

Overview of European Union climate and energy policies



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Executive summary

The EU climate and energy targets to be met by 2020, known as the "20-20-20" targets, include a minimum 20% reduction in greenhouse gas emissions below 1990 levels, 20% renewable energy in final energy consumption, and a 20% reduction in primary energy use (compared with projected levels) to be achieved by improving energy efficiency. In addition, the EU has offered to increase its emissions reduction target to 30% in 2020, provided that other countries commit to similar ambitious reductions.

According to the European Commission, the EU is on track to achieving a *domestic* 20% GHG reduction in 2020 and 30% in 2030.

The long term target for EU is an 80-95% greenhouse gas emission reduction in 2050. In order to reach this target additional policies are required as shown in Figure 1.

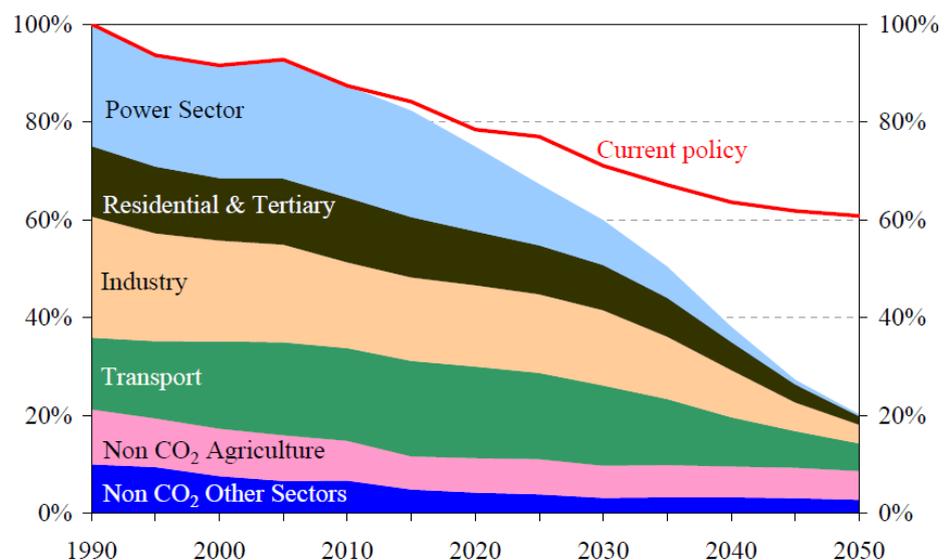


Figure 1: EU greenhouse gas emissions towards an 80% domestic reduction. Source: EU Roadmap for moving to a competitive low carbon economy in 2050, 2011

A common feature of a number of the current European climate and energy policies is that their time perspective is limited to 2020. Investments in new energy production facilities and grids are often made with view to be operational for up to 30 or 40 years. The relatively short term focus of the policies therefore creates uncertainty for investors, and poses a risk of investments being made in technologies that do not into the long-term objectives of the Union.

The key EU climate and energy policies are illustrated in the figure below, including the timeline for their introduction and coverage.

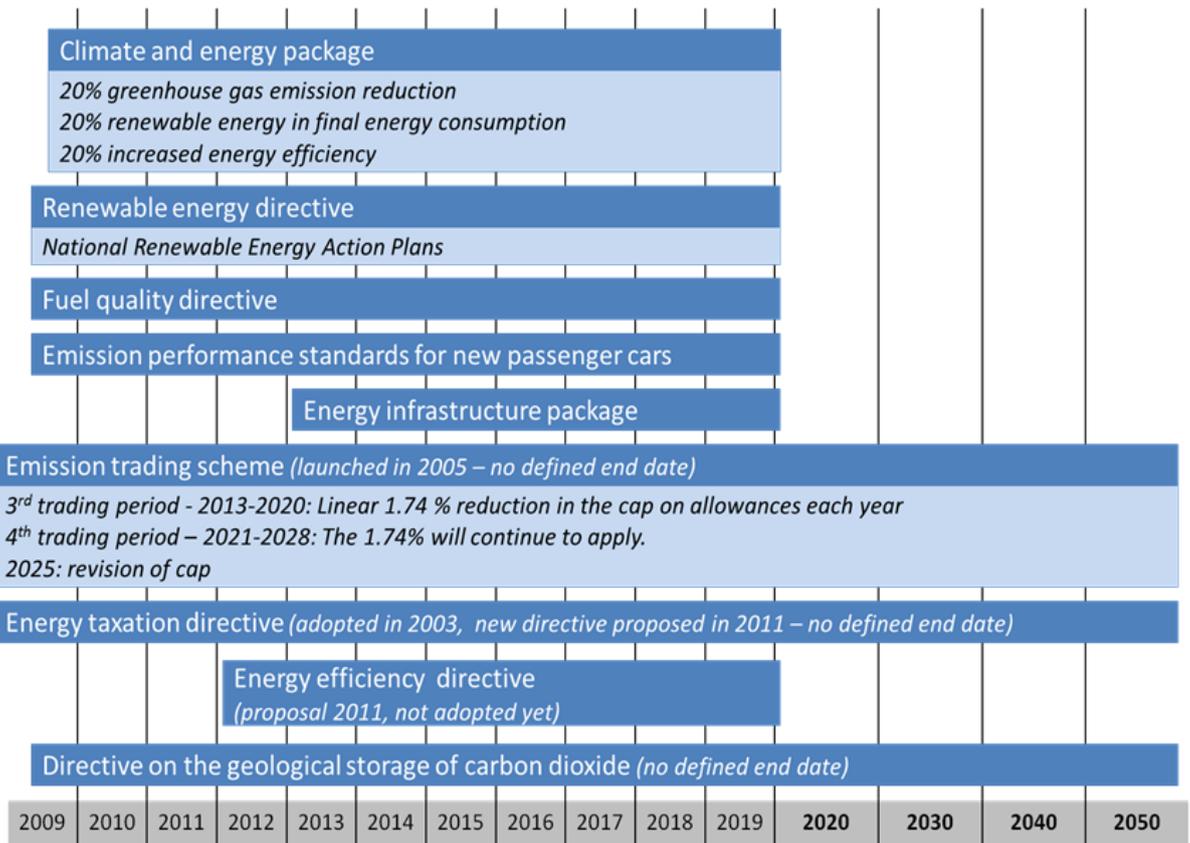


Figure 2: EU energy policies for the period until 2050

As Figure 2 demonstrates, most policy areas lack policy measures and targets for the period after 2020. In this memo, different suggestions for improvements of current policies and ideas for further research are presented. Among others, these cover the following topics and research questions:

- Clarification of the type of support for renewable energy after 2020. Should the current policies of national actions plants continue or is common regulation – based on either a market for RE certificates or feed in tariffs – preferable? Or should the ETS be the main driver in the longer term?
- Development of a firm long-term strategy on how to tackle the challenges of the transport sector

- How to revitalize the ETS and return to an emissions price within the EU that is sufficient to make the ETS effective? Another problem with the EU ETS is that citizens, companies and other stakeholders that reduce electricity consumption or invest in renewable electricity generation capacity do not see any *additional* CO₂ reductions of their efforts. The reason is that the EU ETS both works as a cap and a lower limit on CO₂ emissions.
- The need for an analysis on whether planned investments in gas infrastructure are compatible with the long term goal of achieving 80% domestic GHG reduction
- Clarity on future priorities on research and development, including the balance between nuclear power and renewable energy

1 Introduction

The EU 2020 targets, and the ambitious target for 2050 on an 80-95 % CO₂ reduction, are defining the long term development trends for the EU climate and energy policy. In order to keep on track towards achieving the targets, several challenges will need to be addressed. While there are already policies in place to address some challenges, there can still be identified a number gaps between the targets set out and the current policies.

