agreement on the need to set a new EU-wide GHG emissions reduction target. Further discussions will be necessary in order to establish a common view among Member States on other targets for 2030.

NGOs specifically highlight the cost of non-action or delayed action and the positive contribution of a low-carbon energy transition to future sustainable economic growth. Therefore they are generally asking for a more ambitious GHG target. They mostly suggest an ambitious target for GHG reductions of 40-60% with some are proposing a target for 2030 of up to 80% GHG reductions compared to 1990.

An important share of *European business organisations* believes that Europe has to put cost-competitiveness, security of supply and climate objectives on a more equal footing. Whereas there is general consensus that the EU should set a 2030 emissions reduction target to incentivise investments in low-carbon and energy-efficient technologies, there is no agreement on the other targets As regards GHG, parts of European industry clearly advocate a 40% reduction target, whereas others just indicate that, when deciding on the most appropriate level of ambition, the EU should first discuss it with Member States and business stakeholders and take into account the outcome of the international negotiations to avoid the negative consequences of unilateral decisions.

Utilities and the *power sector* (in line with their respective *business organisations*) are generally favourable to a single economy-wide EU GIHG emissions target in line with the 2050 Energy Roadmap[161]. In their perspective, a target of 40% reduction against 1990 levels is generally considered in line with the reductions needed to achieve an 80-95% reduction by 2050. They also note that the 2030 framework has to be decided as soon as possible to provide regulatory certainty. In the same perspective, *oil and gas* companies generally support a single GHG target, with gas companies mostly favoring an ambitious target of 40%.

An important share of *energy intensive industry* associations also support this vision and are mostly only favourable to a top-down climate target under the condition of the establishment of a substantial global agreement with comparable burdens for industry worldwide. An important part of the same industry fears that legally binding targets would prevent the EU from adjusting its policy to changing economic circumstances. Any agreement on GHG reduction targets for 2030 should be conditional on a global agreement. Part of the *energy' intensive industry* is rather asking for a relative/flexible target for industry allowing for economic growth.

Non-energy intensive companies and *trade unions* advocate for an ambitious GHG target that would provide green stimulus to the growth in the EU. Both stakeholders' groups are generally positively inclined toward a 40% GHG emissions reduction target for 2030.

Communication "Energy Roadmap 2050" COM/2011/885

As far as citizens are concerned, views are very mixed, and although they tend to be divided on the need for further targets, there seems to be a general agreement on at least a new GHG target.

Renewable Energy Target

As mentioned in the previous section, there is no consensus among respondents on whether RES and energy efficiency targets for 2030 should be established.

In addition to the *Member States*' positions provided in the previous section, it can be noted that the *renewables industries, NGOs, local and regional authorities and trade unions* are mostly in favour of an ambitious and more comprehensive framework, irrespective of action in third countries. From their perspective the EU should continue a multiple and mutually supportive targets approach, which is seen as the most effective framework. Several *NGOs* and *RES representatives* argue that the RES target should be set at 45% for 2030.

Renewables associations and *non-energy intensive companies* are generally supportive of *three targets* with a strong level of ambition both concerning the renewable and the energy savings targets. In the same vein, *NGOs* generally ask the EU to agree on a set of ambitious, legally binding targets that could provide investment security for economic actors and reduce the costs of financing. European *trade unions*, while emphasising the importance of the social dimension of climate and energy policies, are generally in favour of a strong legal framework with binding quantitative targets for renewable energy, GHG emission reductions and energy efficiency, also stressing the importance of the workplace as a potential driver for energy efficiency.

Some *institutional investors* also emphasize the fact that an EU-wide approach and binding RES target would incentivise private sector investments in low carbon technologies.

On the other hand, many other stakeholders and in particular *industrial associations* believe that, due to their overlapping scope with the EU ETS, the EU targets for energy efficiency and RES should not be continued after 2020 or should be defined as second-level targets. Some *energy intensive industrial consumers* are in favour of a moderated combined RES-Carbon Capture and Storage target for 2030.

In the same vein, some *utilities* and the *power sector* generally advocate against renewable energy and energy efficiency targets and state they should not be considered on an equal footing with the GHG target. From their perspective, if developed, these dimensions should rather remain indicative and contribute to achieving the overall objectives of emission reduction, security of supply and competitiveness. Other *utilities* opine that legally binding RES and energy efficiency targets should be set as they have proven effective in promoting investments and enabled cost reductions through the scaling of RES.

Energy efficiency target

More specifically on the question of having an *energy efficiency target,* some companies fear that an absolute energy consumption cap would threaten growth perspectives. *Property owners* are also particularly sceptical and some of them advocate that the 2030 framework should include EU-wide benchmarks rather than binding targets in order to leave significant flexibility to Member States for an adaptation to the national context. A wide group of stakeholders, including also some *Member States,* propose that the energy efficiency target should be related to energy intensity rather than absolute energy consumption.

Conversely, a majority of European *NGOs and non-energy intensive industries* claim that the setting of an ambitious, binding 2030 EU target for energy savings would send a clear signal to investors and lower perceived risks, thereby reducing the costs of financing, while providing flexibility to Member States for the development of specific measures. *NGOs* propose targets between 30% and 50%.

Other targets

During the consultation a number of proposals on possible alternative targets emerged. Most of the proposals revolve around the objectives of competitiveness, security of supply and physical infrastructure. These will be covered in more detail in the dedicated paragraphs in Sections 0 and 0.

A *number of industry associations* are also asking for an introduction of sub-sectoral targets that will also be illustrated in Section 0.

At what level should the targets apply?

Stakeholder views on this question are varied and mostly relate to the target or set of targets proposed. There is consensus around the question of defining a GHG target at the EU level, broken down into ETS and national non ETS targets (for a discussion on extending the scope of the ETS, see Section 0). As regards to the other two targets, positions are very differentiated. Stakeholders that are in favour of RES and energy efficiency targets are generally open to a dual level approach, with EU and national targets, recognizing the importance of assuring a higher level of flexibility to Member States; while those not in favour of such targets generally do not indicate how they consider that such targets should be met, were they to form part of the 2030 framework.

The *RES industry* is generally in favour of EU level RES targets to be broken down at national level as under the current framework. From their perspective a sole EU target with an EU wide harmonised support mechanism, would limit Member States' flexibility to meet their targets and would lead to the concentration of RES in the most mature markets creating unbalanced costs and public acceptance issues in these countries. Part of the same industry suggests that EU RES target should be made binding upon effort sharing calculation taking into account RES penetration levels and specific economic conditions.

Some other stakeholders also stress that RES and energy efficiency targets should be broken down at national level, based on indicative targets. Others argue for a more Europeanised approach to meeting such targets that would be less distortive to competition and market integration. Some further suggest that Member States should prepare specific programs to increase their share of RES and efforts on energy efficiency. From a different perspective, some stakeholders, *NGOs* in particular, propose the introduction of administrative penalties or economic sanctions for underachievement of targets.

Local and regional authorities are calling for measures to be adopted at the most appropriate level of government. From their perspective EU energy policy should incentivise and support local sustainable energy production and distribution. Therefore a number of them also claim the adoption of certain sub sectoral targets to be implemented at the local level.

