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Renewable Energy Road Map
Renewable energies in the 21st century: building a more sustainable future

SUMMARY OF THE IMPACT ASSESSMENT

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Renewable energy roadmap – Summary of the Impact Assessment

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1. INTRODUCTION

Through Presidency conclusions, the European Council has asked the Commission to bring forward a Renewable energy roadmap and to look into the option of a 15% renewable energy target for 2015.[1] The European Parliament, for its part, has called for a mandatory target for renewable energy of 25% of overall energy consumption in 2020 (together with mandatory sectoral targets).[2] This impact assessment examines the question of whether the EU should adopt quantified targets for the share of renewable energy in 2020[3]; and if so, for what amounts and in what form.

It takes as its context the objectives of EU energy policy: environmental sustainability, security of supply and competitiveness. Renewable energy sources can potentially contribute to all three. They entail few greenhouse gas emissions and avoid contributing to climate change, the most important environmental problem. They are predominantly indigenous and contribute to fuel diversification and security of supply. They can contribute to competitiveness by bringing new, innovative producers into the energy market.

The impact assessment evaluate these effects, quantifying them where possible. It uses runs from two models: PRIMES and Green-X.

2. ACTIVE RENEWABLE ENERGY POLICY OR BUSINESS-AS-USUAL?

The EU can adopt a "business-as-usual"[4] attitude to the development of renewable energy, or a coherent policy in its favour. Renewable energy is expected to reach a share of between 10.5 and 12.5% in 2020 under business-as-usual conditions. This is compared with pro-active policy scenarios under which, in line with the positions of the European Parliament and European Council, renewable energy can achieve a share of 20% in 2020.

Feasibility

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1 Presidency Conclusions 7775/06 of 24th March 2006.

2 European Parliament resolution of 14 December 2006.

3 Note: according to the model runs used in this impact assessment, a 20% share of renewable energy in 2020 (as called for by the Parliament) is consistent with a 15% share in 2015 (as suggested in the European Council).

4 It is important to note that the "business-as-usual" scenario described here is not the same as a baseline scenario, since it includes around 13% more energy savings than can be expected under the baseline scenario, and therefore reflects the measures set out in the Energy Efficiency Action Plan (COM (2006) 545).

The first question is whether a much higher share is feasible. Two aspects are examined: the availability of sufficient biomass for energy purposes, and the ability of the electricity system to absorb sufficient amounts of wind and other forms of variable power.

To achieve, for example, a 20% renewable energy share, at most 230 million tonnes of oil equivalent (Mtoe) of bioenergy would be needed, split between domestic production and imports. On the conservative assumption that 15% of the biomass used is imported[5], the contribution that would have to come from the EU would be a maximum of 195 Mtoe. Such a result is modelled by the Commission's energy models and appears feasible. It can also be compared with the European Environmental Agency's estimate that in 2020 the EU25 will be capable of supplying 235 Mtoe of bioenergy[6]. Since this EU25-based assessment does not take into account Romania and Bulgaria, countries with low domestic energy consumption and high potential to produce bioenergy, it can be concluded that biomass availability is not a feasibility constraint.

Similarly, variable power might contribute up to 18% of electricity generation. This is not considered to raise feasibility (intermittency) problems: several comprehensive studies exist that demonstrate the technical possibility of integrating this level of variable power into the power network.[7]

It is also worth noting that the energy models used incorporate the energy sector's (often long) investment cycles (asset lifetimes) in determining the rate of growth of new technologies and the replacement of conventional energy with renewable energy.

Costs

In the absence of the full internalisation of external costs and benefits, most forms of renewable energy cost more than the conventional alternative. The difference is expected to narrow, but not vanish, by 2020.

Assuming energy prices based on oil at $48/barrel, the renewable energy used in the business-as-usual scenario is expected to cost, in 2020, €13 billion (bn) a year more than the conventional alternatives. For a 20% share of renewable energy, the extra cost would be €24 to €31 bn. However, these extra costs would almost entirely balanced if oil prices were higher – e.g. $78/barrel and if CO_2 emissions were to be valued at €25/tCO_2.

Greenhouse gas emissions

Under the business-as-usual scenario, annual savings of 430-600 million tonnes (Mt) of CO_2 would result from the use of renewable energy in 2020. With a renewable energy share of 20%, the equivalent figure would be 600-900 Mt.[8]

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5 Most regions of the world have more biomass production potential, relative to their expected energy demand, than Europe does – and thus the capacity to produce biomass for export. Biomass imports are likely to make an important contribution to EU renewable energy contribution in 2020.