This memo has been prepared for the Climate Strategies network during December 2011 to provide a background briefing paper for the *Supporting European climate policy to 2030* seminar hosted by Climate Strategies in Copenhagen (January 2012) . Its purpose is to create an overview of the current situation, policy targets and long-term analyses to support a discussion and identification of relevant future analysis and research areas for the Climate Strategies network.

2 Gaps between targets and policies

The climate and energy targets to be met by 2020, known as the "20-20-20" targets are:

- A reduction in EU greenhouse gas emissions of at least 20% below 1990 levels
 - including contributions from flexible mechanisms such as credits from the Clean Development Mechanism, i.e. internal EU reductions are lower down to approximately 14%
 - the flexible mechanisms can be used both by countries (to compensate non-ETS emissions) and by companies (ETS emissions)
- 20% of EU final energy consumption to come from renewable resources
- A 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency

In addition to these targets the EU has offered to increase the EU's emissions reduction to 30% in 2020, "provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities".

Table 1 (below) illustrates the current 20% targets and the conditional 30% target divided between the domestic part and the part that can be obtained with CDM.

	Current 20% target	Conditional 30% target	Impact of current policies*	Impact of current policies + EE plan*
Domestic	App 14%	App 19 %	20%	25%
With CDM	20%	30%	> 20%	> 25%

*Table 1: Current 20% GHG emission reduction target and conditional target. Emission reductions expected with current policies and current policies including implementation of Energy Efficiency and RE initiatives respectively. *According to the Commissions Climate Road Map (EU Roadmap for moving to a competitive low carbon economy in 2050, 8 March 2011)*

According to the EU Commission, the EU is on track to achieving a domestic 20% GHG reduction in 2020 and 30% in 2030. If there is a full implementation of the Energy Efficiency Plan and the EU delivers on its commitment to reach

20% RE, the Commission expects the EU to be able to outperform the current 20% emission reduction target and achieve a 25 % reduction by 2020.¹

According to the Commissions Climate Road Map (EU Roadmap for moving to a competitive low carbon economy in 2050, 8 March 2011) achieving emission reduction of 25% by 2020 will be the cost-effective pathway to achieving the long-term objectives in 2050.

However, as shown in Figure 3 (below), even if the policies have as a great an impact as estimated by the Commission, there is a substantial gap between the long term target for greenhouse gas reduction and the current policies.

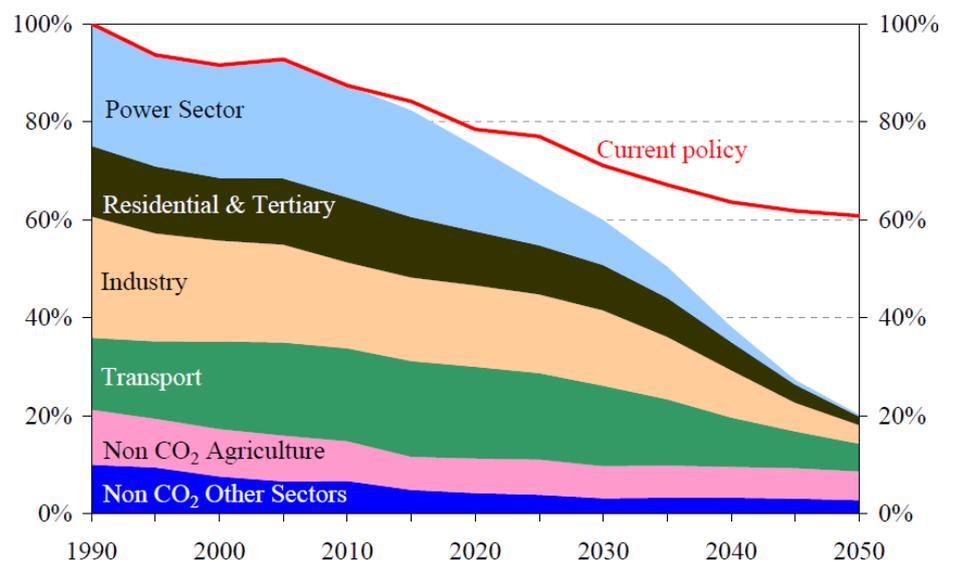


Figure 3: EU greenhouse gas emissions towards an 80% domestic reduction. Source: EU Roadmap for moving to a competitive low carbon economy in 2050, 2011

Based on scenario analyses presented in the Commissions own climate road map, a 40% domestic reduction is required by 2030 whereas current policies would only lead us to a 30% domestic reduction. The magnitude of the reductions needed in key sectors by 2030 and 2050 is shown in Figure 4.

¹ EU Roadmap for moving to a competitive low carbon economy in 2050, 2011

GHG reductions compared to 1990	2005	2030	2050
Total	-7%	-40 to -44%	-79 to -82%
Sectors			
Power (CO ₂)	-7%	-54 to -68%	-93 to -99%
Industry (CO ₂)	-20%	-34 to -40%	-83 to -87%
Transport (incl. CO ₂ aviation, excl. maritime)	+30%	+20 to -9%	-54 to -67%
Residential and services (CO ₂)	-12%	-37 to -53%	-88 to -91%
Agriculture (non-CO ₂)	-20%	-36 to -37%	-42 to -49%
Other non-CO ₂ emissions	-30%	-72 to -73%	-70 to -78%

Figure 4: Sectorial reductions. Source: EU Roadmap for moving to a competitive low carbon economy in 2050, 2011

A common feature of a number of the current energy policies is that their time perspective is limited to 2020. This is in contrast with investment periods for new energy production facilities and grids, which are often made with view to be operational for 30 or 40 years. The relatively short term focus of the policies creates uncertainty for investors, and at the same time poses a risk of investments being made in technologies that do not into the long-term objectives of the union.

The Commissions' Climate Roadmap 2050 has indicated milestones for greenhouse gas emissions and the Energy Roadmap 2050 states an intention to develop a policy framework for 2030. Such indications from the Commission are important, but still they need to be translated into actual policies to have real impact.

In the following section some key policy areas are described with a view to identifying possible gaps between policy measures and targets, and suggesting ideas for improvements of current policies. The aim is to contribute to a discussion about which areas could be looked further into if the long EU energy and climate goals are to be reached.

1. Energy efficiency and energy savings

The proposed energy efficiency directive will address a number of challenges regarding how to implement energy savings. The proposal for an obligation for energy companies to save 1.5 % of their energy sales each year is among the positive features – as is the obligation for large companies to do regular energy audits and the provisions regarding energy renovation of public buildings.

However, as to energy savings in the private building sector and energy savings in industry, a fundamental issue is that such investments often have a payback time exceeding the demands of the private sector – even though investments are commercially and socio economically viable. This issue appears to be only partly dealt with in the proposed directive and may need to be addressed further.

For energy intensive industries, the EU Emissions Trading System (ETS) was supposed to be the driver for energy efficiency and energy savings measures. However, with EU Allowances (EUA's) in the ETS being traded at around €6/tonne by the end 2011 the ETS is highly unlikely to fulfill this aim.

2. Renewable energy

Long term, well known framework conditions are a prerequisite for investments in renewable energy. However, the National Renewable Energy Action Plans (developed by each member country), which are the key measure for deployment of renewable energy technologies, only set targets to 2020.

A number of questions could be raised regarding how to frame support for renewable energy in the longer term:

- What renewable energy targets are required by 2030?
- Should the current policies arising from national actions plans continue, or is common regulation – based on either a market for RE certificates or feed in tariffs – preferable?
- Is the CO₂ price to be the driver for renewable energy – and when will RE be able to compete with conventional energy technologies?