Have there been inconsistencies in the current 2020 targets and if so how can the coherence of potential 2030 targets be better ensured?

The stakeholders in general agree that the three targets for GHG, RES and energy efficiency have interacted, but have diverging views on whether this is problematic or not.

Some of the *Member States* note that the effectiveness of the 2020 framework is undermined due to the interactions between the three targets. While some *Member States* propose to set a single target, others call for further analysis and better coordination on how to make the targets more coherent (see Box 3 above). Several *Member States* note that a national impact assessment is needed to better evaluate the interaction and consequences of potential 2030 targets at their specific country level. Some *Member States,* in line with some *industrial organizations,* also think that the climate and energy policies should be better coordinated with the EU industrial policy.

Industrial organizations, energy intensive industries, utilities and *the power sector* generally stress that overlapping targets undermined the EU ETS price signals. They point out that RES support schemes have promoted costly technologies and a more market-based approach is needed. According to *energy intensive companies,* the overlapping Energy Efficiency Directive and ETS for energy intensive industries will lead to additional burdens and higher costs, and they propose that the Energy Efficiency Directive exempts the ETS sectors.

In a different perspective, *renewable companies, non-energy intensive equipment manufacturers and local authorities* state that the three targets arc positively reinforcing each other. They note that the EU ETS has not been undermined by the RES target, but instead by the economic slowdown, decreased demand for allowances and widespread use of international credits. *RES companies* and some *NGOs* then note that the major inconsistency has been that the GHG target for 2020 was set too low and the assessment of the interactions should be considered when deciding on the 2030 framework. Many of these entities also underline that a GHG target alone and the ETS currently provide no useful incentive for either RES development or energy efficiency improvements.

Academia also concludes that the three headline targets design can be better developed, and point out the need to better examine the potential interactions while others propose that a single, ambitious GHG target is needed that would provide a clear and credible signal.

Are targets for sub-sectors such as transport, agriculture, industry appropriate and, if so, which ones? For example, is a renewables target necessary for transport, given the targets for C02 reductions for passenger cars and light commercial vehicles?

Many stakeholders note that emissions reductions in sub-sectors such as transport, and buildings should contribute to the decarbonisation efforts with the aid of various policies.

Several *Member States,* in line with some *utilities, industrial organizations* and *NGOs* see a benefit of further developing efficiency standards for buildings, EU-wide efficiency standards for appliances and vehicle C02 efficiency standards. *NGOs* also point that F-gas regulations are appropriate.

Nonetheless, *Member States* generally ask to preserve a certain degree of flexibility at national level to ensure the most cost-efficient decarbonisation path. Some of them do not favour specific sectoral targets within the non-ETS sectors and, if these should be introduced, they ask for careful consideration in setting them. Within a framework of three targets, *NGOs* and representatives of the *RES industry* agree that sub-sector targets are not necessary so as to preserve flexibility at Member State level.

Utilities, energy intensive companies and *general business organizations* note that sectoral policies are needed to address the non-ETS sector, but do not generally favour binding targets for specific sectors. Some *utilities* note that indicative targets could be set for the heating, transport and building sectors, while *energy intensive companies* argue that if targets are to be set, this needs to be done through a bottom-up approach.

From another perspective, some *non-energy intensive companies* think that binding GHG targets could be beneficial to tap the potential for non-ETS sectors. This view is supported by *financial sector representatives* that argue that binding targets would be useful to provide certainty and guide investments.

Transport Sector

Many stakeholders note that even if there is no binding target for the transport sector, other EU policies need to contribute to emissions reductions.

Several utilities and *energy intensive companies* suggest extending the ETS to cover the transport sector. If this is not technically feasible, some suggest a sub-sector target or a carbon tax for the transport sector. *Utilities* and *energy intensive companies* also generally note that within the transport sector, the focus should be on promoting electrification of the sector, promotion of behavioural changes and continued use of C02 standards for cars. *Gas companies* add that fuel substitution in heavy duty vehicles and maritime shipping should be addressed. Several *Member States* also note that electrification of transport should be pursued.

NGOs believe that the specific transport RES target has led to the unsustainable use of biofuels. Therefore they call for transport policy that would focus on efficiency improvements through shift in demand and vehicle efficiency. They ask for new standards within the Fuel Quality Directive[1 5] to ensure reduction in greenhouse intensity of fuels as well as for tightened C02 standards for cars.

Few *non-energy intensive companies* agree that the debate on indirect land use change related to biofuels needs to be resolved but they see a benefit in having a binding target for the transport sector. Several support 2nd and 3rd generation of biofuels that do not compete with food and have proven lifecycle benefits. The *agriculture sector* also calls for the continuation of a transport sector renewable target that would provide needed certainty for continued investments.

Directive 2009/30/EC amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC

Transport sector representatives generally note that technology and mode neutral policies are needed to lower emissions and not one mode should be favoured over another.

Finally, *RES companies* generally prefer an overall RES target, though they note that Member States might put indicative targets in their National Renewable Energy Action Plans.

Buildings

Many stakeholders agree that improving the energy performance of buildings needs to contribute to emission reductions with various suggestions on the policy framework to support this.

Several *utilities* suggest that EU-wide performance standards are needed, or alternatively, a few note that tax on performance could be introduced. *Energy intensive companies* and *gas companies* suggest that buildings should have higher performance standards and financing support at EU level could be provided. They could be supplemented with stricter standards on energy efficiency of appliances. *NGOs* agree that building emission reductions could be addressed through building renovation policies.

Non-energy intensive companies and *building sector representatives* note that a binding energy efficiency target for buildings might be needed to boost activity and create jobs. On the contrary, *property owners* bring up that they might not be able to afford renovations and a lot of buildings will not comply with overly strict regulations.

Agriculture

Most stakeholders do not address the agriculture sector even though a few note difficulties in calculating carbon flows and ascribing performance of reductions from land use, land use change, forestry and other stores of carbon. Some *NGOs* welcome specific agriculture policies such as sustainable programs to enable non-ETS emission reductions.

Representatives of the *agriculture sector* say that an indicative non-binding ambition could help to realize the potential of multiple land-based RES to mitigate climate change and diversify supply. They typically note that a binding target of emissions in the agriculture sector is unfeasible.

How can targets reflect better the economic viability and the changing degree of maturity of technologies in the 2030framework?

There is a general consensus from a wide range of stakeholders and Member States alike, that future policy goals should give greater consideration to future technological development.

Some *Member States* have underlined that setting only the emissions reduction target would leave them with the necessary flexibility to react to changing technologies. From their perspective they should have the freedom to shape the low-carbon energy mix.

A large number of respondents focused their replies on the integration of RES in the new framework. Many stakeholders opine that renewable electricity support schemes should be progressively limited to non-mature technologies and, when still needed, those schemes should avoid market distortions and promote fair competition with other RES and conventional energy sources in a framework which addresses existing market failures comprehensively.