6 European Environmental Agency (2006), How much bioenergy can Europe produce without harming the environment?, EEA report no. 7/2006

7 GWPC 2006 Conference Paper: "Design and operation of Power Systems with Large Amounts of Wind Power, first results of IEA collaboration". See website of IEA Implementing Agreement on Wind: http://www.ieawind.org/AnnexXXV/Task25_Publications.html.

8 The emissions calculations include CO_2 but not other greenhouse gas emissions covered by the Kyoto Protocol, including methane (CH_4) and nitrous oxide (N_2O). This means that the GHG benefits of

Security of supply

The Green-X and PRIMES policy scenarios show that the avoided fuels in 2020 from increasing the share of renewable energy range from around 234 - 300 Mtoe/year[9] of which approximately 200Mtoe/year would be imported. Oil imports from the Middle East and CIS can be expected to be at least 50 Mtoe lower.

Oil is the fuel posing the most serious security of supply problems, especially in transport. A scenario with higher biofuel shares would do most to address the EU's most serious security of supply problem. Security of supply is also an important issue in the heating sector, given its high reliance on oil and gas.

Employment, GDP and export opportunities

Results from PRIMES and GREEN-X were fed into models of the whole economy. These take into account, among other things, the price changes that will result from the promotion of renewable energy. One of the three models[10] used suggested that GDP would be a little more than 0.5% higher with a 20% share of renewable energy in 2020 than under business-as-usual conditions and that employment would grow by just less than 0.3%, about 650 000 jobs. The second model[11] suggested that in the biofuels sector jobs would increase by 144 000 and that GDP would increase by around 0.23%. The third model[12], which looked into the electricity sector, estimated a welfare loss of 0.05%.

These modelling exercises focus on the effects of European demand for energy from renewable sources and for the capital equipment needed to produce it. However, an active renewable energy policy also creates potential for European manufacturers to export this technology. This export potential is greatest for innovative technologies, but also exists for well-established technologies.

Biodiversity

Climate change is the major threat to biodiversity. Thus renewable energy's positive impact on greenhouse gas emissions contributes positively to biodiversity. However, the local biodiversity impacts of energy production should also be taken into account. For wind power and biofuels for instance, production processes with a large negative biodiversity impact must be prevented: for example, avoiding siting wind turbines in "pinch points" through which migrating birds are obliged to pass or felling rain forest to permit the production of palm oil to make biodiesel. To avoid these production processes, the Commission is working on

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biomass are overstated, since production process (included in life-cycle analysis) leads to both CH_4 and N_2O emissions. The emissions calculations also include direct emissions alone, not lifecycle emissions. These methodological issues are particularly important in the case of biofuels, and are fully taken into account in the impact assessment for the review of the biofuels directive. [ref]

9 The figures from the "high renewables and efficiency" scenario in the PRIMES model is 234 Mtoe, whereas the Green-X scenarios give a range of 250 – 300 Mtoe.

10 The ASTRA model was used to assess the employment and GDP impact of the achievement of a 20% renewable energy share across all three energy sectors.

11 An input-output (I/O) model was constructed, using inputs from the Commission's ESIM agricultural market model, to estimate the GDP and employment effects of the use of a 14% share biofuels.

12 The PACE-POLES models were used to estimate the GDP effect of a 35% share of renewable energy in electricity generation.

guidelines for how environmental impacts should be taken into account in wind power development and plans to develop a scheme as part of the revision of the biofuels directive.

Taking these measures into account, it can be concluded that the biodiversity impact of a significantly higher renewable energy share would be substantially positive, even before considering any negative biodiversity impact from conventional energy. In fact, conventional energy production has substantial biodiversity impacts (oil spills are an example). Under a policy of renewable energy promotion, these impacts would fall because a high share of renewable energy means less use of conventional energy.

Air quality

Replacing fossil-fired electricity generation with renewable energy has generally positive air quality effects, especially when the fuel replaced is coal. Replacing conventional transport fuels with biofuels has minimal air quality effects, because of the strong controls on pollution from road transport.

Replacing conventional heating with biomass heating can have a negative air quality effect if poor quality equipment is used. To avoid this, all efforts should be made to ensure that support measures should only be available for equipment of high quality.

International aspects

European demand for biomass, especially biofuels, can contribute to improving trade relations with the European Union's trading partners, in particular developing countries, many of which have the potential to produce and export biomass and biofuels at competitive prices. Renewable energy sources can create an important opportunity for job creation and rural development in developing countries. A strong renewable energy policy in the EU can therefore be regarded as an important tool in policy towards developing countries.