It could be looked into if development of RE should be followed by a reduction of the CO₂ quota ceiling in order to ensure a positive impact on CO₂-emissions. Similarly, consideration should be given to how initiatives by individual countries, cities etc. should be managed in relation to the quota system.

As to investments in the energy sector, the EU Energy Roadmap includes a section on mobilizing investors, including that "new long term investors need to be brought in". However none of the ten conditions to be met focuses exclusively on the challenges of financing renewables apart from the rather vague statement that "well designed market structure instruments and new ways of cooperation are required...". Designing new models for attracting long-term financing (such as pension funds) for renewable energy – as well as

for other large scale investments in the energy – may pose a subject for further analysis.

3. Transport

As can be seen in Figure 4, a reduction of greenhouse gas emissions from the transport sector of 54-67% in 2050 compared to 1990 is considered necessary by the Commission to reach the climate goals². By contrast, levels of emissions from the transport sector increased by 30% from 1990 to 2005. The transport sector is an important but difficult policy area.

A transformation to electricity based transport (for light transport) will be needed, and it will be necessary to come up with solutions for heavy transport. Current EU policies do not seem to address how this transformation of the transport sector can take place. Moreover, it can be discussed whether the goal of 10% renewable energy in the transport sector by 2020 – which is likely to be complied with mainly from imported first generation bio-fuels – will bring the EU closer to long-term solutions. To put it in another way, the EU seems to be lacking a firm long-term strategy on how to tackle the challenges of delivering emissions reductions in the transport sector.

4. Economic measures

- **ETS**

The price of CO₂ emission allowances have dropped to below one fourth of the foreseen value when the ETS directive was revised. The experience during recent years has therefore raised questions about the ability of the ETS to ensure stable and predictable prices, important for long term investment decisions. At current prices, the ETS is very unlikely to be the driver of technological innovation towards 2020 that was envisioned.

This immediately raises the question of whether, and how, the ETS can achieve an EUA price at a level necessary to support longer-term low carbon investment and infrastructure development. It is questionable whether the revision of the ETS mechanism taking effect from 2013 is sufficient or if further political or legislative measures are necessary to provide this longer-term signal. In addressing this issue, a number of questions are raised:

² This includes road, rail and air transport but not sea transport. From the start of 2012 aviation will be part of the EU ETS.

- Is the mechanism itself (the ETS) the problem or it is simply the targets that are not sufficiently strong?
- What ETS targets are required for the period 2020-2030?
- Should the ETS mechanism be supplemented by floor/ceiling prices to ensure confidence and predictability of investors?
- Could a number of large Member States form a coalition to ensure emissions prices do not fall below (say) €30 per tonne CO₂, sufficiently large to constitute a “critical mass”? (Assuming that a number of Member States must be expected to oppose such a common policy.)

Another problem with the ETS system is that it removes the incentives of citizens, companies and other stakeholders to reduce their CO₂-emission and electricity consumption because of the firm ceiling of the ETS. Hence, it could also be explored if a mechanism can be developed to allow a reduction of the ceiling in connection with initiatives going beyond what is a direct consequence of the higher energy price, e.g. cities that undertake CO₂ neutrality.

- **Taxation**

The Commission’s proposal for a revised Energy Taxation Directive aims to restructure the way energy products are taxed in order to remove current imbalances and take into account both their CO₂ emissions and energy content.

The directive proposes splitting the minimum tax rate into two components – one based on the emissions of the energy product fixed at €20 per tonne of CO₂ and another based on energy content (€9.6 per GJ for motor fuels, and €0.15 per GJ for heating fuels). The CO₂ component to the energy tax is a new feature and could in principle have an impact on emissions.

However, there are some issues that should be addressed. Petrol is currently taxed higher than diesel, which is appropriate in order to reduce emissions, because diesel cars are generally more efficient than petrol driven cars. The question is if this benefit will disappear when the taxes of diesel and petrol are aligned as proposed in the directive? Also, will a tax level of €20 per tonne have more than a very limited effect? (€20 per tonne corresponds to less than a 10% increase in the price of heating oil). More generally, the effect (if any) that this proposed directive will have on emissions and energy demand is open to question.

More generally, it could also be discussed how economic measures can be shaped to achieve results. Taxation, for example, is a difficult measure for EU member states to agree upon. In addition to this, taxes can be a costly form of regulation because all emitters are affected independently of their actual possibilities to reduce emissions.

5. Infrastructure

The Commission places much emphasis on the development of energy infrastructure as a means to reach the energy and climate goals. The Commission estimates that in the next ten years, around €200 billion are needed for the construction of electricity grids and gas pipelines in order to meet the 2020 goals. This is a 30% increase in investments in the gas sector and a doubling of investments in the electricity sector compared to the previous decade.

Question to be looked into include:

- Are the measures in the infrastructure package sufficient to provide for the needed investments in electricity infrastructure?
- Is a significant increase in investments in gas infrastructure over the coming years compatible with the long term climate goals – considering that natural gas still is a fossil fuel and as such it should be gradually phased out of energy supply in the long term? Will the investments in gas infrastructure result in delayed investment in renewable energy technologies?
- Is sufficient emphasis being put on the development of district heating and utilization of surplus heat from power (CHP) and industrial facilities? There is a substantial potential for cost effective collective heat supply particularly in urban areas as well as a potential for utilizing waste products from forestry, agriculture etc for district heating purposes. District heating and cooling networks are mentioned, but not dealt with in the Commissions communications on Energy infrastructure priorities for 2020 and beyond – even though the district heating networks form a very important part of the energy infrastructure in many countries and has big potential for further expansion³.

³ The potential for further use of CHP and district heating has been analysed within the project ECOHEAT COOL <http://www.euroheat.org/ecoheatcool>

6. Research and Development

The R&D effort in the EU, including 7th Framework Program and its successor, Horizon 2020, is considered a key element in the effort to develop energy technologies that transform the EU into a low carbon economy by 2050. In addition to this, the SET plan⁴ aims at employing EU and member states resources and effort in a smarter and more efficient way through joint strategic planning and programming.

It could be evaluated if this effort is sufficient and if resources are prioritised in a way that benefits energy and climate goals optimally, both at national and EU level.

Specifically, the way in which funds are distributed between EU research in nuclear energy and EU research in renewable energy and other low carbon technologies and measures could be explored. Additionally, the role for different allocation methods to achieve goals such as supply security and a long term sustainable low carbon economy could be explored.

7. CCS

According to the Energy Roadmap 2050, Carbon Capture and Storage (CCS) plays an important role in reaching decarbonisation targets. According to the Roadmap, CCS will have to be applied to all fossil fuels from around 2030 onwards in the power sector, and CCS is also an important option for decarbonisation of several heavy industries (such as steel and cement production). Combined with biomass, CCS could deliver "carbon negative" values; however, the financial incentives would need to be structured correctly to support this goal.

However, the future of CCS is currently uncertain. Its development depends on public acceptance and adequate carbon prices, it needs to be sufficiently demonstrated on a large scale and investment in the technology ensured in this decade, and it needs to be deployed at scale from 2020 in order to be feasible for widespread use by 2030.

Consideration could also be given to whether the development of CCS is likely to proceed as foreseen, including necessary policy changes to push for CCS, the role of funding to take demonstration projects to completion and the needed development of infrastructure. Such an analysis should reflect that previous assumptions regarding CCS no longer apply. Current low EUA prices

⁴ European Strategic Technology Plan

undermine the case for investment in, and development of, CCS technology, while the funds to support CCS provided through the auctioning of EUA's is reduced dramatically.