Renewable industry representatives generally consider that targets should not be confused with support mechanisms. Although they agree that there is a need to adapt support mechanisms, they point out that renewable energy technologies used today are already becoming cost-competitive with conventional power generation in many parts of Europe. More technologies would be competitive before 2020, if given adequate support in the meantime. Some stakeholders have asked for the introduction of sub-targets for technologies under development to increase R&D and advance deployment of such technologies. Others condemn sudden changes or retro-active cuts and favour the promotion of flexible support mechanisms, which would respond to cost reductions and market evolutions in order to avoid overcompensation.

In the same line of thought, *NGOs* also recognize that some support mechanisms should be adjusted and propose that the rules for such adjustable support mechanism arc clearly defined in advance.

Some *industry representatives* are suggesting the introduction of an EU-wide goal for immature or more precisely promising non-competitive technologies, whereas others are in favour of interim milestones. This would allow for an evaluation of the accuracy of the support schemes in place and, if needed, timely revisions in order to accelerate or decelerate the speed of deployment of certain technologies. Some *regional and local* organizations are also underlining that technologies need to be adapted to their environment, such as rural, mountainous or isolated areas.

Energy intensive industries generally fear that such targets as proposed above could lead to increases in energy costs. They are suggesting that targets should include a measure of the economic cost and the impact of these technologies.

How should progress be assessed for other aspects of EU energy policy, such as security of supply, which may not be captured by the headline targets?

From the consultation it clearly emerges that the dimension of *competitiveness* and *security of supply* would have to be better integrated in the new framework. Several *Member States* are stressing the need to monitor and eventually define clear indicators to support the competitiveness of the EU and the security of energy supplies.

Security of Supply

As regards *security of supply,* part of industry is stressing that progress in physical market integration, security and reliability of energy supply are crucial and thus propose the introduction of *infrastructure* and/or *energy independence targets*. Some utilities in particular are highlighting that a number of gas power stations are being mothballed. Therefore a wide range of instruments are generally suggested, such as *benchmarks towards a minimum* *capacity of energy storage, minimum compulsory interconnection exchange capacity targets* or a new *target for cross-border transmission infrastructure development*.

The introduction of indicators for import independence (gas and oil) and short-term electricity balancing for intermittent generation have also been proposed. The *industrial consumers* are generally asking to refocus EU and national policies so as to incorporate competitive prices and security of supply. Measures proposed range from EU rating tools or monitoring systems on generation adequacy and security of supply, energy prices and the costs and impacts of climate and energy policy to the *introduction of an EU-wide security of supply minimum target* in terms of indigenous fuel use (in %). Some *Member States* also ask for the introduction of intermediate target for minimum interconnections between Member States or a binding interconnection target whereas others ask for appropriate EU indicators for energy infrastructure developments, research and experimental development (see Box 3 above).

On the other side of the spectrum. *NGOs* and part of the *renewables industry* are generally suggesting that security of supply can be provided by a continuation of the three headline targets for 2020. In particular energy efficiency and RES targets would contribute to lower dependence on fossil fuel imports and increase security of supply. Some of them propose the introduction of an annual comprehensive *EC progress report* as a tool to monitor trends, identify the most effective measures and provide much needed background information for EU decision-makers. .

Some local and regional authorities propose to assess the progress of EU energy policy by measuring the energy autonomy of different levels of administration.

Competitiveness

Several proposals were made to introduce indicators to assess *energy competitiveness,* mostly by European *business associations* and *energy intensive companies*. EU rating tools or monitoring systems on energy prices and the costs and impacts of climate and energy policy were proposed by *industrial consumers*. In this vein, a target for addressing the energy price differential between the EU and major competitors was proposed by some *business representatives*. It is suggested that this new target should be based upon the analysis of multiple energy prices (gas, electricity, solid fuels and oil) and the comparison with major competitors - especially the USA.

Many contributions of the *energy intensive* industry also propose to couple an intensity-based GIIG target (relative to economic activity rather than absolute target) with *industrial targets* to be expressed as industry's share of GDP.

7.3.5. *Instruments*

Are changes necessary to other policy instruments and how they interact with one another, including between the EU and national levels?

There is an overall agreement that the ETS provides a single regulatory framework for the sectors covered by it and it should remain the central instrument for the 2030 climate framework. It is seen as cost-effective, compatible with the internal energy market and technology neutral. There are nonetheless diverging views among stakeholders on whether the ETS has to be reformed, what changes are necessary and what additional policies should supplement it.

The majority of *Member States* support the ETS as the major instrument to achieve the EU climate and energy policy goals. Whereas some *Member States* argue that the ETS should be reformed to increase credibility, others note that it functions as expected and thus are opposed to reforming it.

General business organizations and *many energy intensive companies* believe that no measure is necessary for strengthening the EU ETS, as this would, from their perspective, undermine its long-term market nature. Some *energy intensive companies* further argue that current absolute cap on emissions would hamper European growth. Hence, from their perspective the ETS should be reformed to protect competitiveness by removing the absolute cap on emissions.

From a different perspective, *utilities, gas companies, academia* and *NGOs* typically request that the ETS is reformed in a timely manner so that it can drive investments in low carbon technologies and the needed infrastructure. They, together with *non-energy intensive companies,* generally support the temporary backloading of allowances and note that structural changes are also needed.

Utilities and gas companies, non-energy intensive companies and RES companies mostly favour introducing a flexible supply mechanism, that adjusts the supply of the EU ETS based on changing circumstances such as experienced in the recent economic slowdown. *Academia* agrees that a supply mechanism should be introduced with clearly defined rules of when an intervention would occur. Some *general business organizations* say that if a supply mechanism is to be introduced, it needs to be done after a very thorough impact assessment.

Another favoured reform is increasing the linear reduction factor. *Non-energy intensive* companies call for increasing the linear reduction factor. *Some utilities and academia* agree that it needs to be adjusted before the end of Phase 3 of the EU ETS. From another perspective, *energy intensive companies* note that the ETS linear reduction factor cannot be changed before a comparable and ambitious international agreement.

Less mentioned by the stakeholders is the introduction of a carbon price floor. Still, a few *utilities* and *think tanks* and some *RES companies* suggest that a price floor for carbon allowances should be introduced to decrease the volatility of the price and give certainty for investors. This view is not supported by *general business organizations* that request that the ETS remains a market-driven mechanism.

There are diverging views on whether or not international credits are to remain as part of the ETS. Typically *general business organizations* and *energy intensive companies* argue that international credits should remain part of the EU ETS as they would allow flexible and cost- efficient solutions and would help to prevent the risk of carbon leakage. On the other side, typically *NGOs* and *trade unions* call for limiting and eliminating international credits. According to *NGOs,* international credits led to dubious environmental impacts in developing countries and prevented domestic action and had a negative impact on the carbon price. *Trade unions* add that international credits should be removed both from the ETS and the Effort Sharing Decision to incentivize emission reductions in the EU.

Extend the ETS

Extending the scope of the ETS is mostly seen by the actors as ensuring more sectors contribute to the decarbonisation as opposed to a reform related to the surplus of allowances on the market. Some *utilities, several gas companies and energy intensive companies* point out that the ETS should be extended to cover buildings and the transport sector if it is technically feasible as they note that all sectors should contribute to the low carbon transition. On the other side, a few *NGOs* are sceptical with extending the ETS as in their view the instrument has not yet proven to be effective in reducing emissions. They argue in favour of a binding target for the non-ETS sector that could be supplemented with national and EU-wide carbon tax.

