



3 May 2011

Background paper

Energy Roadmap 2050 – State of Play

EU context

The EU has committed to reducing greenhouse gas emissions to **80-95% below 1990 levels by 2050** in the context of necessary reductions by developed countries as a group. The European Council has recognised that this commitment will require a **revolution in energy systems**, one which must start now, and is looking forward to the elaboration of a low carbon **2050 strategy** providing the framework for the longer term action in the energy and other related sectors¹. Energy system developments in Europe will be driven also by the need for **energy security** and **affordable energy** in a changing global energy context.

The Commission's approach to **decarbonisation**² is firmly grounded in the EU's growth agenda, set out in the **Europe 2020** strategy. The climate and energy targets for 2020³ will contribute to the achievement of a smart, sustainable and inclusive economy which should help the EU and the Member States deliver high levels of employment, productivity and social cohesion. The **Resource Efficient Europe Flagship Initiative**⁴ in the Europe 2020 strategy focuses on the natural resources underpinning the economy and quality of life in Europe, aiming for emissions reduction, productivity improvement, costs reduction, economic opportunities and competitiveness. It is in this framework that **long-term roadmaps** are being prepared. The first two have already been presented, two more, including the Energy Roadmap 2050, will be presented before the end of the year.

Low-Carbon Economy Roadmap

In the Roadmap for moving to a competitive low carbon economy in 2050⁵, the starting point is that the targeted 80-95% reduction in greenhouse gas emissions by 2050 will have to be met **largely domestically**. On the basis of modelling of scenarios to achieve an economy-wide GHG emissions reduction of some **80% by 2050**, with technologies which either already exist or are in development, the Commission finds that domestic

¹ Extraordinary European Council, 4 February 2011. The European Council added that "due consideration should be given to fixing intermediary stages towards reaching the 2050 objective@,

² Includes all greenhouse gases

³ European Council, 8/9 March 2007: By 2020, at least 20 % reduction in greenhouse gas emissions compared to 1990 (30% if international conditions are right, European Council, 10-11 December 2009); saving of 20 % of EU energy consumption compared to projections for 2020; 20 % share of renewable energies in EU energy consumption, 10% share in transport

⁴ COM(2011) 21, 26 January

⁵ COM(2011)112, 8 March

emission reductions of the order of 40% and 60% below 1990 levels would be the **cost-effective pathway** by 2030 and 2040, respectively. In this context, it also shows reductions of 25% in 2020⁶. Even though the year-on-year emissions reduction effort would become greater over time in this pathway, this should be feasible through a wider set of cost-effective technologies gradually becoming available.

The contributions of **key sectors** to these emissions reductions were also explored in the Roadmap, with scenario analyses. Uncertainties about the future (notably, global climate cooperation, future rates of technological innovation and fossil fuel prices) were reflected in these scenarios, and conclusions on feasible emissions reductions in each sector were based on results across several different scenarios. **Sectoral milestones** expressed as ranges of greenhouse gas emissions reductions in 2030 and 2050 were put forward. For the power sector, a reduction in CO₂ emissions of over 90% by 2050 is targeted⁷, over 80% for industry, around 60% for transport, around 90% for residential and services, over 40% (non-CO₂) for agriculture, over 70% for other non-CO₂ emissions. For 2030, corresponding milestones are around 60% for the power sector, close to 40% for industry, around 45% for residential and services.

The Commission is now preparing **sectoral roadmaps**. They are going into more depth than the Low-Carbon Economy Roadmap, on the relevant global and EU context, the dynamics within the sector and the interplay of decarbonisation and other sectoral objectives. They should result in a good picture of the **policy challenges and possible responses**⁸.

Also planned is a **Roadmap to a Resource Efficient Europe**, building on and complementing on other initiatives, focusing on increasing resource productivity and decoupling economic growth from resource use.

Transport 2050 Roadmap

In the first of the sectoral roadmaps, the **Transport 2050 Roadmap**⁹, the focus is on creating a Single European Transport Area to achieve a competitive and resource efficient transport system by 2050 supported by a fully integrated transport network linking all EU Member States as well as all transport modes and systems. This should enable a **profound shift in passenger and freight transport patterns**, resulting in a competitive transport sector which allows increased mobility, cuts CO₂ emissions to 60% below 1990 levels by 2050 and breaks the transport system's dependence on oil. A number of **benchmarks** are put forward: for example, phase out conventionally fuelled cars in cities by 2050 and halving their use by 2030; deliver an EU-wide core network of transport corridors with efficient transfer between transport modes by 2030 and a high-capacity network by 2050.

⁶ This 25% reduction could be achieved if the revised Energy Efficiency Plan would be fully and effectively implemented meeting the 20% energy efficiency target

⁷ The share of low carbon technologies in the electricity mix is estimated to increase from around 45% today to around 60% in 2020, including through meeting the renewable energy target, to 75 to 80% in 2030, and nearly 100% in 2050; see low carbon economy Roadmap.