It may also be relevant to explore long-term scenarios for the EU that do not rely on significant contributions from CCS, considering the uncertainties that are still attached to the technologies.

3 EU policy targets for 2020 and 2050,

In March 2007 the EU's leaders endorsed an integrated approach to climate and energy policy that aims to combat climate change and increase the EU's energy security while strengthening its competitiveness. They committed Europe to transforming itself into a highly energy-efficient, low carbon economy.

3.1 The "20-20-20" targets

To kick-start this process, the EU Heads of State and Government set a series of climate and energy targets to be met by 2020, known as the "20-20-20" targets. As mentioned above, these are:

- A reduction in EU greenhouse gas emissions of at least 20% below 1990 levels
 - including contributions from flexible mechanisms such as credits from the Clean Development Mechanism, i.e. internal EU reductions are lower, down to approx. 14%
 - the flexible mechanisms can be used both by countries (to compensate non-ETS emissions) and by companies (ETS emissions)
- 20% of final energy consumption to come from renewable resources
- A 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency.

The EU leaders also offered to increase the EU's emissions reduction to 30%, "provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities"⁵.

3.2 2050 target

Scientific evidence indicates that global warming needs to be limited to less than 2°C above the temperature in pre-industrial times (around 1.2°C above today's level) if the world is to have a fair chance of preventing severe climate change. This temperature ceiling has been endorsed by all major economies in the Copenhagen Accord⁶.

⁵ http://unfccc.int/meetings/copenhagen_dec_2009/items/5264.php

⁶ <http://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf>

80-95 % reduction

Without global action to limit climate change, temperatures could increase by 2°C or more by 2050 and 4°C or more by 2100⁷. To stay below 2°C, every country will have to reduce its greenhouse gas emissions, but developed countries will need to take the lead by targeting a cut of 80-95% below 1990 levels by 2050. The European Council and the European Parliament have endorsed this target range as an EU objective in the context of developed countries as a group making the reductions needed.⁸

⁷ According to the IEA it's "Current Policies Scenario", which assumes no change in government policies and measures beyond those that were enacted or adopted by mid-2011, is consistent with a long term temperature increase of 6°C or more (IEA WEO 2011, p. 210)

⁸ EU: Memo/11/150, March 2011.

4 Studies and analysis

In this section, some of the key studies and analyses on how to reach the long term targets are reported: The EU Low Carbon Economy Roadmap 2050, the Energy Roadmap 2050, the White Paper on Transport and the European Climate Foundation 2050 roadmap.

4.1 Roadmap for moving to a competitive low carbon economy 2050

In a Communication from March 2011 the EU Commission outlines the findings of an analysis of cost-effective ways of reducing greenhouse gas emissions by 2050.

In order to be in line with the 80% to 95% overall greenhouse gas (GHG) reduction objective by 2050, the Roadmap indicates that a cost effective and gradual transition would require a 40% domestic reduction of greenhouse gas emissions compared to 1990 as a milestone for 2030, and an 80% reduction by 2050. Building on what has already been achieved, the EU needs to start working on appropriate strategies to move in this direction, and all Member States should soon develop national low carbon Roadmaps (if not already done). The Commission is prepared to provide some of the necessary tools and policies.

The analysis shows that with existing policies, the EU will achieve the goal of a 20% GHG reduction domestically by 2020 (domestic meaning real internal reductions of EU emissions and not offsetting through the carbon market). Were the revised Energy Efficiency Plan to be fully and effectively implemented, meeting the 20% energy efficiency target, this would enable the EU to outperform the current 20% emission reduction target and achieve 25% domestic reductions⁹. However, the Communication does not suggest setting new 2020 targets, nor does it affect the EU's offer in the international negotiations to take on a 30% reduction target for 2020, if the conditions are right. The 30% target would, however, include off-sets in other countries.

The Roadmap gives ranges for emissions reductions for 2030 and 2050 for key sectors. To realize these milestones as cost-effectively as possible, and to maximize benefits for EU manufacturing industries, the Commission considers

⁹ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SEC:2011:0288:FIN:EN:PDF> , Impact assessment of "A Roadmap for moving to a competitive low carbon economy in 2050", p. 124 (EU Commission, 8 March 2011)

implementation of the Strategic Energy Technology Plan to be crucially important.

The Commission intends to use the Roadmap as a basis for developing sector specific policy initiatives and Roadmaps, such as the 2050 Energy Roadmap and the White Paper on Transport. According to the Climate Change Roadmap, the Commission will initiate the appropriate “sectoral dialogues”.

4.2 Energy Roadmap 2050

The EU Energy Roadmap 2050 was issued 15 December 2011. In the Roadmap, the Commission outlines what can be done to create common EU conditions for the necessary transformation of the European energy system on which national strategies and instruments can be based.

According to the Roadmap, ten conditions must be met:

- The immediate priority is to implement fully the EU's Energy 2020 strategy. All existing legislation needs to be applied, and the proposals currently in discussion, notably on energy efficiency, infrastructure, safety and international cooperation, need to be adopted swiftly.
- The energy system and society as a whole need to be dramatically more energy efficient. The co-benefits of achieving energy efficiency in a wider resource efficiency agenda should contribute to meeting EU decarbonisation goals in a faster and cost-efficient manner.
- Particular attention should continue to be given to the development of renewable energy. Its rate of development, impact in the market, and rapidly growing share in energy demand call for a modernization of the policy framework. The EU's 20% renewable energy target has so far proven an efficient driver in the development of the renewable energy in the EU, and timely consideration should be given to options for 2030 milestones.
- Higher public and private investments in R&D and technological innovation are crucial in speeding-up the commercialization of all low-carbon solutions.
- The EU is committed to a fully integrated market by 2014. In addition to the technical measures already identified, there are regulatory and structural shortcomings which need to be addressed. Well-designed market structure instruments, and new ways of cooperation, are required for the internal energy market to deliver its full potential given that new investments are coming into the energy market and the energy mix is changing.

- Energy prices need to better reflect costs, notably of the new investments needed throughout the energy system. The earlier prices reflect costs, the easier the transformation will be in the long run.
- A new sense of urgency and collective responsibility must be brought to bear on the development of new energy infrastructure and storage capacities¹⁰ across Europe and with neighbors.
- There will be no compromise on safety and security for either traditional or new energy sources. The EU must continue to strengthen the safety and security framework and lead international efforts in this field.
- A broader and more coordinated EU approach to international energy relations must become the norm, including redoubling work to strengthen international climate action.
- Member States and investors need concrete milestones. The Low carbon economy roadmap has already indicated greenhouse gas emission milestones. The next step is to define the 2030 policy framework, reasonably foreseeable and the focus of most current investors.

On this basis, the Commission will continue to bring forward initiatives, starting with comprehensive proposals on the internal market, renewable energy and nuclear safety next year.

As to investments in the energy sector, the EU Energy Roadmap includes a section on mobilizing investors including that "new long term investors need to be brought in". However none of the ten conditions to be met focuses exclusively or directly on finance, instead relying on the rather vague statement that "well designed market structure instruments and new ways of cooperation are required....".

4.3 White paper on transport, 2011

In 2011, the Commission adopted the "Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system". The Roadmap includes a number of initiatives to build a competitive transport system with the aim to increase mobility, remove barriers in key areas, reduce Europe's dependence on imported oil and cut carbon emissions in transport by 60% by 2050.

¹⁰ The energy road map mentions the importance of both gas, heat and in particular electricity storage capacity.