RES support schemes

On renewable energy support mechanisms, there is a general consensus that these should be designed and implemented in a more cost-efficient way in order to avoid over-subsidisation and market distortions. Yet, there are diverging views on the necessary changes.

Several *Member States* support the thesis that RES subsidies should be more coherent and include stronger elements of cooperation between Member States, and welcome the forthcoming guidance from the European Commission on RES support mechanisms.

Typically *energy intensive companies, utilities and the power sector, and general business organizations* call for adoption of technology neutral policy for the transition to the low carbon economy. Support provided should be limited, technology neutral, harmonized at the EU level and temporary. Several *utilities* bring up that further RES support schemes are not cost-efficient and additional support such as priority dispatching is distorting the market. They note that generous RES subsidies might lead to RES technology penetration beyond the infrastructure adaptation rate. Hence, they call for progressive phase-out of RES subsidies and removing non-economic support.

From a different perspective, *non-energy intensive companies, RES companies* and *NGOs* argue that market distortions should be eliminated, including removing subsidies for fossil fuels and nuclear energy.

Renewable, *non-energy intensive companies and NGOs* acknowledge that RES support schemes should be adapted to the technology maturity of the various technologies, but note that continuing demand pull for RES is still needed. RES companies add that flexibility should be introduced in the support schemes to reflect their maturity and prevent retroactive changes in the support mechanisms that were observed in some Member States. They also request better coordination across the EU on support mechanisms.

NGOs also bring up the issue that only sustainable bioenergy should be counted towards the RES targets to avoid unsustainable use of land to meet targets. Some *Member States* also suggest that the EU should play a role in determining the sustainability of bio energy, while others point out that this would lead to additional administrative burdens.

Energy efficiency

For a discussion on energy efficiency related policies, see Section 0.

GHG reductions in the non-ETS sectors

Many stakeholders underline that the non-ETS sectors must continue to contribute to the decarbonisation efforts. Most *Member States* argue that they should retain flexibility in addressing the non-ETS policies as they can adapt them to national circumstances. A the same time many stakeholders such as some *Member States, utilities, NGOs, energy intensive companies* and *think tanks* point out that EU wide standards for buildings and product performance standards such as efficiency standards for cars, vans and lorries and eco-design for appliances should be continued for sectors outside the ETS.

NGOs argue that the Effort Sharing Decision should be strengthened, including a transposition placing duties on the national authorities. They note the Effort Sharing Decision was not strong enough and international credits undermined domestic action. They call for the setting of an ambitious legally binding target for the Effort Sharing Decision and the provision of financing for Member States less able to act.

Some *utilities* suggest that for sectors outside the ETS, command and control policies would work best while a few add that a carbon tax might be introduced at EU level with a price signal coherent with the ETS price signal. *NGOs* generally agree with some adding that carbon tax can be introduced for the ETS sector as well.

State Aid

Several *energy intensive companies* and *general business organizations* note that state aid rules need to be amended to add competitiveness protection provision. On the other side, they note that compensation for the risk of carbon leakage due to indirect costs (C02 costs passed through to electricity prices) should not be through state aid as it would depend on Member State ability to pay. Instead, free allowance allocation should be used as it is market based and would harmonize support at EU level. Some *utilities* and *think tanks* underline that harmonized state aid can be the mechanism to compensate for indirect costs.

How should specific measures at the EL' and national level best be defined to optimise cost- efficiency of meeting climate and energy objectives?

NGOs, renewable energy organizations and many *non-energy intensive representatives* argue that a longer term legal framework is required to achieving a cost-efficient decarbonisation path. *RES companies* in particular note that a long term commitment is needed to target specific technologies and retroactive changes to the support schemes should be avoided as these increase artificially the cost of capital.
Many stakeholders note the risk of market fragmentation due to incoherence between national policies. Industrial stakeholders call for better coordination and harmonization of national policies. Many see the harmonization of RES support mechanism, or at least the convergence, as an important step to more cost-efficient policies. *General business organizations* note the risk of market fragmentation if national policies such as a national carbon price tax are introduced. They also note that better coordination needs to be achieved between energy policies. They ask for establishing mandatory consultation procedures for energy policy decisions that might affect other Member States.

From a different perspective, *Member States* advocate for retaining control over their energy policies. They stress that they need flexibility in order to achieve the targets in the most cost- effective way and certain policies should remain under national authority. Nonetheless, some *Member States* note it as important to continue harmonization of policies and achieve the internal energy market in order to have a cost-effective policy. Hence the EU can play a role to ensure consistency of policies.

How can fragmentation of the internal energy market best be avoided particularly in relation to the need to encourage and mobilise investment?

There is a broad agreement between all stakeholder groups that the *completion of the internal market* for energy is a key strategy for minimising the cost of energy and securing supply. In this vein, the consistent implementation of the *Third Energy Package* across Member States is seen as a priority. The vast majority of stakeholders are aware that its completion from a regulatory perspective but also through a *higher rate of interconnections,* including smarter infrastructures, will be an important step.

Some major *business associations* are calling for a better coordination of national policies and cooperation to ensure the proper functioning of the future interconnected energy market. From their perspective, non-harmonized instruments with purely a national design such as RES-E promotion schemes and the current design of capacity mechanisms will not help to realise the internal energy market.

Utilities and *the power sector* insist on the importance of the right legislative environment that can deliver a transparent, liquid and well-functioning single European market in gas and power, such as the gas target model[143], the security of supply regulation, and the regulation on wholesale Energy Market Integrity and Transparency (REMIT). *Transmission System Operators* underline that cooperation

[143] Related to gas, a vision for a gas target model was presented by CEER at the end of the year 2011 and endorsed by the Madrid Forum in its 21st meeting in March 2012. The target model, proposed by the energy regulators is based on hub-to-hub trading through the establishment of a number of well- functioning market areas and trading regions, which would be closely linked through cross-border interconnections, with market based allocation mechanisms and an efficient use of capacity through appropriate congestion management measures.

mechanisms and demand-response measures could represent other important instruments to cost-effectively deliver the goals of the 2030 framework. Furthermore, they stress that distribution networks must be better linked across borders and relevant infrastructure projects need to be coordinated between all countries affected. Joint planning of networks, in particular of interconnections, could play an important role to ensure the most cost-efficient and coherent solutions for infrastructure networks.

Several stakeholders are also asking the Commission to come forward with a reflection on the existing energy *market design* which, as it currently stands, makes it difficult to integrate a further increase of electricity from RES. *Renewables associations* are generally asking for the development of cross-border grid infrastructure and for the EU to harmonise market design conditions (eg. via harmonised network codes, integrated intraday, balancing markets but also via the development of storage and demand-response measures), increased flexibility from power generation capacity and improved cooperation mechanisms.

