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Final report of the Advisory Group on the Energy Roadmap 2050

Summary record of the PRIMES Peer review Meeting

Results of the public consultation on the Energy Roadmap 2050

Accompanying the document
COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS
Energy Roadmap 2050

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FINAL REPORT

The Advisory Group on the Energy Roadmap 2050

13 December 2011

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1. Introduction:

The *Ad Hoc* Advisory Group (the Group) was set up with the aim of providing independent advice to the Commissioner for Energy in the preparation of the 2050 Energy Roadmap. The Group met on three occasions (in April, July and September 2011) and this report summarises the main contributions from the Group members, and lists a number of agreed recommendations to the Commissioner.

The terms of reference are attached in annex (a). The members of the Group are listed in annex (b). Details of the meetings and working arrangements are set out in annex (c).

By the very nature of the Group's membership, views on major aspects of the Energy Roadmap inevitably differed, sometimes strongly. For the Group's work this has been an advantage, helping to sharpen the modelling and scenario work the Commission has been undertaking, forcing the different views to be tested out over the period to 2050. Given the period of four decades, a host of uncertainties, new technologies and changes in the nature of the European economy and society as a whole are likely to play out in ways that it would be foolish for anyone to try to predict. The actions by other major carbon emitters – such as the US, China and India – are yet to be determined following the Copenhagen and Cancun meetings in 2009 and 2010 respectively. The Group stressed that the design of the policy framework depends upon the nature of this uncertainty, and again the diversity of views has helped to provide insights into the robustness of different policy options.

It is important to bear in mind what is beyond the scope of the Group. The Group is not responsible for the contents of the Roadmap, nor is it required to provide a detailed analysis or a critique of the modelling that the Commission has conducted or intends to conduct. The Group was not informed about and did not discuss the outcome of simulations carried out by the Commission in order to

assess the impact of alternative paths to 2050 carbon targets. These are tasks for the Commission. Crucially, the Group has not produced its own Roadmap.

In providing advice, the Group has been mindful of its terms of reference which take the current European energy and climate change policies as a *given starting point*. The Roadmap is designed to provide a framework for future policies to achieve the three aims of European energy policy – decarbonisation, security of supply and competitiveness.

2. What is a Roadmap?

At the first meeting of the Group, there was extensive debate about the role and limits of the Roadmap. Some members of the Group considered the term "Roadmap" as overused, with various organisations giving the term very different meanings. The importance of considering a range of possible transition paths to decarbonisation has the corollary that *there is no one single "Roadmap"*, but rather many. This should be reflected in the various scenarios that the Commission is investigating, and in the ways in which they are presented.

The central role of deep technical change was emphasised by members, though there was disagreement about the extent that the deployable technological options over the next four decades were largely already known and determined, or whether there were likely to be major changes within the Roadmap period. Particular emphasis was placed on the implications of adequate transmission and distribution investment, smart meters, and super grids and the implications of a more active role for the demand side. For the period to 2030, much more is already known, and hence whilst the Roadmap is to 2050, in practice the transition to 2030 can be given much more definition than the subsequent decades.

Members raised the question of domain, and the extent to which the Roadmap should focus on energy in the wider sense, rather than place too much emphasis

on electricity. The view was expressed that decarbonisation of electricity was more straightforward than other energy sources and uses, and that the Roadmap should explicitly recognise all these other energy dimensions, rather than focussing exclusively on electricity. The role of transport – and in particular the electrification of transport – was emphasised by the Group, with significant consequences for the design and expansion of the electricity networks and almost complete decarbonisation of electricity production. The rationale for separate Roadmaps for transport and energy was therefore questioned, as was the provision of separate finances for the two sectors in the EU's budgetary arrangements. Recognition of the wider role of the oil and gas sectors in the Roadmap and the avoidance of too narrow an emphasis on the electricity sector was stressed.

Some members were concerned about the extent to which detailed modelling and underlying assumptions would be understood by the wider public, who would have to bear the costs of the decarbonisation transition, particularly if Europe's leadership in climate change was not matched by similar measures from other major economies. The price implications for consumers would need to be communicated and part of the role of the Roadmap should be to engage with the public on the full costs and implications of the radical transformation that decarbonisation implies. In this regard, attention was specifically drawn to the UK DECC 2050 Pathways Calculator as an example of how citizens could engage in the debate.

Recommendation One: The Commission should set out in the Roadmap its role, limits and uncertainties, and address the diversity of possible transition paths. Flexibility in the face of possible technical and other change should be given a central place in the Roadmap.

Recommendation Two: The Commission should integrate the transport and energy Roadmaps, with explicit modelling of the consequences of the electrification of transport for the electricity and gas sectors, and of the role of the oil sector.