10 goals

The Roadmap sets out the following ten goals:

- (1) To halve the use of 'conventionally-fuelled' cars in urban transport by 2030; phase them out in cities by 2050; achieve essentially CO₂-free city logistics in major urban centers by 2030.
- (2) Low-carbon sustainable fuels in aviation to reach 40% by 2050; also, to reduce EU CO₂ emissions from maritime bunker fuels by 2050 by 40% (if feasible 50%).
- (3) 30% of road freight over 300 km should shift to other modes such as rail or waterborne transport by 2030, and more than 50% by 2050, facilitated by efficient and green freight corridors. To meet this goal will also require appropriate infrastructure to be developed.
- (4) By 2050, complete a European high-speed rail network. Triple the length of the existing high-speed rail network by 2030 and maintain a dense railway network in all Member States. By 2050 the majority of medium-distance passenger transport should go by rail.
- (5) A fully functional and EU-wide multimodal trans-European transport network (TEN-T) 'core network' by 2030, with a high quality and capacity network by 2050 and a corresponding set of information services¹¹.
- (6) By 2050, connect all core network airports to the rail network, preferably high-speed; ensure that all core seaports are sufficiently connected to the rail freight and, where possible, inland waterway system.
- (7) Deployment of the modernized air traffic management infrastructure (SESAR) in Europe by 2020 and completion of the European Common Aviation Area. Deployment of equivalent land and waterborne transport management systems. Deployment of the European Global Navigation Satellite System (Galileo).
- (8) By 2020, establish the framework for a European multimodal transport information, management and payment system.
- (9) By 2050, move close to zero fatalities in road transport. In line with this goal, the EU aims at halving road casualties by 2020. Make sure that the EU is a world leader in safety and security of transport in all modes of transport.
- (10) Move towards full application of "user pays" and "polluter pays" principles and private sector engagement to eliminate distortions, including harmful subsidies, generate revenues and ensure financing for future transport investments.

4.4 European Climate Foundation Roadmap 2050

Power sector roadmap

The Roadmap 2050 project for the power sector is an initiative of the European Climate Foundation (ECF). The ECF was established in early 2008 as a non-

¹¹ Such as multimodal transport management and information systems as well as navigation, traffic monitoring and communication services

profit initiative to promote climate and energy policies that greatly reduce Europe's greenhouse gas emissions.

Roadmap 2050 has been developed by a consortium of experts funded by the ECF. The technical, economic and policy analyses were conducted by a number of organizations and research institutes in the energy field with involvement of leading utilities, transmission operators, equipment manufacturers, academics and NGOs.

The roadmap examines several decarbonisation scenarios for the power sector and, based on a back-casting method, sets out the near-term implications of this long-term commitment.

The project finds that in each of the low/zero-carbon pathways, using 40%, 60%, 80% or 100% renewable energy sources, the future cost of electricity is comparable to the future cost of electricity under the current carbon-intensive infrastructure. Roadmap 2050 also shows that with the necessary investments in energy efficiency and Europe's power network infrastructure, a decarbonised power sector using available technologies can provide the same high level of reliability that consumers enjoy today, in all low/zero carbon pathways.

With the exception of existing hydroelectric facilities, almost all of the power generation capacity required to supply Europe in 2050 will need to be built in the next 40 years. This is a major undertaking regardless of the energy mix, and would pose a massive challenge even in a high-carbon scenario. The key finding of the Roadmap 2050 project is that the challenge is basically the same in a high-carbon, a low-carbon or a zero-carbon energy scenario in terms of overall cost to consumers and the European economy.

What does change significantly is the required level of investment early in the cycle. Capital expenditure on energy infrastructure will need to increase by 50-100% in the next 15 years to deliver a zero-carbon power sector by 2050. In this scenario, the overall energy bill for the economy will be heading downward by 2020, and the day-to-day running costs fall fast throughout the period.

According to the EFC Roadmap, policy development and implementation for 2010-15 will need to focus on:

1. Energy efficiency measures, creating cost savings and reducing demand.
2. Investments in regional grid inter-connection, minimizing reserve capacity and load-balancing requirements, plus a broad program of smart grid pilot projects anticipating rapid expansion.
3. Continued and accelerated technology development.
4. Market reform to ensure an effective long-term investment case for business.
5. Laying the foundation for rapid fuel switch to electricity in buildings and transport sectors.

The ECF Roadmap emphasizes the disconnect between the EU ambition for massively increased power sector investment and the capability of the existing corporate structure in the power sector to implement and finance this. It suggests that new models for attracting long-term financing (especially pension funds) will be needed, and that this is a topic which requires much further development.

According to Roadmap 2050 transformation of the European power sector would yield economic and sustainability benefits, while at the same time securing and stabilizing Europe's energy supply. Achieving at least 80% greenhouse gas reductions in 2050 based on zero carbon power generation in Europe is technically feasible and fully reliable, including pathways based on very high contributions from renewables, and makes economic sense.

5 Current and planned policies within EU

This section considers the EU Treaty provisions that relate to climate and energy, the EU Climate and Energy Package, as well as current initiatives on energy efficiency, infrastructure, economic incentives and related measures.

5.1 The Treaty

The EU treaty's provisions relating to climate and energy are outlined in three chapters: specific articles on trans-European networks, and more general articles on environment and energy.

Trans-European Networks

The trans-European networks provisions¹² stipulates that to enable citizens, businesses and regional and local communities to derive full benefit from an area without internal frontiers, the EU shall contribute to the establishment and development of trans-European networks in the areas of transport, telecommunications and energy infrastructures.

Within the framework of a system of open and competitive markets, action by the EU shall aim at promoting the interconnection and interoperability of national networks as well as access to such networks. It shall take account in particular of the need to link islands, landlocked and peripheral regions with the central regions of the Union.

In order to achieve these objectives, the EU:

- shall establish a series of guidelines to identify projects of common interest;
- shall implement measures to ensure the interoperability of the networks; and
- may support projects of common interest supported by Member States, which are identified in the framework of the guidelines.

Environment

According to the chapter on the Environment¹³, EU policy on the environment shall contribute to the pursuit of the following objectives:

- preserving, protecting and improving the quality of the environment;
- protecting human health;
- prudent and rational utilization of natural resources; and

¹² Articles 170-172

¹³ Articles 191-193

- promoting measures at international level to deal with regional or worldwide environmental problems, and in particular combating climate change.

Energy

The Energy provision¹⁴ in the Treaty stipulates that the EU energy policy - in the context of the establishment and functioning of the internal market and with regard for the need to preserve and improve the environment - shall aim to:

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

5.2 The Climate and Energy Package 2009

In January 2008 the European Commission proposed binding legislation to implement the 20-20-20 targets. This 'Climate and Energy Package' was agreed by the European Parliament and Council in December 2008 and became law in June 2009. The package comprises four pieces of legislation:

Strengthening ETS

A revision and strengthening of the Emissions Trading System. A single EU-wide cap on emission allowances will apply from 2013 and will be cut annually, reducing the number of allowances available to businesses to 21% below the 2005 level in 2020. The free allocation of allowances will be progressively replaced by auctioning, and the sectors and gases covered by the system will be somewhat expanded. See section 4.4 for further on the ETS scheme.

Emissions from non-ETS sectors

An 'Effort Sharing Decision' governing emissions from sectors not covered by the EU ETS, such as transport, housing, agriculture and waste, has been agreed upon. Under the Decision, each Member State has agreed to a binding national emissions target for 2020 which reflects its relative wealth. The targets range from an emissions reduction of 20% by the richest Member States to an increase in emissions of 20% by the poorest. These national targets will cut the EU's overall emissions from the non-ETS sectors by 10% by 2020 compared with 2005 levels.