To attract *long-term investors* (e.g. insurance companies, pension funds), there is a general consensus that a strong and stable EU policy is needed. Transparency on market rules, tax exemptions, support grants and simplified administrative procedures are seen as some of many possible tools to enhance private investments. More efforts are also required to increase regulatory stability (permit granting) and public acceptance. Hence, the adopted changes at national level to facilitate and speed up investments need to be fully implemented (Energy Infrastructure Package).

Part of the progressive community in favour of an energy savings binding 2030 target underlines that this will encourage Member States to improve implementation of the EU *acquis* for energy efficiency, thereby contributing to the harmonisation of the regulatory environment.

Capacity mechanisms

As regards *capacity mechanisms,* an important part of stakeholders, including**citizens, NGOs* and *industry* voice a sceptical view and are asking Member States to limit further fragmentation of the energy market and the EU to strive for European solutions in the least discriminatory and distortive manner. Some are suggesting that violations of the EU rules on competition, state aid and the internal market must be sanctioned. However the *power sector* generally consider such instruments as fundamental to ensure the construction of the necessary capacity based on the long term needs of the electricity system .

Which measures could he envisaged to make further energy savings most cost-effectively?

Renewables associations and *organisations representing companies offering solutions to energy efficiency improvements* generally advocate long term targets for both RES and energy efficiency as the best tools to stabilise the market and provide the sector with certainty, thereby facilitating the achievement of both 2020 targets and long term ambitions. From their perspective, having binding targets for energy savings would be the most effective way to foster investments and decrease costs. The effective implementation of the Energy Efficiency Directive would be of a paramount importance.

In line with these views, several *NGOs* are also insisting that additional public funding should be allocated to R&D in energy efficiency, in order to ensure the widest range of technologies is available to deliver long-term energy savings in the energy sector and the wider economy. They note that lack of financing and split incentives are barriers for energy efficiency improvements. Horizon 2020[l6ii] and the SET plan[169] are expected to contribute significantly to the achievement of energy and climate targets.

On the contrary, other *industry representatives* generally believe that energy efficiency should be achieved by voluntary initiatives, rather than by mandatory requirements which would lead to new administrative burdens.

Some industrial stakeholders also underlined that the most cost-efficient way of making further energy savings would be to improve the energy efficiency of existing buildings by way of thermal[8] renovation. In this respect, they note the European Commission should ensure that both the recast Energy Performance of Buildings Directive[170] and the new Energy Efficiency Directive are properly implemented by the Member States. Some *industrial stakeholders* also note that the lack of access to financing needs to be addressed. *Properly owners* fear that some existing buildings in Europe may not be able to meet EU-imposed high energy efficiency standards and this could result in many older properties needing to be demolished.

Several stakeholders, such as, but not limited to, *consumer associations* and *Distribution System Operators (DSO),* have also highlighted the importance of raising *citizen and consumer awareness,* for instance by introducing energy performance labels for household appliances. Transparency of costs for consumers at all levels is most likely to drive energy saving measures. When promoting the construction of *smart grids,* consumer flexibilities should be used to optimise the grid load. Real time monitoring and flexibilities provide new business opportunities for energy service companies in promoting energy efficiency.

Electrification of heating, cooling and transport are also perceived by some stakeholders as efficient tools to ensure cost-efficient energy savings. Finally, *trade unions* generally stress the importance of the workplace as a potential driver for energy efficiency and together with *non-energy intensive companies,* ask the promotion of dedicated environmental trainings.

How can EU research and innovation policies best support the achievement of the 2030 framework?

Research and innovation support is broadly recognized as key for achieving the future objectives of the 2030 framework and there is a strong overall agreement on the need for EU- level coordinated research initiatives. Some stakeholders note that national support schemes for R&D need to be better coordinated. Many stakeholders also recognize the importance of private sector participation in innovation and call for a clear and stable regulatory framework that would facilitate their participation.

From the consultation it emerges that the different stakeholders generally consider that Horizon 2020 and the SET Plan will play an instrumental role to support the EU innovation agenda. Several stakeholders suggest that structural and cohesion funds should be utilized.

Several *Member States* propose that high potential technologies should be prioritized within Horizon 2020. *Utilities* note that research priorities should be better aligned with the energy agenda, while *general business organizations* and *energy intensive companies* argue that funding should be in line with the ambition levels of the climate agenda.

Utilities suggest that Member States need to increase their cooperation on high cost industrial technologies such as Carbon Capture and Storage (CCS) and infrastructure projects. Several *utilities* argue that R&D should support the full value chain of all types of fuels, including conventional and unconventional fuels, promising renewable technologies, smart grids, infrastructure projects and energy storage. From a different perspective, *NGOs* call for less focus on nuclear technologies and some point out that no further support should be provided to CCS as it increases dependence on fossil fuels.

Energy intensive companies, *utilities and general business organizations* argue that projects should be supported through the demonstration phase. Deployment support should be limited and these funds should instead be used for R&D on lowering costs of promising technologies. In the same line of thought, oil and gas companies note that support to pre-commercial technologies should be provided, but commercial deployment should be incentivized through the ETS and GHG intensity goals. *Energy intensive industries* generally request that a focus also be given to R&D for industrial processes themselves and not only for specific energy technologies. *Oil and gas companies* note that the SET plan should be technology neutral and open to all promising technologies.

Non-energy intensive companies on the other hand argue that support should not only be focused on R&D and demonstration but also on deployment. *RES companies* and *NGOs* are of the same opinion, noting that demand pull and supply push are needed to commercialize technologies. *Non-energy intensive companies* generally call for further funding on RES, gas turbines, CCS, demand response, energy storage, and smart grids. *NGOs* ask for increased focus on RES and energy efficiency. *RES companies* request that the SET Plan is extended to cover all RES technologies.

Some local authorities and *trade unions* bring up that the Intelligent Energy-Europe[171] should reinforced within Horizon 2020 and help fill the gap between R&D and wide market uptake of innovation. Local authorities also point that Horizon 2020 should include non-technical innovations such as capacity building and new financing instruments.

Many stakeholders approve NER 300 type instruments that could help with innovation on the demonstration phase of various technologies. *Energy intensive companies* bring up that NER 300 type support should be provided to industrial processes as well. *General business organizations* and *some utilities* call for continued support of CCS technologies under the NER 300. NGOs also call for NER 300 for projects with EU-wide importance. *RES companies* approve of the NER 300 so far with focus on innovative RES technologies such as offshore wind. Some *non-energy intensive companies* suggest the creation of a fund for clean energy that allocated funds after a competitive process such as the NER 300.

Some *stakeholders* urge cooperation within the SET Plan between academics, policy makers and the industry.

7.3.6. *Competitiveness and security of supply*

Which elements of the framework for climate and energy policies could be strengthened to better promote job creation, growth and competitiveness?

NGOs and most of the *renewable and non-energy intensive industrial associations, trade unions* and *companies* are stressing that renewables and energy efficiency offer specific advantages in terms of job creation, competitiveness and innovation. Europe's competitiveness and its capacity to create jobs in the climate and energy sector, depends on its ability to drive innovation in sectors of the future. Therefore stable and ambitious long-term market and legislative frameworks are key for competitiveness, jobs and growth, whereas from their perspective a greenhouse gas-only approach would not be sufficient to make the huge job potential in renewable energy a reality. The development of RES and energy efficiency would also reduce import dependency, easing pressure on national budgets and trade deficits while freeing up financial resources for investment within the EU. In the same line, some *sectoral associations* are also insisting that Energy efficiency of buildings and in particular renovation of existing buildings as well as the EU's technological leadership in heating and cooling systems must be strengthened to better promote local job creation and growth. Others underline that other low carbon technologies, such as nuclear and CCS, could promote competitiveness and that their potential contribution should be recognised.