Recommendation Three: The Commission should set out in the Roadmap how the outcomes will be presented transparently to the wider public to ensure full public engagement and understanding of the necessary tradeoffs.

3. What is the policy context for the Roadmap?

There are three main pillars to the existing policy framework on which the Roadmap must build:

- The Internal Energy Market (IEM)
- The climate change framework
- The external framework, including the European Energy Community Treaty and the Eastern Partnership

These measures are all in the context where the choice of the energy mix and most of the policy instruments remain largely a *national* matter. The Lisbon Treaty, whilst incorporating a chapter on energy and considerably extending the powers of the Commission with respect to energy policy, specifically reserved the energy mix to national governments.

Taking each in turn, there have been three phases to the development of EU directives to complete the **Internal Energy Market (IEM)**: the first round of Directives (1996 and 1998); the second round (2003); and the third package (2007). The current aim is to complete the IEM by 2014. The Group drew attention to the fact that most of the current low carbon technologies (notably wind and solar) were being supported *outside* the market, hence reducing the scope and role of the IEM. It was noted too that coal and nuclear received support in a number of EU member countries. The need to align the IEM and the decarbonisation and security agendas was emphasised, and the Roadmap should explain how this is to be achieved.

The **climate change framework** itself builds upon several phases to the development of EU climate change policy. Early measures included support for the Kyoto Protocol, and then the EUETS. Most recently the Climate Change Package set out the 2020-20-20 measures, with Directives covering the 2020 carbon target and the 20% renewables targets, and an ambition to achieve the 20% energy efficiency target by 2020. The EU has adopted a commitment to reduce the production of greenhouse gas emissions to 80-95% below the 1990 levels by 2050, and actively pursued an international agreement at Copenhagen. The Roadmap is being prepared on the *assumption* that other countries will play their part in addressing what is a global and not just a European problem. The Group nevertheless considered the possibility that international agreement may not be forthcoming as rapidly or completely as the Commission would like.

The overarching *Low Carbon Roadmap*, already published, provides a further framework within which the Energy Roadmap is set.

On the **external dimension,** the EU has an active neighbourhood energy policy. The main components are the European Energy Community Treaty (ECT), the Eastern Partnership and the relations with Russia. For the purposes of the Roadmap, the important element is the ECT that incorporates the *acquis* into treaty members' obligations, and in particular the carbon and renewables targets. The implication is that the Roadmap will influence energy policy beyond the EU's borders – in the Balkans, North Africa, Eastern Europe, South East Europe and the Caspian states. One member, stressing the importance of universal global access to electricity, regarded this as a core issue for the Roadmap.

4. Are there trade-offs between the objectives?

The IEM and the climate change package confront Europe with an enormous challenge, the scale of which is yet far from apparent to the general public (who will have to pay for the investments) and indeed to many governments. The

almost complete decarbonisation of the energy sector in the next four decades requires the replacement of most of the existing assets. Energy intensive industries will either have to switch to low carbon energy supplies or exit the European economy. The relative price of energy between the EU and other major economies (including also compensation measures to combat carbon leakage) will be critical in determining the outcome for the energy intensive sectors. Both the completion of the IEM and the decarbonisation of the energy sector require the development of an integrated set of energy networks — and hence further infrastructure beyond the requirements for decarbonisation.

These enormous investments must be achieved whilst ensuring security of supply and protecting and enhancing the competitiveness of the European economy – in other words, all three objectives (decarbonisation, security of supply and competitiveness) need to be met *simultaneously*. There was also discussion of the relation between the IEM and decarbonisation on the one hand, and technological development on the other.

It has been claimed that these three objectives do not conflict: that decarbonisation policies enhance security of supply by reducing reliance on (frequently imported) fossil fuels, and that the investment in decarbonisation will create green growth, offsetting losses to "brown" jobs and industries. The assumption of high, rising and volatile fossil fuel prices forms part of this "win-win-win" argument. The Group held differing views about the direction of fossil fuel prices, (notably in respect of gas and the impact of shale gas) and in any event it was argued that the Roadmap should not be dependent on any one fuel price projection, and the scenarios should model a wide range of possible outcomes.

Not all the Group was entirely convinced by this happy coincidence of objectives. Some members of the Group considered that intermittent renewable technologies may, if developed to a substantive or dominating share of the energy market and not complemented by appropriate measures, create issues in respect of security of supply, and for many members of the Group the problem of

carbon leakage remains a substantive one, if other countries do not follow the EU's lead.