Binding national RE targets

Binding national targets for renewable energy add up the average renewable share across the EU to 20% by 2020, which is more than double the 2006 level of 9.2%. The national targets range from a renewables share of 10% in Malta

¹⁴ Article 194

to 49% in Sweden. The differences between the countries reflect (among other things) that some countries already have high shares of renewables in their energy mix whereas other countries have very low shares.

CCS

A legal framework is to be set up in order to promote the development and safe use of carbon capture and storage (CCS). Although the different components of CCS are already deployed at commercial scale, the technical and economic viability of its use as an integrated system has yet to be shown. The EU therefore plans to set up a network of CCS demonstration plants by 2015 to test its viability, with the aim of commercial uptake of CCS by around 2020. Revised EU guidelines on state aid for environmental protection, issued at the same time as the legislative package was proposed, enable governments to provide financial support for CCS pilot plants.

There are a number of factors challenging the plans to commercialize CCS. The current prices on CO₂ are very low. Hence the income from auctioning EUA's to finance CCS facilities is much less than foreseen when the system was put in place.

Analysis of options beyond 20%

In May 2010, the European Commission published a communication "Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage", which revisits the analysis of the implications of the different levels of ambitions (20% and 30% targets) and assesses the risk of carbon leakage.

The communication sets out how changed global circumstances have impacted on the targets set in 2008. While the absolute costs of meeting a 20% target have been reduced, it also represents a risk that the effectiveness of the 20% target as a motor for change diminishes. Therefore, it is important to analyze the direct consequences of a possible move to a 30% target.

No 30% target yet

The communication concludes that a political decision to move to a 30% target cannot be taken without consideration of the international context: as yet, the conditions set for stepping to 30% have not yet been met. In addition, such a decision also needs to be taken in full consciousness of the current economic circumstances of the EU. According to the Communication, both the international context and the economic analysis suggest that the EU should maintain the option for moving to a 30% target and should be ready to act when the conditions are right.

5.3 Directive on the promotion of the use of energy from renewable sources

The renewable Energy Directive is part of the Energy and Climate Package and was adopted in April 2009. It establishes a common framework for the production and promotion of energy from renewable sources. It has the following provisions:

National targets and measures for RE incl. RE in transport	Each Member State has a target calculated according to the share of energy from renewable sources in its gross final consumption for 2020. In addition, the share of energy from renewable sources in road transport must amount to at least 10% of final energy consumption in the sector by 2020.
National renewable energy action plans	The Member States are to establish national action plans which set the share of energy from renewable sources consumed in transport, as well as in the production of electricity and heating, for 2020.
Cooperation between Member States	Member States can “exchange” an amount of energy from renewable sources using a statistical transfer, and set up joint projects concerning the production of electricity and heating from renewable sources. It is also possible to establish cooperation with third countries under certain conditions.
Guarantee of origin	Each Member State must be able to guarantee the origin of electricity, heating and cooling produced from renewable energy sources.
Access to and operation of the grids	Member States should build the necessary infrastructures for energy from renewable sources. To this end, they should ensure that operators guarantee the transport and distribution of electricity from renewable sources; and they should provide for priority access for this type of energy.

5.4 Fuel Quality Directive, 2009

In April 2009, a revised Fuel Quality Directive¹⁵ was adopted. It amends a number of elements of petrol and diesel specifications as well as introduces a requirement on fuel suppliers to reduce the greenhouse gas intensity of energy supplied for road transport (Low Carbon Fuel Standard).

In addition, the Directive establishes sustainability criteria that must be met by biofuels if they are to count towards the greenhouse gas intensity reduction obligation.

¹⁵ [Directive 2009/30/EC](#)

5.5 Emission performance standards for new passenger cars and vans, 2009

Legislation setting emission performance standards for new passenger cars was adopted in 2009. The legislation is a key part of the EU strategy to improve the fuel economy of cars and ensure that average emissions from new passenger cars in the EU do not exceed 120gCO₂/km by 2020.

Some key elements of the adopted legislation are as follows:

- Limit value curve. The fleet average to be achieved by all cars registered in the EU is 130 grams CO₂ per kilometre (gCO₂/km) by 2012. A so-called limit value curve implies that heavier cars are allowed higher emissions than lighter cars while preserving the overall fleet average.
- Phasing-in of requirements. In 2012, 65% of each manufacturer's newly registered cars must comply on average with the limit value curve set by the legislation. This will rise to 75% in 2013, 80% in 2014, and 100% from 2015 onwards.
- Penalty payments for excess emissions until 2018. If the average CO₂ emissions of a manufacturer's fleet exceed its limit value in any year from 2012, the manufacturer has to pay an excess emissions premium for each car registered.
- Long-term target. A target of 95gCO₂/km is specified for the year 2020. Details of how this target will be reached, including the excess emissions premium, will have to be defined in a review to be completed no later than the beginning of 2013.
- Eco-innovations. Certain innovative technologies cannot demonstrate their CO₂-reducing effects under the type approval test. As an interim procedure until the test procedure is reviewed by 2014, manufacturers can be granted a maximum of 7gCO₂/km of emission credits on average for their fleet if they equip vehicles with innovative technologies, based on independently verified data.
- Pools acting jointly to meet emission targets. Manufacturers can group together to form a pool which can act jointly in meeting the specific emissions targets.
- Monitoring CO₂ emissions from new passenger cars. Under the legislation, the Commission sets down rules on the data required to monitor the CO₂ emissions of new cars.

5.6 The Energy Infrastructure Package 2011

With the Energy Infrastructure Package issued October 2011 the Commission proposed that the EU from 2014 co-finances construction of large energy in-

infrastructure *from its regular budget*. In the present financial period (2007-2013), the EU finances mainly feasibility studies for energy projects (€155 million) and €3.85 billion are invested into energy projects under the European Energy Plan for Recovery. These are one-off amounts

Huge investments needed

The Commission stipulates that in the next ten years, around €200 billion is needed for the construction of gas pipelines and electricity grids in order to meet the 2020 goals: €140bn for electricity transmission systems, storage and smart grid applications, €70bn for gas pipelines, storage, Liquefied Natural Gas terminals and reverse flow infrastructure (to allow gas to flow in both directions) and €2.5bn for CO₂ transport infrastructure. Compared to the period 2000 to 2010, this would result in a 30% increase in investments in the gas sector, and a 100% increase in the electricity sector.

It is estimated that the investments needed to achieve the 2020 goals will not be made or not be made on time, for two main reasons:

- Building permits take too long to obtain. For example, it can take more than 10 years to gain permission to build an overhead electricity line, increasing investor uncertainty and hence costs.
- Not all the investments needed are commercially viable.

Common Interest projects

The Commission therefore proposes to select a number of projects of "Common Interest" which are important to reach its climate and energy goals. They should display economic, social and environmental viability, and involve at least two Member States.

Projects having obtained this label will benefit from a special permit granting procedure which is easier, faster and more transparent than normal procedures: Each member state will designate a single competent authority responsible – "a one stop shop" – for the completion of the entire permit granting process. The whole permit granting procedure will not exceed three years.

CEF Facility

Furthermore, the projects will be eligible for EU funding, be it grants, project bonds or guarantees. In the period 2014-2020 €9.1bn is earmarked for energy infrastructure under The "Connecting Europe Facility" (CEF). The EU will co-finance up to 50% of the costs for studies and works and in exceptional circumstances up to 80% for projects that are crucial for regional or EU-wide security of supply or solidarity, require innovative solutions or have cross-sector synergies. To be considered for grants for works, the projects will have to prove that they are commercially not viable.