On the other side of the spectrum, *European industrial consumers* and *trade unions* stress the need for competitive energy prices and costs, security of supply and climate policies that do not endanger industrial competitiveness. Some of these also argue that ambitious climate and renewables objectives in particular could endanger EU price competitiveness of energy (for this aspect, see section 0 below).

There is wide concern among stakeholders from Central and Eastern European Countries, in particular *Member States* and *citizens,* about the impact of European climate and energy policy on European competitiveness. A wide number of stakeholders underline that, if compared to the USA, the energy price differential is increasing, causing a competitive disadvantage for energy-intensive industries in the EU. As a result, this would jeopardise growth and employment in Europe.

European industry associations and *energy intensive companies* also fear that a "green economy" dependent on subsidies, or on regulatory taxes on consumers or industry, is unlikely to be economically sustainable. *Trade unions* stress that training and education of our workforce are also necessary to promote competitiveness and the modernisation of our energy systems. As already discussed, *European companies* generally see the modernisation of European energy infrastructure and the completion of the single market as important steps to increase security of supply and enhance competitiveness.

For issues relating to carbon leakage and the design of climate policy to prevent it, see section 0 below.

What evidence is there for carbon leakage under the current framework and can this be quantified? How could this problem be addressed in the 2030framework?

Whereas there is no consensus among stakeholders on the existence of carbon leakage, the consultation registered a concern from a large number of *Member States*, *industries and organizations* on this issue.

Member States recognize that carbon leakage will be an increasingly important issue within the 2030 framework, and call for a framework which ensures European competitiveness. The vast majority supports, if no international agreement is reached, the continuation of free allowance allocation to industries that would be most affected, while ensuring that the carbon leakage rules remain cost-effective.

The *energy intensive industry and general business organizations* highlight how competitive pressures have been increasing on EU industry mainly due to development in emerging economies and recent shale gas exploitation in the US. They note that European industry needs enhanced protection mechanisms. They state that allowance revenues should be utilized to compensate the affected industries for cost increases in order to avoid carbon leakage or to support low carbon technology investments. *General business organizations* call for compensation for indirect pass-through costs of increased electricity prices, and ask for harmonization of the compensation across Member States, suggesting the development of an EU-wide instrument to replace the national state aid mechanisms, as currently governed by state aid guidelines. A few *industrial stakeholders* also propose to consider a border carbon tax for imports to create a level playing field.

Utilities generally note that there is limited evidence for carbon leakage at this stage. They ask for careful re-examination of businesses which are at risk of carbon leakage. In case there is no international agreement, they agree that free allowances should be used to compensate businesses. *Trade unions* note that the carbon leakage list needs to be reviewed but energy intensive industries should be preserved in the EU.

From a different perspective, according to *NGOs, RES organizations, non-energy intensive companies and part of academia* there is little evidence for carbon leakage at this stage. From this perspective, NGOs stress that free allowances are discouraging investments in low carbon technologies. *RES organizations, academia and non-energy intensive companies generally* note that other market factors, such as labour costs have a more significant impact on investment decisions. They also argue that most climate policy costs are passed to final consumers. In that context, free allocation should be reduced to better reflect the lower carbon costs that are currently on the market.

What are the specific drivers in observed trends in energy> costs and to what extent can the EU influence them?

Although the reasons for the current high energy costs in the EU are diverse and complex, there is an overall agreement that *fossil fuels price increases* have been one of the main drivers of energy price increases in the EU. From this perspective, stakeholders stress that the European Union has little margin for manoeuvre to influence world trends in energy costs.

In addition, taxes, tariffs and levies and the lack of competition due to a fragmented internal energy market are commonly considered as other important drivers having an impact on high energy prices. The completion of the *internal energy market* - including increased cooperation and coordination between Member States - is therefore seen by a majority of stakeholders as an important step to mitigate the rise of energy costs in Europe.

A wide segment of the *industrial community* and in particular *energy intensive associations* and companies are underlining that the increase of the relative price of energy in comparison to the USA results mainly from the shale gas revolution. The same stakeholders are generally also blaming the expansion of renewable energy and the related subsidies for the rising energy costs. From their perspective, the diversification of gas sources - both through new suppliers and routes as well as through the increased use of European conventional and *unconventional resources* - would be particularly important to reduce this differential. These stakeholders are calling for *external EU energy policies* to play an important role in fostering relations with major energy suppliers, to further diversify energy sources and to promote competition, and as such to have a positive impact on energy costs. The persistence of *regulated, prices* in some Member States is another issue generally raised by several industrial associations as having an impact on competition and energy prices.

In contrast, a vast majority of *NGOs* and the *renewable industry* believe that RES could make the European Union much more resilient to international energy prices fluctuations whereas renewable schemes would have limited impacts on average retail electricity bills. These stakeholders underline that several renewable technologies, such as wind and solar, could be exploited at very low marginal costs. From their perspective, the completion of the internal energy market and related infrastructure development would enable much more efficient operation of the power system and cost-effective integration of renewables (thereby reducing the need for back-up, storage etc.) and decrease overall energy system costs.

Partially in line with this view, *institutional investors* and a vast majority of *utilities* and the *power sector* criticise the oligopolistic nature of electricity and gas markets in many Member States and the corresponding insufficient levels of competition. There is also concern about the rising need for costly substitutions of old energy infrastructures as well as the increasing cost of capital.

A number of *citizen* and *consumer associations* agree with this last concern and stress that the investments for the expansion and modernisation of the energy infrastructure have an impact on prices for consumers. From their perspective attention should also be given to the protection of final consumers in order for them to have access to affordable and efficient energy commodities.

Several *NGOs*, *trade unions* and part of the *industrial sector* focus on the importance of *energy savings policies* to contain the cost impact of energy use, which would also decrease import dependence and the fossil fuel import bill. Policies that reduce energy demand would also reduce pressure on international fossil fuel prices, thereby having a positive effect on European fossil fuel prices.

Finally, stakeholders from different backgrounds and *academia* in particular, ask for more research and innovation to reduce overall cost and ease the penetration of new technologies.

Relatively few stakeholders have indicated that currently the EU ETS carbon price is an important factor contributing to the increase of energy costs, whereas a high number of *industrial stakeholders* are concerned how the ETS would impact prices in the long term.

How should uncertainty about efforts and the level of commitments that other developed countries and economically important developing nations will make in the on-going international negotiations be taken into account?

There is universal recognition that the EU needs to engage the international community and reach an agreement consistent with the internationally agreed target to limit atmospheric warming to below 2°C, while protecting the EU competitiveness. Yet, there are diverging views on how to solve the political uncertainty linked to international negotiations within the 2030 framework.