Some members considered that the Roadmap should make clear whether the carbon objective was unconditional in respect of the action of other countries, and whether it was a "trump" objective, or could be traded off against security and competitiveness objectives. To the extent that the Roadmap was primarily identifying policy frameworks and scenarios to achieve the 2050 emissions reduction target, the Group recommended that the Roadmap should identify the consequences to the other objectives of various decarbonisation paths, and set out the measures that would need to be taken to ensure adequate security of supply and protect competitiveness with different technological mixes. In particular, various levels of renewables shares should be explicitly modelled alongside the security and competitive implications comprising the whole life cycle.

Recommendation Four: the Roadmap should explicitly address and make transparent the potential trade-offs between the three objectives under each scenario. The Roadmap should explicitly provide for flexibility in policy measures in the event that other countries do not play their part in addressing the global challenge of climate change, and if competitiveness and security problems materialise.

Recommendation Five: the Roadmap should set out the consequences and mitigating measures under each scenario for security of supply and competitiveness while taking the whole lifecycle into account. Each scenario should set out the associated measures to protect security and competitiveness.

5. What happens if other countries do not follow the EU lead?

A number of members of the Group were particularly concerned about the consequences of other major economies not following the EU's lead. It is already apparent that the ambitions the EU had for the Copenhagen COP have not been fulfilled, and recent developments in the US do not encourage the expectation of early action on binding legal carbon caps. Whilst China has moved quickly to develop its domestic supply and its export potential in renewables technologies, members of the Group noted that China also plans to greatly expand its coal-fired electricity generation. On current plans, such an increase in China's coal burn would negate much of the positive impacts of EU mitigation measures, and indeed the "carbon leakage" problems may be exacerbated, and continue to undermine the impact of the reduction of carbon production in Europe. Whilst carbon production might fall, carbon consumption may not – and indeed strong rises in carbon consumption in some EU countries since 1990 were noted.

The Group reiterated the importance of the Energy Roadmap focussing on *global* climate change, and assessing the impact of European policy not just on EU carbon production, but on global emissions. Thus some members considered that carbon *production* and carbon *consumption* within the EU should both be explicitly modelled for the Roadmap. Some members questioned both the feasibility and the relevance of the EU's 2050 carbon *production* target in this context. Others pointed to a number of difficulties in measuring and modelling carbon consumption.

The problem of carbon leakage is not limited to China, India and the US. Leakage to countries on the EU's borders was specifically mentioned, and in this context the importance of the ECT was emphasised. In the absence of appropriate policies and measures, energy intensive industries on Europe's borders could evade the carbon reduction costs, and export their products back into the EU. Additionally, higher carbon electricity generation could be generated just outside Europe and then fed back in as and when the European-wide electricity grids develop.

The Group concluded that the issue of carbon leakage could not be ignored and that the Roadmap should explicitly address this issue. The options include setting carbon targets in consumption terms, border taxes (ensuring a level playing field between EU carbon constrained industries and imports from countries which do not price carbon) and adjustments to the EUETS to take account of the position of energy intensive industries.

Recommendation Six: Whilst recognising the practical difficulties and the possible implications for the EUETS, the Roadmap should pay explicit attention to the challenges from carbon leakage under different scenarios, including consideration of the measurement of EU carbon consumption. The Roadmap should not be exclusively focussed on carbon production.

Recommendation Seven: The Roadmap should explicitly address scenarios in which other countries take longer to develop climate change policies.

Recommendation Eight: The ECT should be further developed in respect of agreeing carbon policies with Europe's neighbours.

6. Should there be intermediate targets?

In debating the role of the Roadmap in setting out a variety of transition paths, the Commission is taking the overarching carbon reduction target to 2050 as a *given.* The question therefore arises as to whether the Roadmap should indicate an intermediate carbon reduction target after the 2020 target, and before the 2050 target, and whether it should be conditional, in carbon production or consumption terms, and extend to targets for specific technologies (or groups of technologies), notably renewables and energy efficiency. Unsurprisingly members did not form an agreed position on an extended bundle of targets, and therefore debate focussed on the minimum basis of an intermediate carbon target.

Members of the Group were broadly sympathetic to the development of a 2030 intermediate carbon or greenhouse gas target consistent with the longer term targets, though there was considerable debate and disagreement about whether this should be unilateral or be conditional on other countries adopting similar targets. Members also discussed the basis of the range of possible disaggregated targets, noting the issues not only of conditionality, but also the sectors to which targets might be applied, and importance of carbon consumption.

There were very strong differences of opinion on the issue of additional intermediate targets. Some members expressed support for a rolling forward of the renewables and energy efficiency targets, highlighting impacts on investors and infrastructure implications. Others argued against such targets, highlighting the problem of "picking winners", the need to take account of technical change, the role of gas, and the problems of lobbying and capture.