Aiming at shares other than 20%

Using one of the scenarios under study, a sensitivity analysis was carried out to compare the impact of achieving a 20% share in 2020 with that of achieving shares of 16, 18 or 22%.

When renewable energy's share is set at a level below 20%, the estimated reductions in costs (relative to a "20%" scenario) are roughly equal to the reductions in benefits. For example, the "16%" variant would imply 20% less renewable energy use; 19% less CO_2 savings; 24% less savings in fossil fuel imports; and 23% less investment costs.

By contrast, when renewable energy's share is set at a level above 20% - in the "22%" variant – costs increase more than benefits do. 10% more renewable energy would be used; CO_2 savings and fossil fuel import savings would grow by comparable amounts (7 and 12% respectively); but investment costs would grow by 26%.

This reinforces the wisdom of not aiming at a share above 20%.

Conclusion

Based on this analysis, and depending on the political weight placed on each factor, it would be reasonable for the EU to conclude that the active approach to renewable energy is worth pursuing, with an ambitious objective for 2020.

3. HOW SHOULD RENEWABLE ENERGY BE PROMOTED?

If the EU is to pursue the objective of a high share for renewable energy in 2020, it is necessary to consider how.

Options for the tools to be used

Non-regulatory measures such as voluntary agreements, consumer information and RTD can play a helpful role. However they cannot be expected, on their own, to lead to the achievement of a significantly higher renewable energy share in 2020.

Efforts to internalise external costs are ongoing, but progress is slow, and insufficient for achieving the Community's renewable energy objectives.

Targets have a solid history as a tool in EU renewable energy policy. In particular, the legislative targets that the Community has adopted for renewable energy in electricity generation[13] and transport[14] have set the context for growth in both sectors. If the EU is to mount a serious effort to achieve a much higher renewable energy share, it seems essential to continue a target based approach.

Sectoral targets or a single renewable energy target?

As an alternative to building on the current system of sectoral targets, it would be possible to shift to a system with a single renewable energy target for each Member State. This would have the advantage of giving the market complete flexibility in choosing how to achieve the goal. In principle, it could be expected to keep the cost of doing so to a minimum. In general, this seems an appropriate approach for the future policy to pursue.

However, it needs to be taken into account that one of the main functions of targets is to establish a framework offering investor certainty. It is also important to avoid the risk that the market's focus on investing in the current cheapest technology results in the delay of the development of more promising and efficient technologies, due to their higher costs. The limitation of technologies could mean that security of supply goals, as well as emissions reductions targets could be missed.

These risks are particularly pronounced for biofuels, the only available means of addressing the (critical) security of supply and emissions concerns in the transport sector.

This analysis suggests that the more balanced technology development created by sectoral targets for biofuels would lead to longer term economic and environmental benefits. It is therefore recommended to adopt a minimum target for biofuel use in 2020.

Different mixes of renewable energy

To examine the possible development of each of the energy sectors, three scenarios were developed, each with an overall renewable energy share of 20% in 2020 but with a different breakdown between sectors:

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[13] Directive 2001/77 of 27 September 2001 of the European Parliament and the Council on the promotion of electricity produced from renewable energy sources in the internal electricity market (OJ L 283, 27.10.2001, p.33).

[14] Directive 2003/30/EC of 8 May 2003 of the European Parliament and the Council on the promotion of the use of biofuels or other renewable fuels for transport, OJ L 123, 17.5.2003, p. 42.

(1) A PRIMES "high renewables and efficiency" scenario, under which renewable energy would account for 43% of electricity generation; 15% of petrol and diesel consumption in transport; and 16% of heating and cooling.

(2) A Green-X "least cost" scenario, starting with the cheapest technology, results in more renewable energy in electricity generation than in the PRIMES scenario and less (12%) in transport.

(3) A Green-X "balanced" scenario, under which the potential of renewable energy is fulfilled through similar efforts across sectors and technologies. This results in a higher share of renewable energy in heating and cooling than the other scenarios (21%); a lower electricity share (34%); and an intermediate transport share (14%).

On the basis of these scenarios, a 14% target specifically for biofuels could be assessed as optimal. However, whilst such growth would be feasible, a more cautious approach should be adopted when fixing a binding, minimum target.

The impact assessment therefore explains why, based on conservative assumptions related to the availability of sustainably produced biofuels and car engine and biofuel production technologies, a reasonable target for biofuels in 2020 would be around 31 mtoe of transport fuel consumption.

Based on this analysis, and depending on the political weight placed on the different factors mentioned, it is recommended to combine an overall 20% 2020 renewable energy target with a sectoral target of 10% for biofuels.