New financial instruments

The financial portfolio for energy infrastructure projects also includes equity instruments (e.g. investment funds) and risk-sharing instruments (e.g. loans and guarantees, and notably project bonds), which are to create a bigger multiplier effect than grants. By combining various forms of support, the aim is to tailor the financial assistance provided to the particular needs of a project. Risk-sharing instruments are likely to be suitable for larger project-financed investments, such as big gas import pipelines involving numerous shareholders. Highly innovative projects with a significant technological risk, notably in offshore transmission, might require grant support to get off the ground.

Citizen involvement

In many Member States it is currently practice that public consultation is held after the submission of the application file to authorities. According to the proposed regulation citizens must be involved at a very early stage of the permit procedure – that is before the project developer submits a formal application for the permit. This is in order to ensure citizens concerns can be taken into account in the planning phase of the project.

Timeline for the regulation

The Regulation should be adopted by the European Parliament and the Council by the end of 2012 for an entry into force at the beginning of 2013. This will enable the establishment of the first Union-wide list of projects of common interest, in view of their possible financing under the CEF, which will enter into force in 2014.

5.7 Economic incentives

ETS

The EU ETS based on the "cap and trade" principle

The EU ETS was launched in 2005 and works on the "cap and trade" principle. This means there is a "cap", or limit, on the total amount of certain greenhouse gases that can be emitted by the factories, power plants and other installations covered by the system. Within this cap, companies purchase (or receive via free allocation) emission allowances which they can sell to or buy from one another as needed. The limit on the total number of allowances available ensures that they have a value. At the end of each year, each company must surrender enough allowances to cover all its emissions, otherwise fines are imposed. Where a company reduces its emissions, it can keep any spare allowances to cover its future needs, or else sell them.

Plans for expansion of the system

The ETS operates in 30 countries (the 27 EU Member States plus Iceland, Liechtenstein and Norway). It covers CO₂ emissions from some 11,000 installa-

tions currently accounting for almost half of the EU's CO₂ emissions, and 40% of its total greenhouse gas emissions.

As part of the climate and energy package 2008 a substantial revision of the EU ETS was agreed upon and will take effect from 1 January 2013. Airlines will join the scheme in 2012, and the scheme will be further expanded to the petrochemicals, ammonia and aluminium industries and to additional gases in 2013. At the same time a series of changes to the way the EU ETS works will take effect in order to strengthen the system, including:

- A modest broadening of the scope (in addition to bringing in aviation in 2012) to bring in certain additional industries and greenhouse gases, as well as installations undertaking the capture, transport and geological storage of CO₂ emissions;
- The replacement of the current system of national caps on emissions allowances by a single cap on allowances for the whole EU;
- A linear 1.74% reduction in the cap on allowances each year until 2020. The 1.74% will continue to apply beyond the end of the trading period in 2020 and will determine the cap for the fourth trading period (2021 to 2028) and beyond. It may be revised by 2025 at the latest.¹⁶
- A move towards full auctioning of allowances in place of the current system of cost-free allocation. From 2013 at least 50% of allowances will have to be bought at auction and the aim is to reach full auctioning by 2027. Exceptions can be made for specific energy intensive industries where it is judged that having to buy all allowances would damage their international competitiveness;
- More harmonised rules on monitoring, reporting and verification of emissions in order to enhance the reliability and credibility of the scheme;
- The possibility to link EU ETS to mandatory cap-and-trade systems in third countries not only at national level but also at regional or state level;
- Harmonized rules on the use of carbon credits from CDM and JI projects in third countries. In the 2008-2012 trading period, the EU allows operators to use JI/CDM credits up to a percentage determined in the National Allocation Plans. Unused entitlements are transferred to the next trading period (2013-2020) and a limited additional quantity is allowed to be used in such a way that the overall use of credits is limited to 50% of the EU-wide reductions over the period 2008-2020.

¹⁶ EU: MEMO/08/796, 2008

- The possibility for Member States to exclude from the system small installations emitting relatively low amounts of CO₂ provided these installations are subject to measures that will have an equivalent effect on their emissions.

Consequences

The Commission expects the changes to be introduced in 2013, notably the move towards auctioning of allowances, to enhance the effectiveness of EU ETS. Total emissions within the EU ETS in 2020 will be 21% lower than in 2005, the Commission stipulates.

However, currently (14.12.2011) allowances are priced at a very low level of €6.3/tonne. This is considered to be due in part to reduced industrial activity during the economic crisis, and due to impact of other policies such as development of renewable energy, taxation etc.

Taxes

Taxation of energy products is to a certain extent harmonized at EU level. The existing Energy Taxation Directive sets forth minimum rates for the taxation of energy products used as motor fuels and heating fuels, as well as electricity (Figure 5). However, according to the European Commission, the directive has become outdated and inconsistent. Taxation based on volumes of energy products consumed cannot address EU's energy and climate change targets.

The current minimum taxation levels are:

	Based on energy content	Equivalent to:
Oil	0,59 €/GJ	8,1 €/tonne CO ₂
Coal	0,15 €/GJ	1,58 €/tonne CO ₂
Natural gas	0,15 €/GJ	2,7 €/tonne CO ₂
Petrol	10,9 €/GJ	158 €/tonne CO ₂
Diesel	9,4 €/GJ	126 €/tonne CO ₂

Figure 5: Current level of EU energy taxation. Source: Ministry of Taxation, Denmark. <http://www.ft.dk/samling/20111/almindel/sau/bilag/54/1042155/index.htm>

In April 2011 the Commission presented its proposal to overhaul the rules on the taxation of energy products in the EU. The new rules aim to restructure the way energy products are taxed to remove current imbalances and take into account both their CO₂ emissions and energy content.

Key elements

The proposed Energy Taxation Directive will allow Member States to use of taxation to, ultimately, support "sustainable growth". To do so, it proposes

splitting the minimum tax rate into two components that, taken together, would determine the overall rate at which a product is taxed:

- One would be based on CO₂ emissions of the energy product and would be fixed at €20 per tonne of CO₂.
- The other one would be based on energy content, i.e. on the actual energy that a product generates measured in Gigajoules. The minimum tax rate would be fixed at €9.6/GJ for motor fuels, and €0.15/GJ for heating fuels. This will apply to all fuels used for transport and heating. *It appears that these new minimum taxes are not very different from current minimum levels.*

The proposal takes social aspects into account with an option for Member States to completely exempt energy consumed by households for their heating, irrespective of the energy product being used.

The proposal also allows long transitional periods for the full alignment of taxation of the energy content (until 2023), in order to leave time for industry to adapt to the new taxation structure.

Subsidies

The proposed grants and financial instruments included in the Energy Infrastructure Package – the CEF Facility - are described in section 4.3.

It should be noted that national renewable energy action plans often includes support for renewable energy. However many member states still support fossil energy such as coal mining¹⁷.

5.8 Energy Efficiency Directive, proposal 2011

Background
EU Energy Efficiency
Plan

The EU target for energy efficiency is a 20% reduction in primary energy use compared with projected levels. According to the Commission's most recent projections, which take into account measures implemented at national and European level up to the end of December 2009, consumption in 2020 is expected to be at a level equivalent to a saving of only 9%. Therefore, in March 2011 the Commission issued its Energy Efficiency Plan. The plan is a strategy paper that sets out proposals for binding measures to save energy.

Energy efficiency di-
rective

In June 2011 the European Commission followed up on the Energy Efficiency Plan with its proposal for an Energy Efficiency Directive.

¹⁷ As an example Germany's subsidies to hard-coal mining made up € 2.1 billion in 2009. However, they should be phased-out entirely by 2018 (OECD website, 10-01-2012)
http://www.oecd.org/document/15/0,3746,en_21571361_44315115_48804623_1_1_1_1,00.html .