Whatever form of intermediate targets is adopted, the Group emphasised the need for *annual monitoring and reporting* on progress towards the 2050 target. It was argued that a process of annual reviews allows not only an assessment of how well the EU is doing, but would also help the credibility of the targets by requiring the EU to set out how it would deal with over- or underperformance as it materialised, or as conflicts between the three overarching objectives emerge, and the consequences for further policy actions.

Recommendation Nine: **the Roadmap should set out intermediate 2030 greenhouse gas targets to provide further clarity to investors. The Commission should assess the arguments for and against conditional or unconditional targets as well as for and against renewable and energy efficiency and other possible complimentary low carbon targets, taking account of the role of the transport sector and buildings.**

Recommendation Ten: There should be annual reviewing and reporting of progress in respect of each of the three objectives.

7. Why Europe?

The Roadmap is explicitly an EU construct, and hence at the core is the need to both respect the reserved areas for member states, and to spell out the benefits of achieving the overall objectives through common European approaches where appropriate, and where the gains from cooperation can be clearly demonstrated. Members of the Group noted in particular the consequences to neighbouring countries of Germany's recent decisions.

In respect of a number of European dimensions, members of the Group drew particular attention to first, the extent to which infrastructure was more cost effective if developed for the internal market *as a whole*. Insufficient attention has been paid to modelling a European electricity and gas transmission network linked to pan-European production sites (super grids), rather than solely considering links between the member states. Such modelling and the recognition of the impacts of technical change for grids should be explicit in the Roadmap and its role in implementing the IEM should be emphasised. Second, the gains to security from interconnection, and hence the creation of considerable Europe-wide portfolio effects from new infrastructure, should be explicitly modelled in the Roadmap. Third, the key role transmission plays in facilitating the development of renewables and support, given their intermittency and their locations (frequently not coincidental with the major load centres), should be incorporated into the scenarios and their implications. Finally, the gains from pooling R&D and innovation efforts in respect of renewables, CCS, batteries and storage, and other technologies should be estimated, and their implications for the S.E.T. Plan spelt out.

Recommendation Eleven: the Commission should commission an independent study of the economic gains from European energy network integration and the economic gains from a common approach to climate

change mitigation, and compare these with the costs and benefits of heterogeneous national approaches to renewables and the technology mix.

8. How much harmonisation?

Notwithstanding the gains from a Europe-wide approach noted above, many measures to achieve the three objectives are national and indeed even more localised. Measures to improve the energy efficiency of buildings are an obvious example. Particular attention was directed towards cities and urban design, and the potential gains from integrated city planning.

Some members stressed that these national competences do not however rule out the gains from common targets (for example for renewables and energy efficiency), nor the benefits from coordination and the sharing of R&D, innovation and best practice. If some countries make more rapid progress towards decarbonisation, some members considered that they would face a competitive disadvantage against slower EU members with implications for the IEM. Others thought it might be a competitive advantage.

The Group discussed the case for making the 2020 energy efficiency targets mandatory. There was no consensus on this. Issues raised included: the difficulty in defining benchmarks and baselines; and the short time now available to achieve the targets. The role of air conditioning was also raised. Some members questioned whether energy efficiency, though by definition a "good thing", would reduce demand, and if so by the amount assumed in Commission estimates. Others considered that energy efficiency had such a central role to play in meeting the overarching objectives, that notwithstanding the practical issues raised, the EU 2020 efficiency targets should be made mandatory, and rolled forward to 2030.

In terms of the aspects of existing policies which are delegated to national competence, the Group noted the plethora of renewables support mechanisms across the EU, and the possible inefficiencies which might result. Looking ahead, specialisation in different types of renewables has obvious cost advantages. It was noted that solar energy was likely to be more successful in the south of Europe and wind power might be best placed on the north western locations.

This specialisation might extend beyond the EU's borders, notably in respect of solar in North Africa, and in this context, opportunities within the framework of the Energy Community Treaty and the EU's external relationships should be fully explored in the Roadmap.

9. What role for the carbon price?

The Group agreed that a carbon price was one necessary and crucial element in the transition, though there were different views as to how central it should be. Some members placed great emphasis on this market-based mechanism, and in particular its role in avoiding picking technological "winners". Others viewed the role of the carbon price as one component in a package of technology-driven measures. It was however widely (but not unanimously) viewed as unhelpful and economically inefficient to have different carbon prices and different carbon price mechanisms across the EU, not only raising the costs of transition, but also potentially distorting the internal market, especially the IEM.