⁸ Including materials efficiency, for example. The Low-Carbon Economy Roadmap highlights that the EU Emissions Trading System will be critical in driving a wide range of low carbon technologies into the market, so that the power sector itself can adapt its investment and operational strategies to changing energy prices and technology. For the ETS to play this role on the identified pathway to 2050, both a sufficient carbon price signal and long-term predictability are necessary. In this respect, appropriate measures need to be considered, including revisiting the agreed linear reduction of the ETS cap.

Implications for the **rest of the energy system** of these developments in the transport system have been considered¹⁰. Final consumption of oil by transport could decrease by about 70% by 2050, relative to business as usual. At the same time, demand for electricity in the road and rail transport sectors would rise substantially as would demand for biofuels, especially in aviation, inland navigation and long distance road freight, where electrification is not or less an option. It is noted that electro-mobility would need to be supported by an upgrading of Europe's networks and decarbonisation of the electricity sector.

Energy Roadmap 2050

The aim in the Energy Roadmap 2050 is to sustain a debate on the **long-term EU strategy**, bearing in mind the objectives – safe, secure, sustainable and affordable energy contributing to European competitiveness. The EU has chosen a **market-based approach** in its energy policy. Markets must be capable of triggering investments, including the capital-intensive, long-lived investments which all transitions to a low-carbon energy system need. For energy markets to do this, **investors need to see the long-term strategy** into which today's policy and regulatory decisions fit. The EU has also chosen cooperation and **interdependence** among Member States, so clarity on the long-term direction in EU energy policy and its implications is essential for **citizens** throughout the Union and their **governments**.

It is estimated that a continuation of current trends and policies would result in only a **40%** reduction in energy-related greenhouse gas emissions in the EU by 2050¹¹, so the next decades will see much change in the sector. Energy supply and demand and the infrastructures and markets which will bring them together – all will come into play. The amount and **rate of change** could have **wide-ranging impacts** in Europe and abroad, in terms of skills needed, availability of human resources¹², location of new investments, opportunities for local communities, international relations etc.

The Roadmap will be underpinned by a set of **scenario analyses** carried out for the Commission¹³. It will also draw from scenario analyses put forward by stakeholders¹⁴, the International Energy Agency and some Member States. **The purpose is not to choose one scenario**. It is to assess, as much as possible given the many factors which enter into play and the many uncertainties, the long-term impacts of broad **energy policy choices** open to the EU going forward.

Some challenges are already clear. For example, increased **energy efficiency** throughout the economy and the energy system plays an important role in all decarbonisation scenarios, reducing emissions relatively cheaply and in the longer-term, limiting the need for the more expensive energy supply options in the system, and allowing consumers to keep their energy bills in check – the Energy Efficiency Plan goes in this direction¹⁵. The increased scope for action on the **demand side** in most decarbonisation scenarios,

⁹ COM(2011)144, 28 March

¹⁰ SEC(2011)358

¹¹ Common Reference Scenario in the Low-Carbon Economy Roadmap, the Transport 2050 Roadmap and the Energy Roadmap 2050.

¹² See European social dialogue and New Skills for New Jobs initiative, both concerned with anticipating future skill needs as a result of the move towards a low-carbon economy.

¹³ The specification of these scenarios has been finalised after the Fukushima accident

¹⁴ eg. European Climate Foundation, Eurelectric, Greenpeace

¹⁵ See also Energy Efficiency Plan - COM(2011)109, 8 March

enabled by smart meters and grids¹⁶, and its increased value in a system rewarding flexibility, means a whole different involvement of **consumers and local generators** in the energy market. In all scenarios, investments in **infrastructures**¹⁷ are needed for various reasons, from smart grids enabling demand side action including decentralised energy supply to regional and European networks enabling greater trade and reliance on renewables, to CO₂ transport and storage¹⁸. **Carbon pricing** will be important. The **energy mix for electricity generation** should become increasingly low-carbon. The higher capital costs and lower operational costs of most low-carbon generation options may challenge **financing** and the **market**. Reliance on **fossil fuels** diminishes in all decarbonisation scenarios but their contribution is important in the medium term. **Timing** is an important dimension. Given the long life time of many energy sector investments, risks of lock-in of technologies and stranded assets need to be considered. Support for too-early deployment of technologies can be expensive and risky.

EU energy policy, with its bases, 2020 targets and 2020 strategy¹⁹ already in place, must now be geared up to achieving substantial greenhouse gas emissions reductions by 2050 in a way which avails of new opportunities and makes most sense in terms of energy security, sustainability, resource availability and economic and social impacts.

The Roadmap will focus on the possibilities which the European market and policy framework can open up for efficient use of resources across Europe. Based on such factors as development of renewables where it makes most sense, most effective use of flexible resources needed in low-carbon power systems, large markets for large, capital-intensive investments, it can be argued that there is a real **cost of non-Europe** in the energy system. From an economic perspective, many energy system developments can best be achieved on an EU-wide basis, encompassing both EU and Member State action while respecting respective competences²⁰. Possible implications for the further development of **EU policy** and the **coherence** needed among Member State actions will be explored in the Roadmap, with support from the scenarios and drawing from the EU experience and achievements in energy policy development and implementation so far. There will of course be **continuity** between the Roadmap and recent Communications on energy policy matters.