Mandatory 1.5 % savings yearly	The directive proposes a legal obligation to establish energy efficiency schemes in all Member States where energy distributors or retail energy sales companies will be obliged to save every year 1.5% of their energy sales, by volume. Savings should take place through the implementation of energy efficiency measures among final energy customers - or by alternative energy savings mechanisms in Member States that lead to the same results but are not based on obligation on energy companies. These could, for example, be funding programs or voluntary agreements.
Energy audits	Large companies will have to do regular energy audits carried out in an independent manner. Member States are encouraged to develop incentives for companies that introduce an energy management system as a systematic framework for the rational use of energy. Exchange of best practices in energy efficiency and projects aimed at building capacity on energy management are also proposed for SMEs.
Public buildings	From 1 January 2014, 3% of public buildings should be renovated each year, with the clear aim to reduce energy use. Public sector will have a legal obligation to purchase energy efficient buildings, products and services.
Meters	Member States shall ensure that final customers of electricity, natural gas, district heating or cooling and district-supplied domestic hot water are provided with individual meters that accurately measure and allow making available their actual energy consumption and providing information on actual time of use.
Billing	Member States shall ensure the accuracy and the frequency of the billing, and that the billing is based on actual consumption, for all the sectors covered by the Directive, including energy distributors, distribution system operators and retail energy sales companies. This should be done not later than 1 January 2015 for electricity, natural gas, hot water and centralized heat.
National heating and cooling plan	By 1 January 2014, the Member States must have established a national heating and cooling plan for developing the potential for the application of high-efficiency cogeneration (CHP) and efficient district heating and cooling.
Binding measures	The proposal foresees binding measures rather than a binding target for each member state: once the directive enters into force, Member States will have the obligation to apply all its provisions.

In addition, the Commission proposes that:

- (1) Member States set themselves non-binding national energy efficiency targets, and
- (2) The Commission will propose binding national targets if in 2014 the EU is not likely to achieve the 20% target.

6 R&D

6.1 7th EU Framework Programme

Research activities funded by the EU are currently dealt with under the 7th Framework Program of the European Community for research, technological development and demonstration activities (2007-2013), or FP7. The program is open to a wide range of organisations and individual researchers from the EU and third countries.

FP7 funds:

- *collaborative research projects* carried out by transnational consortia of industry and academia ('Cooperation' Program);
- *'frontier research'* of individual teams ('Ideas' Program);
- *researcher mobility* and career development ('People' Program);
- *research capacities and infrastructures* ('Capacities' Program).

The largest segment of the overall €50.5 billion budget is dedicated to collaborative research. FP7 is implemented through annual work programs.

FP7 includes a variety of opportunities for energy related research funding. A major one is the 'Energy Theme' of the Cooperation Program which is solely dedicated to energy issues.

Energy Theme

The energy theme of the FP7 Cooperation Program has a total budget of €2.35 billion (for 2007 – 2013) and is jointly managed and implemented by the European Commission's Directorate General for Research and the Directorate General for Energy.¹⁸

The Energy theme funds research in the following areas: Hydrogen and fuel cells, Renewable energies for electricity, fuel production and heating and cooling, Photovoltaic, Biomass, Wind, Geothermal energy, Concentrated Solar Power, Ocean, Hydro, CO₂ capture and storage technologies for zero emission power generation, Clean Coal Technologies, Smart energy networks, Energy efficiency and savings, Knowledge for policy making and Horizontal Program Activities (Future Emerging Technologies, Materials for energy applications).

¹⁸ One exception is research on fuel cells and hydrogen which is implemented by the Fuel Cells and Hydrogen Joint Undertaking.

Aside from the energy theme there are other areas in the Cooperation Program addressing energy relevant issues. FP7 Programs like 'People', 'Ideas' or 'Capacities' includes opportunities for energy related research as well.

6.2 Horizon 2020

In June 2011, the Commission presented a new proposal for the new EU Financial Framework for 2014-2020. Here was also presented the draft framework for the EU's new research program that will replace the FP7. The program is called Horizon 2020 – an umbrella term for the EU research programs.

The EU Commission has indicated there is a need for further investment in new energy technology in the range of €50 billion, but the specific allocation of Horizon 2020 and the funds earmarked for energy research is expected first presented by the end of 2011. Most of the increased investment must come from Member States and industry, but there was a clear signal to the budget negotiations between Parliament and the Council that energy research, development and demonstration should be given greater priority.

6.3 The SET plan

The European Strategic Technology Plan (SET-Plan) is the technology pillar of the EU's energy and climate policy. The SET-Plan, adopted by the European Union in 2008, is a first step to establish an energy technology policy for Europe. The Commission considers it a principal decision-making support tool for European energy policy, with a goal of:

- Accelerating knowledge development, technology transfer and uptake;
- Maintaining EU industrial leadership on low-carbon energy technologies;
- Fostering science for transforming energy technologies to achieve the 2020 Energy and Climate Change goals;
- Contributing to the worldwide transition to a low carbon economy by 2050.

The main idea of the SET-Plan is to employ available resources in a smarter way through joint strategic planning and programming. The SET-Plan mechanisms for achieving the required technology revolution are:

- A *Steering Group* which defines the overall strategy and reinforces the coherence between national, European and international efforts. It is composed of representatives from Member States governments and chaired by the Commission.

- *Industrial Initiatives:* On a sectoral level seven European Industrial Initiatives (on Solar Energy, Bioenergy, Wind Energy, CCS, Smartgrids, Smart cities and Sustainable Nuclear Fission) bring together the industry active in each of these areas. Each initiative has set itself a target and has established a Technology Roadmap and Implementation Plan with concrete milestones.

In parallel, the European Energy Research Alliance (EERA, founded by fifteen leading European Research Institutes) has been working since 2008 to align the R&D activities of individual research organisations to the needs of the SET-Plan priorities, and to establish a joint programming framework at the EU level.

6.4 Nuclear R&D

Nuclear research in the EU takes place under the Euratom Framework Program. The Euratom Framework Programs run parallel to the FP Programs for research and development under the EC Treaty.

The amount of funding in the EC framework programs and the Euratom Framework programs are shown in Figure 6 (below). It is worth noticing that Euratom nuclear research funding in the present program exceeds funding of the energy theme of the FP7 Cooperation Program.

	1994-98 FP 4, bn €	1998-02 FP5, bn €	2002-06 FP6, bn €	2006-13/11*) FP7, bn €
EC Framework program	11,9	13,7	17,9	50,5
Euratom Framework program	1,3	1,3	1,4	2,8

Figure 6: Budgets for EC and Euratom Framework Programs since 1994. *Note that FP7-EC covers a period of 7 years (2006-13) and FP7-Euratom covers a period of 5 years (2006-2011).
Source: European Commission - RTD – Euratom.

7 Conclusion

The purpose of this memo has been to create an overview of the current situation, policy targets and long-term analyses to support a discussion and identification of relevant future analysis and research areas for the Climate Strategies network. Looking at existing policy measures, and gaps between targets and policies, a number of challenges were identified and recommendations for how to improve current policies were described. The most obvious problem identified in the memo is the lack of policy measures for the period after 2020 within almost all energy policy areas, which make long term planning and investments difficult.

A number of studies and analyses on how to reach the long term targets were reported, including The EU Low Carbon Economy Roadmap 2050, the Energy Roadmap 2050, the White Paper on Transport and the European Climate Foundation 2050 roadmap. The descriptions give an impression of possible development paths for EU in the long term, and challenges in reaching the targets.

Lastly existing research and development under the 7th EU framework programme within the energy field was described, including budgets and the overall focus for EU investments in energy.