The EUETS was set up with the intention of creating a credible EU-wide carbon price which would drive emissions reductions. The EUETS was the first large scale emission trading scheme, and the assumption was that other countries would, in due course, set up their own ETS regimes (especially the US), and that gradually these would become fungible with the EUETS. This has not happened, nor, in the opinion of the majority of the Group, is such an international development likely in the near future, or even at all.

For a variety of reasons, a number of member states have deemed the carbon price in the EUETS too low, volatile and short term to be sufficient, and have introduced their own explicit or implicit carbon taxes. These national innovations in carbon pricing have included: carbon taxes for the non-EUETS sectors; carbon taxes that overlap with the EUETS; and floor prices of carbon. In addition, energy taxes have been adjusted at the national level to take greater account of the carbon content of the different fuels.

Members of the Group considered the possible flaws in the EUETS design and some members of the Group expressed a considerable degree of scepticism about the future role of the EUETS. Others regarded the EUETS as central to EU climate change policy. Some members of the Group argued that the Roadmap should make clear whether, if an intermediate target to 2030 is recommended, the EUETS cap would be formally tied to it.

Most of the Group considered that the development of lots of different carbon prices was not only inefficient in carbon terms but also distorted the IEM. It recommended that the Commission should, through the Roadmap, set out the costs and benefits of this national diversity, as part of the wider consideration of the costs of different pathways to achieve the 2050 carbon target.

Mindful of the problem of carbon leakage and the possible undermining of energy intensive industries within the EU, where other countries do not adopt commensurate carbon prices and carbon reduction measures of their own, the Group considered the case for a carbon border tax and other possible border adjustments. Many practical and political obstacles were noted, but the Group concluded that this was sufficiently likely to be an efficient way of addressing leakage to conclude that the Roadmap should at least investigate the costs and benefits of this option, and compare it with other options.

An alternative under consideration is to give special treatment under the EUETS to energy intensive industries facing international competition. Notwithstanding

the appeal to some lobbyists and its broader political appeal, this approach has a number of obvious drawbacks, not only weakening the EUETS, but also implying higher reductions (and less permits) for the rest of industry.

Recommendation Twelve: the Roadmap should stress the central role of a common carbon price in the EU and clarify the relationship between the EUETS and an intermediate 2030 target.

Recommendation Thirteen: **the Roadmap should take explicit account of national measures to introduce carbon taxes and carbon floor prices, and set out the rationale, benefits and costs of a common European approach to carbon pricing, and the costs and benefits of national diversity. The Roadmap should explore options to bolster and reinforce the carbon price across the EU.**

Recommendation Fourteen: the Roadmap should propose a regular assessment of the measures taken to combat carbon leakage and consider the case for a carbon border tax and other compensating measures.

10. What role for scenario modelling and the PRIMES model?

The second meeting of the Group was devoted largely to consideration of the Commission's scenarios and the supporting role of the PRIMES model. It should be stressed that it was not the job of the Group to comment on and critique in detail the PRIMES model, but rather to consider how it fed into the scenarios and the Roadmap.

The PRIMES model is one tool, and it plays a central role in the Commission's work on the Roadmap. Members of the Group raised a host of questions, and as a result a number of key points emerged. Essentially what matters is the assumptions that feed into the modelling of the scenarios, and the Group stressed the need for the Commission to be very explicit about these

assumptions, as well as testing sensitivity to changes in these exogenous variables.

Amongst the issues that emerged were: the assumption of perfect foresight by companies, but not by individuals; the use of different discount rates; the costs of different technologies; and fossil fuel prices. There was considerable debate about the role of fossil fuel price assumptions, including of the IEA's recent contributions. Major recent developments in international gas markets, notably shale gas, were considered.

The Group was concerned about the transparency of the PRIMES work, and in particular the property rights in the algorithms and detailed internal workings of the model. Whilst assumptions were published, the model remains the private property of the National Technical University of Athens. The consequence is that independent parties cannot replicate the results. This is a commercial matter for the Commission, but members of the Group pointed out that it does have obvious consequences for the credibility of the Roadmap.

The technical nature of the modelling limits that ability of wider public engagement, and some members of the Group were concerned that the Commission should make its work more widely available to non-technical audiences.

The Commission's seven scenarios (but not the results) were presented to the Group and in particular: the Common Reference Scenario; the Current Policy Initiatives Scenario; and the Five Decarbonisation scenarios. Particular attention by the Group members was paid to the decarbonisation scenarios: energy efficiency; diversified supply technologies; high renewables; delayed CCS; and low nuclear.

Amongst the issues discussed were: the extent to which the carbon price drives the scenarios; the absence of a "high nuclear scenario"; and the impact of delayed CCS not only on the electricity sector but also on industrial emissions. Amongst

the points made were: that the delayed CCS scenario could be taken as, in effect, a high nuclear scenario; and that a scenario with CCS plus biomass was needed as one of the ways of moving towards negative carbon emissions. Indeed negative carbon emissions technologies might be required in all scenarios to meet the overarching targets.