For the views of different Member States, see Box 3.
Energy intensive companies support the idea that the efforts and level of commitments cannot be taken unilaterally. *General business organizations* oppose setting targets before an international agreement, noting that only no-regrets options can be implemented in the meantime. If targets are to be set beforehand, *energy intensive companies* agree that they should incorporate a level of flexibility to allow for adjustments based on the outcome of international negotiations. These mechanisms need to be clearly defined. Some *citizens* are also concerned about European competitiveness and oppose unilateral EU action.

On the other side, many *utilities* argue that the EU should take action as quickly as possible to trigger long-term investments, while *non-energy intensive companies* also note that this would allow the EU to retain its competitive advantage. These suggest that the EU should establish dual targets - one unilateral and one more ambitious in case an international agreement is reached in 2015, but both of these targets should be decided upon as soon as possible to provide visibility to the economic actors.

In the same political line, *NGOs* call for action irrespective of actions from third countries since conditional commitments by the EU did not achieve the necessary results. They point out that other countries, such as China and the United States* are already making commitments and the EU needs to act to keep its early mover advantage in renewables and energy efficiency technologies. *Trade unions and some citizens* are also in favour of an early and clear commitment to reduce costs of decarbonisation and ensure job creation.

How to increase regulatory certainty for business while building in flexibility to adapt to changing circumstances (e.g. progress in international climate negotiations and changes in energy markets)?

There is a general consensus that regulatory certainty can be increased by creating a stable long-term legal framework. Answers generally provided focus once again on the trade-off between binding and flexible policies.

An important part of the *business* and *investment community* underlines that the European Commission should communicate a clear policy framework. In this respect, targets can help clarify what stakeholders are expected to deliver as long as those are commonly agreed, credible in terms of delivery and adapted to national circumstances. *NGOs* insist on stronger political line, stressing the importance of an explicit political commitment regardless of climate action in third countries whereas a number of *Member States* argue that the future framework should also take into account national specificities and to changing economic and political circumstances.

In order to increase certainty for investors, *renewable industry* insists on the need for a clear framework with a close monitoring system. Disruptive and retroactive policy changes have to be avoided. Regarding climate policies, an automatic downward adjustment mechanism is often proposed to increase regulatory certainty while adapting to changing circumstances.

Industrial consumers insist that planning and investment security are crucial with regard to the needed investments in the EU energy system. The new framework should therefore offer to the industry the required certainty and flexibility while avoiding short term intervention. The legislator should take greater account of the reality of the market and promote regulatory simplification and transparency while political intervention should be limited. The backloading proposal and recent proposal on biofuels (ILUC) are seen by part of the European industry as causing uncertainty.

Finally, *Utilities,* while also condemning short-term selective measures intervening in the market, are generally insisting that existing EU legislation should be duly implemented in all Member States. Government and national authorities are playing an important role to ensure a common level playing field while more coordination could reduce negative effects of national policies through cross-border impacts.

How can the EU increase the innovation capacity of manufacturing industry? Is there a role for the revenues from the auctioning of allowances?

Action to improve the innovation capacity of the manufacturing industry is welcomed by the participating stakeholders. Overall most stakeholders welcome the use of NER 300 type instruments at the EU level, calling for continuation of the program as discussed in section 0.

Industrial organizations and *energy-intensive industries* request that funding should be provided in proportion of the ambition level of the climate policy. *Energy> intensive companies* note the importance to support not only new technologies but also process innovation. They note that some sectors would require break through innovations to lower emissions such a glass and cement hence sufficient support should be provided. They welcome the SPIRE partnership[17]” to deliver solutions for energy and resource efficiency for the industry. Some representatives of the *energy intensive industry* note that auction revenues should be used exclusively as protection against carbon leakage or as incentives for the industries to develop low-carbon technologies.

Several *Member States* argue that the allowance revenues should remain a national competence but overall agree that at least partially these should be used to support low carbon transition of the industry

Industries that provide solutions to the sustainability challenge generally request that 100% of the allowance revenues should be spent to support low-carbon technologies, up from the 50% that currently Member States are obliged to spend on climate mitigation and adaptation. *NGOs* state for example that allowance revenues should not only be used to support manufacturing industry innovation but also contribute to leveraging private investments under the SET Plan and the Green Fund within the UN to support developing countries. *Trade unions* request that part of the allowance revenues be channelled to training and re- qualification for workers in the transition to the low carbon economy.

Many stakeholders, including some *Member States*, highlight the importance of mobilizing private investments to increase innovation. Some *NGOs* propose the creation of industrial fund to support innovation.

How can the EU best exploit the development of indigenous conventional and unconventional energy sources within the EU to contribute to reduced energy prices and import dependency?

Once again, on the definition and development of indigenous energy sources the consultation replies show that two general *diverging* outlooks exist in Europe.

Whereas *Member States* and *citizens* are generally divided, a significant share of the *industry*, the *energy intensive* industry and the *power sector* believes that Europe has to diversify its energy supplies and be more positive towards the development of alternative energy sources such as shale gas. Unconventional energy sources are seen by part of the industry as a possible means of keeping the price of EU energy competitive. In this respect, they are calling for the EU to adopt a clear and stable regulatory framework that could facilitate the safe exploitation of these resources.

At the same time several NGOs and the *renewable industry* advocate that energy savings and renewable energy are the EU's only significant and long-term indigenous energy solutions. From their perspective, RES are the only indigenous sources in which the EU has a competitive advantage.

Moreover, several *climate NGOs, local authorities, citizens* but also a minority of *companies* have some doubts on the potential for European shale gas exploitation to contribute to reduced import dependency, as shale gas reserves within the EU are not comparable to those of the U.S. Hydraulic fracturing methods are associated with a range of environmental impacts and some of them claim that the carbon "footprint" of shale gas may be significantly greater than for conventional gas. In line with these positions, some *citizens and NGOs* are also concerned about the potential implications for health and the environment.

How can the EU best improve security of energy supply internally by ensuring the full and effective functioning of the internal energy market (e.g. through the development of necessary interconnections), and externally by diversifying energy supply routes?

Views are split on which sources can guarantee greater security and should therefore be given priority, often related to stakeholders' sectoral interests. Some argue that RES bring instability to internal security of supply due to their intermittency and tend to argue for a diverse portfolio of energy sources and suppliers as the best way to ensure security' of supply. Others argue that, along with the necessary grid infrastructure developments, a focus on RES and energy efficiency will ensure a diversified portfolio of technologies, hence offering the best potential for sustainable energy independence in the long run.

Industry widely supports the timely completion of the internal energy market, the development of cross-border interconnections and better coordination between national policies. Some stakeholders go further, for example arguing for the removal of all remaining price controls. Externally, the diversification of energy suppliers and routes is seen as crucial.

European grid operators primarily argue for greater coordination between the national-level security of supply policies of Member States, as well as for the effective implementation of existing arrangements, such as for example the Ten Year Network Development Plan[144]. Similar to the above, the completion of the pan-European electricity system is seen as key.