Different energy mixes for power generation raise different challenges in terms of incentives for investment in generation and requirements for achieving a balanced, secure power system at regional, national and EU level. Depending on the energy mix envisaged, there could be different implications for the **infrastructure** which needs to be developed, the arrangements for its **use**, arrangements for **energy security** and the nature and degree of **market integration** which is necessary..

In the preparation of the Roadmap, the work of **Member States** on long-term energy strategies is being examined. The Commission welcomes this work and considers that

¹⁶ And other factors, such as energy and carbon taxation; synergies between resource efficiency, energy and GHG savings; better understanding of consumer behaviour resulting in changes in consumption patterns,

¹⁷ Not explored quantitatively in the Commission's scenarios

¹⁸ See also Communication "Energy infrastructure priorities for 2020 and beyond – A blueprint for an integrated European energy network" - COM(2010) 677.

¹⁹ Energy Strategy 2020, November 2010

²⁰ A common European carbon market enabled by the revised EU Emissions Trading System (Directive 2009/29/EC amending Directive 2003/87/EC) will be an important step in this direction, ensuring flexible and cost-effective meeting of decarbonisation targets.

reflections at Member State, regional and EU level can only benefit from cooperation. It is evident that regional and EU markets and policy frameworks are important factors influencing and facilitating the strategies of individual Member States. With the Roadmap, the Commission would like to encourage better understanding of the **implications for markets and policy** of choices made by Member States²¹.

Much change can be expected throughout the energy sector in the coming decades. There will be **new challenges** for the established players and opportunities for **new players**, notably individual consumers and local governments²². The prospect of wide-ranging change was reflected in the responses to the public consultation for the Energy Roadmap 2050.

Consultations

A **public consultation** took place between 20 December 2010 and 7 March 2011. Some 400 replies were received from across the EU, including some Member States (SE, LT, LV, BE, FR). About half the replies were from organisations, half from individuals. Organisations from each part of the energy sector contributed, including centralised supply, fuels, decentralised supply, energy efficiency, local government, social partners, NGOs, academia and national governments. A **report** summarising the results of the consultation is attached.

The questions were a mixture of multiple choice and open-ended. Some respondents attached position papers, some referred to their own scenario analyses. The interest in placing energy policy in a long-term perspective is clearly there. There were some notable **differences in priorities**. For example, in the question about the three most important developments in the global context, utilities focused far more on an international climate framework than did other respondents. In the question about societal challenges to come, utilities and industry focused on public acceptance of new infrastructures, NGOs underlined the increased scope for decentralised power generation and local, integrated solutions for meeting energy, waste management and other needs of communities. In areas for further development of policy at EU level, development of infrastructures was high in the priorities as utilities, others stressed energy efficiency and renewables. In the question about drivers of the future energy mix, the replies covered the whole menu offered, from climate to the cost of secure fossil fuel supplies, public acceptance of infrastructures to EU market integration, to political decisions by Member States. A good reflection of the complexity of the transition before us.

The **Economic and Social Committee**, in its Exploratory Opinion on the Energy Roadmap 2050²³, underlined the importance of framing a properly joined-up European energy policy. This should include integration of a medium and long-term EU strategy.

Organisation of the work, next steps

²¹ On the supply side, each Member State has a right to "determine the conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply, without prejudice to Art 192(2)(c)" TFEU Art 194

²² Issue raised in "An Energy Policy for Consumers- Citizens at the Heart of EU Energy Policy and Decision-Making", Belgian Presidency document for informal Energy Council, 6-7 September 2010

²³ CESE 359/2011, rapporteur Mr Pezzini (Group I, I), adopted 17 February 2011

The planning is for adoption before the end of 2011. A Communication will be supported by an Impact Assessment, as usual.

The **Impact Assessment** will include results of the scenario analyses carried out for the Commission and may refer in the discussion to other scenario analyses relating to the EU. The Commission will provide information on the Impact Assessment and the design of scenarios at a meeting of the Member States' Energy Economic Experts Group on 24 May.

An **Ad Hoc Advisory Group** for the preparation of the Energy Roadmap 2050 has been created. It will meet three times over the next months and its report will be published. It should focus on policy challenges, bearing scenario results in mind. A peer review of the modelling will also be set up.

Director-Generals for Energy of the Member States, meeting on 13-15 July in Belchatow, will discuss the Energy Roadmap 2050 with an emphasis on technologies.

The **European Parliament** is not currently planning any own-initiative report before adoption of the Roadmap. However, at group level, some work is underway (eg Greens/European Free Alliance work on scenarios). An event (hearing, conference etc) before adoption of the Roadmap is being considered by some MEPs.