A number of members expressed more general scepticism about the methodology, and in particular the wider tendency to structure the energy policy around these scenarios rather than a wider framework of policy.

There was also concern about the extent to which the scenarios chosen might be interpreted as the main or only ones the Commission was considering. Criticism was also made of the possible interpretations of the titles given to the scenarios, and that these might encourage the public debate to focus on particular technologies rather than the broader policy framework. By separating out scenarios, common themes may be lost.

The Group was concerned that under each scenario the implications for security of supply and competitiveness might not be fully explored.

Recommendation Fifteen: the PRIMES model should be made publically available so that its results can be replicated by interested parties and to the extent that the PRIMES model is used to support the Roadmap, the assumptions and technology costs should be made explicit.

11. Should the Roadmap be technology-specific?

There were very strong differences between members of the Group on the extent to which the Commission should be technology-specific in the Roadmap, especially in respect of renewables and energy efficiency.

One view was that, given the technological and market uncertainties, and given the uncertainty about the conduct of other major emitters, the most efficient strategy is to rely primarily on markets and market-based instruments to achieve the targets. These market-based instruments might include the carbon price, and prices for security of supply, with a border tax creating a level playing field between the EU and other countries which did not adopt similar measures. A variant might be to auction capacity in low carbon technologies, creating a market-based capacity mechanism, preferably with an EU-wide dimension.

The alternative view was that the Commission could not avoid additional elements of technological choice and some members strongly criticised existing elements. If the EU was minded to develop renewables on a larger scale, it was argued that this would require a host of ancillary investments and policy choices, notably in respect of networks and infrastructure and market design. A large-scale electricification of transport would similarly require major ancillary investments. Some members suggested that this created a "chicken-and-egg" problem, and hence the EU should commit to a preferred path, and coordinate policies to facilitate the necessary investments.

Notwithstanding these differences in views, the Group nevertheless agreed that market instruments will be needed in any event, and at this stage in developing the pathways, the Commission should at minimum in the Roadmap point out the implications for coordinated investments under each of its scenarios.

12. How should network investment and finance be facilitated?

Networks are, in large measure, monopolies, and hence there is little option but to plan their expansion and integration. Markets cannot solve network design and development problems, though they can of course provide the finance.

The Group noted the Commission's various communications on infrastructure and the importance of developing European grids and gas networks—to

complete the IEM, encourage price convergence and gain the economies of scale and portfolio benefits. These networks are doubly important in the context of the carbon reduction targets and building the scope for specialisation in different renewables and other technologies to different geographical areas within the EU and outside.

Such networks will not arise spontaneously, and the Group urged the Commission to take a strong position in the Roadmap not only on the need for Europe-wide networks, but also the associated investments, planning and finance. Pan-European networks should play a central role in the Roadmap.

The Group noted the sheer scale of the required investments to meet the decarbonisation target for 2050, both in networks and with the replacement of most of the electricity generation capacity in Europe, and the consequent urgency given the life cycle of investments.

The Group was concerned that although the Roadmap would require this investment to be forthcoming largely from the private capital markets, the EU had little by way of core policy measures to actually make this happen. Though the investments would in large measure be for the member states to deliver, there is as yet little evidence that this scale of investment will in fact be forthcoming. The role of the EIB was considered by some members to be extremely important. Some members also considered that the IEM should be redesigned to deliver the necessary investment incentives.

A key issue raised is the cost of capital. The Roadmap policy framework is designed to provide more certainty to investors for networks, buildings and generation, but to achieve this it has to be *credible.* It is far from obvious that such credibility has been achieved so far, and the Group emphasised the centrality of the investment finance question to the Roadmap.

Recommendation Sixteen: the Roadmap should place the development of adequate European energy networks at its core.

Recommendation Seventeen: **the Roadmap should place considerable emphasis on the need to finance a major investment programme in both generation and networks, and spell out measures to minimise the cost of capital to the extent they are deemed necessary. There should be explicit reference to the role of European financial institutions, notably the EIB.**

13. What role for EU regulation?

The Group discussed the regulatory context, and the implications of national regulatory approaches for the development of the fully integrated IEM and the Europe-wide grids.

Whilst the IEM is due to be completed by 2014, the plethora of different market designs and the scale of the price disparities suggest that this dimension of European energy policy has a long way to go to meet the spirit as well as the letter of the IEM.