[144] The 3rd Energy Package mandated ENTSO-E to publish a biannual, non-binding, Ten-Year Network Development Plan (TYNDP). The TYNDP is designed to increase information and transparency regarding the investments in electricity transmission systems which are required on a pan-European basis and to support decision-making processes at regional and European level.

Among *Member States* there is a broad agreement on the importance of completing the internal energy market and developing the necessary infrastructure. There is no consensus on whether renewable energy sources should and can be a major factor ensuring security of supply, with a widespread concern over the potential instability that renewables could bring to the network unless the necessary interconnecting infrastructure is in place.

Civil society and in particular *NGOs* also broadly recognise the need for greater grid interconnections across Europe. Along with the *renewable industry* they tend to support the increase of energy efficiency and use of indigenous RES as the best way to improve security of supply. They equally support the establishment of cross-border markets for day-ahead and intra-day trading, as well as a greater flexibility of the system. Furthermore, they advocate targeted support for electricity storage, increased decentralisation of power generation and demand-side response measures as areas with great potential that have so far largely remained untapped. Those respondents addressing external supply diversification arc typically in favour of continued efforts in this regard.

7.3.7. *Capacity and distributional aspects*

How should the new framework ensure an equitable distribution of effort among Member States? What concrete steps can be taken to reflect their different abilities to implement climate and energy measures?

Overall stakeholders argue that it is important to consider several factors when deciding on the distribution of effort among Member States. As regards GHG emissions, it is generally acknowledged that the ETS has provisions to allow for the fair distribution of efforts, so the focus should be on how to share the efforts for the Effort Sharing Decision.

Member States mostly agree that the distribution of efforts should be decided based on national specificities and potential to incorporate certain technologies, including financial capabilities. Some *Member States as well as some NGOs* note that financing could be provided through fill-wide instruments. Several *Member States* note that it would be important also to consider past efforts to lower emissions. In order to define the optimal division, several *Member States* and *general business organizations* suggest that a thorough impact assessment per Member State should be performed to evaluate the different starting points, potentials and financial capabilities.

NGOs note that the highest potential countries also often have the least ability to act, hence the effort sharing should take into account ability to pay and low marginal abatement costs. In the same line of thought, *utilities* cite a mix between financial and socio-economic capabilities that need to be considered. A few *utilities* propose to distribute the efforts based on the share of absolute emissions expected in 2030.

Some *energy intensive companies* suggest that for the non-ETS sector, a bottom up analysis could be done and cost-effective abatement potential across Member States should be implemented. *Oil and gas companies* note that negotiations should be carried out by Member States on how to distribute the efforts. Some of these request transparency in the distribution of efforts. Some *non-energy intensive companies* suggest distribution based on natural resource endowments. *Renewable energy companies* note that the national targets should allow for cooperation mechanisms such as statistical transfers, joint projects and joint support for achieving related to the RES target. *Trade unions* argue that capacity for action should be considered including geographical differences and wealth.

Some local authorities note that within the non-ETS, efforts should be based on the GDP of the Member States but also consideration should be given to potential for renewable resources and energy efficiency.

For distributional aspects relating to a potential RES target for 2030, see section below.

What mechanisms can be envisaged to promote cooperation and a fair effort sharing between Member States whilst seeking the most cost-effective delivery of new climate and energy objectives?

The majority of *Member States* are addressing this issue supporting the use of the ETS auctioning revenues. Member States formulated also some opinion on suitable mechanisms for effort sharing. Some propose the introduction of flexibility measures for GHG emission reduction in different sectors and the preparation of regional plans based on economic development levels or energy market volumes. Others note that trans-border collaboration projects should be better supported, e.g. as regards renewables development but also in view of developing large scale capital intensive technologies such the CCS. Member States' climate change and energy efficiency plans could also be combined into regions or sub-groups.

While the *manufacturing industry* and in particular *the energy intensive industries* mainly focus on the ETS as a suitable mechanism, the *renewable industry* and a majority of *NGOs,* but also major players in the *gas industry* tend to discuss the need for an increased use of cooperation mechanisms in other fields, such as those proposed within the Renewables Directive[10] in the form of statistical transfers, joint projects and joint support mechanisms. It was noted that progress with interconnections would encourage cooperation. Furthermore, these groups argued for a target-sharing based on efforts by all Member States and the consideration of national GDP as well as studies on RES and energy efficiency potentials to help ensure a fair distribution of efforts. Some *NGOs* specifically voiced the need for a reform of the Effort Sharing Decision, as the current flexibilities provided too little pressure on Member States to reduce emissions within their own borders.

Finally, *trade unions* generally stated the need for a reinforced Effort Sharing Decision as an integral part of efforts until 2030. In addition, a reinforcement of the Renewables and Energy Efficiency Directives should be envisaged as well as new binding national objectives.

Are new financing instruments or arrangements required to support the new 2030 framework?

Stakeholders agree that the EU should facilitate climate- and energy-related investments. While some stakeholder request innovative financial instruments, others note that the existing ones are sufficient. There is an overall agreement that it is key to leverage private investments.

Several stakeholders note that financing for less capable Member States should be provided. *NGOs* note the need to address investments in areas that have less financial capabilities such as Central and Eastern Europe. Several *Member States* acknowledge a gap in the cost of capital and support that this issue should be addressed through EU-instruments. Some TSOs suggest increasing the risk tolerance of the European Investment Bank (F.IB) to provide financing to riskier markets or through grouping projects in different Member States together to ensure sufficient funding. Some *trade unions* note that a regional development funds could be created under the European Investment Fund.

Many stakeholders argue for the need to use public funds to leverage private investments. Several stakeholders such as *RES companies, utilities* and *general business organizations* note that pension funds and institutional investors funds will be needed so investments from these need to be facilitated. *General business organizations* point out that an increased access to venture capital and private equity funds is needed. EIB could help with improving access to capital and leveraging private funds.

On infrastructure, according to *financial investors,* government backed investment banks could aid with the substantial investments. Some *general business organizations* argue that joint planning for networks is essential to make them cost efficient. They together some TSOs propose that project bonds could be used for infrastructure across borders. *NGOs and some industrial representatives* note that the Connecting Europe Facility is crucial to support cross border infrastructure projects. Finally, several stakeholders propose that community funds could be used for Projects of Common Interest, as well as for energy efficiency projects.

Energy intensive industries have diverging views - some say that new financing instruments are needed while others point out the focus should be on adjusting and improving the existing ones. They bring up that these should support manufacturing industry through demonstration and deployment and process improvements in energy intensive sectors. Some point to cooperation programs with EIB, the European Bank for Reconstruction and Development and the World Bank to help them for high capital cost projects.

RES companies note that innovative instruments are needed to support RES investments, citing for example offshore wind. They point that EIB could provide loans and guarantees. They also argue that the EIB should stop financing fossil fuel projects.

NGOs generally say that innovative financial instruments are needed to achieve the reduction potential under the Effort Sharing Decision. Some suggest that the EIB introduces an NER- 300 type instrument for the Effort Sharing Decision. For energy efficiency, they propose aggregating investments to make them more attractive to investors. They also support, together with *non-energy intensive companies,* the development of risk-sharing facilities, equity, loans and project bonds.

Local authorities request for better information on how to combine various sources of funding.