Ensuring the European integration of generation and of networks requires significant elements of EU-wide regulation, based upon common principles and rules. The Group noted the positive developments in respect of ACER, and the Roadmap should consider how and whether the renewables and other reserved and protected markets might be brought within the wider EU regulatory framework and the IEM.

Recommendation Eighteen: the Roadmap should in each scenario set out the regulatory requirements and ways to overcome existing barriers.

14. What sort of policy framework should be provided?

The Roadmap is intended to provide a *framework* rather than a specification of a particular technological pathway. However, some members pointed out that for many lobbyists and special interests, there is a strong pressure to favour particular technologies and particular reserved agendas, since they benefit from the subsidies and support mechanisms that would be required for a technologically-specific pathway. This is especially relevant to the advocates of nuclear power and specific renewables, like offshore wind.

Labelling the decarbonisation scenarios by terms like "high RES" and "low nuclear" may act to encourage such lobbyists to push for the adoption of their preferred technology.

The Group agreed that there were certain common policy framework components, independent of the particular pathway pursued. Amongst those discussed (but not necessarily agreed) were: a carbon price; the development of market-based capacity mechanisms; intermediate greenhouse gases 2030 targets; trading in renewables and other low carbon technologies; a plan for EU-wide networks; and common regulatory principles.

Members variously suggested that additional measures, notably to address carbon leakage (carbon border taxes and other compensation measures), linkage between the EUETS and a 2030 target, floor prices for carbon, and an element of technological specificity should all be considered in the Roadmap and the scenarios.

Finally, the Group noted that this policy framework is a *package*, and the Roadmap should pay careful attention to their interactions, especially in respect of security of supply and competitiveness, rather than address each policy component in isolation.

Recommendation Nineteen: a distinction should be made between setting the policy framework and detailed intervention in specific markets. The Roadmap should focus primarily on the former, leaving the choice of detailed policy instruments largely to the member states, whilst maintaining options for harmonisation where appropriate. In particular, the carbon price should be determined, where possible and practical, at the European level. Maximising the ability to trade between member states to meet targets should encourage the harmonisation of specific instruments. Harmonisation of market design should be further encouraged through the competitive forces of the IEM and the completion of the physical infrastructure of European energy networks.

15. Recommendations

Recommendation One: The Commission should set out in the Roadmap its role, limits and uncertainties, and address the diversity of possible transition paths. Flexibility in the face of possible technical and other change should be given a central place in the Roadmap.

Recommendation Two: The Commission should integrate the transport and energy Roadmaps, with explicit modelling of the consequences of the electrification of transport for the electricity and gas sectors, and of the role of the oil sector.

Recommendation Three: The Commission should set out in the Roadmap how the outcomes will be presented transparently to the wider public to ensure full public engagement and understanding of the necessary tradeoffs.

Recommendation Four: the Roadmap should explicitly address and make transparent the potential trade-offs between the three objectives under each scenario. The Roadmap should explicitly provide for flexibility in policy measures in the event that other countries do not play their part in addressing the global challenge of climate change, and if competiveness and security problems materialise.

Recommendation Five: the Roadmap should set out the consequences and mitigating measures under each scenario for security of supply and competitiveness while taking the whole lifecycle into account. Each scenario should set out the associated measures to protect security and competitiveness.

Recommendation Six: Whilst recognising the practical difficulties and the possible implications for the EUETS, the Roadmap should pay explicit attention to the challenges from carbon leakage under different scenarios,

including consideration of the measurement of EU carbon consumption. The Roadmap should not be exclusively focussed on carbon production.

Recommendation Seven: The Roadmap should explicitly address scenarios in which other countries take longer to develop climate change policies.

Recommendation Eight: The ECT should be further developed in respect of agreeing carbon policies with Europe's neighbours.

Recommendation Nine: the Roadmap should set out intermediate 2030 greenhouse gas targets to provide further clarity to investors. The Commission should assess the arguments for and against conditional or unconditional targets as well as for and against renewable and energy efficiency and other possible complimentary low carbon targets, taking account of the role of the transport sector and buildings.

Recommendation Ten: There should be annual reviewing and reporting of progress in respect of each of the three objectives.

Recommendation Eleven: the Commission should commission an independent study of the economic gains from European energy network integration and the economic gains from a common approach to climate change mitigation, and compare these with the costs and benefits of heterogeneous national approaches to renewables and the technology mix.

Recommendation Twelve: the Roadmap should stress the central role of a common carbon price in the EU and clarify the relationship between the EUETS and an intermediate 2030 target.

Recommendation Thirteen: the Roadmap should take explicit account of national measures to introduce carbon taxes and carbon floor prices, and set out the rationale, benefits and costs of a common European approach to carbon pricing, and the costs and benefits of national diversity. The

Roadmap should explore options to bolster and reinforce the carbon price across the EU.

Recommendation Fourteen: the Roadmap should propose a regular assessment of the measures taken to combat carbon leakage and consider the case for a carbon border tax and other compensating measures.

Recommendation Fifteen: the PRIMES model should be made publically available so that its results can be replicated by interested parties and to the extent that the PRIMES model is used to support the Roadmap, the assumptions and technology costs should be made explicit.

Recommendation Sixteen: the Roadmap should place the development of adequate European energy networks at its core.

Recommendation Seventeen: the Roadmap should place considerable emphasis on the need to finance a major investment programme in both generation and networks, and spell out measures to minimise the cost of capital to the extent they are deemed necessary. There should be explicit reference to the role of European financial institutions, notably the EIB.

Recommendation Eighteen: the Roadmap should in each scenario set out the regulatory requirements and ways to overcome existing barriers.

Recommendation Nineteen: a distinction should be made between setting the policy framework and detailed intervention in specific markets. The Roadmap should focus primarily on the former, leaving the choice of detailed policy instruments largely to the member states, whilst maintaining options for harmonisation where appropriate. In particular, the carbon price should be determined, where possible and practical, at the European level. Maximising the ability to trade between member states to meet targets should encourage the harmonisation of specific instruments. Harmonisation of market design should be further encouraged through the

competitive forces of the IEM and the completion of the physical infrastructure of European energy networks.

Annexes

a) Terms of Reference of the Ad Hoc Advisory Group on Energy Roadmap 2050

"The Directorate General for Energy in cooperation with other Commission services is currently preparing an Energy Roadmap to 2050 to be adopted towards the end of 2011. This Energy Roadmap will follow the Low Carbon Economy Roadmap 2050 adopted by the Commission on 8 March 2011[1] and will specifically focus on decarbonisation possibilities and policy challenges in the energy sector.

The objective of the Energy Roadmap 2050 in relation to the Low-Carbon Economy Roadmap would be to assess energy-specific scenarios and the means of achieving decarbonisation, while ensuring energy security and competitiveness for the European Union. This assessment will build on the established EU energy policy and the EU 2020 Energy Strategy, embedding them in a longer term strategy.

It is essential to bring a long-term perspective to bear on today's policy and regulatory decisions in the energy sector. Firstly, the transition to an efficient, low-carbon energy system which has already started must be shown to be on track towards a substantial reduction in greenhouse gas emissions. Secondly, investors, especially those considering long lived investments, want policy and regulatory certainty well into the future.

The purpose of Roadmap is not to choose one scenario or one development path to 2050 as a preferred option but rather to examine a set of possible transitions against which a strategy for the long term and proposals for actions in the coming years can be worked out.

The role of the Ad Hoc Advisory Group is to discuss different scenarios and policy challenges and provide advice for the preparation of the Energy Roadmap. Member of the Advisory Group will bring their contributions in their areas of expertise.

Issues to be discussed could include: energy market integration, financing of infrastructures, drivers towards market compatible national renewables support schemes and use of cooperation mechanisms, incentive to investments in the transition to a secure, competitive, low-carbon energy system, international issues and energy policy approach.

The Ad Hoc Advisory Group will meet approximately three times between May and November 2011 in Brussels Commission premises. The final output of the group will be a report consolidating the results of the meetings providing advice, from the group as a whole, on the challenges to be tackled in the 2050 Energy Roadmap."

[1] http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/272&format=HTML&aged=0&language=EN&guiLanguage=en

b) The membership of the Group

Dieter Helm (chair)

Claude Mandil (deputy chair)

Jorge Vasconcelos

David MacKay

Fatih Birol

Arne Mogren

Frederic Hauge

Brigitte Bach

Coby van der Linde

Eugeniusz Toczylowski

Ignacio J. Pérez-Arriaga

Wolfgang Kröger

Giacomo Luciani

Felix Matthes

c) Meetings and working arrangements

The Group met on three occasions in Brussels.

The first meeting comprised a presentation from Philip Low on the background to the Roadmap, and proceeded to a round table discussion of the objectives of the Roadmap and the issues to be considered.

The second meeting comprised a presentation from Professor P. Capros NTUA on the PRIMES model, followed by a presentation on the Commission's scenarios. Members of the Group discussed these presentations and set out the issues for consideration in the Group's report.

In advance of the third meeting, the Chairman prepared an initial outline draft of the report.

The Commissioner for Energy introduced the third meeting. The Chairman presented his first outline draft report and the draft recommendations. Members of the Group discussed the recommendations.

Following the third meeting, the Chairman revised the draft report, and communicated with members of the Group on detailed drafting points.

At the end of September 2011 the Group agreed this final report.