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Guest editorial

Renewable energy policies in the European Union

1. Introduction

The European Union is small in terms of land area. The total area of the old 15 EU member states is 3.2 million km^2, approximately 2% of the total world land area. This is small compared to some major individual countries, like Australia, Brazil, Canada, China, the Russian Federation and the USA that each occupy 7–17 million km^2. Land is a crucial resource for the development of renewable energy, and therefore it seems somewhat surprising that exactly in this region ambitious growth targets are set for the large-scale deployment of renewable energy: the Union wants to double the share of renewable energy sources in total energy consumption from 6% in 1997 to 12% in 2010. We are about halfway into this period and it seems to be a good moment to carry out a mid-term review. The aim of this special issue is to do a scientific analysis of the developments so far and the expectations for the coming period. It is of course not the first time that renewable energy policies are addressed in the Energy Policy (see e.g. Midttun, 2003; Morthorst et al., 2003). These special issues especially focused on electricity production from renewables and the characteristics of a market for tradable green certificates in interaction with emission trading and market liberalization.

In the current special issue we will mainly examine what we learned so far. Hence, much emphasis is put on ex post policy evaluation. The main questions are: which policies were successful and which were not? How effective was the role of various Member States and the European Commission? And a crucial question is of course: how is progress to achieving the targets?

In this introductory article, we will present an overview of the development of renewable energy in the European Union, also in comparison with other major world regions. A brief sketch of the policies will be given. Finally, we will present the major findings of this special issue and an outlook to the future of renewable energy in the European Union.

2. Renewable energy policy developments in the European Union

In the 1970s and 1980s of the last century, the policy emphasis for renewable energy was on research and technological development. The European Union was not the leader in renewable energy R&D, but initially it was the US. After the extremely high US expenditures in the late 1970s had declined, both the European Union and the US in the last 15 years have been on a comparable expenditure level of about 200 million US_{2001}$ per year. The Japanese R&D expenditures are somewhat lower (Fig. 1). The expenditures presented in Fig. 1 exclude the expenditures by the European Commission that still added very substantially to the budgets for renewable energy, with budgets up to 100 million US$ per year.

Within the European Union, Germany was the largest contributor to R&D. Other countries with a substantial contribution to European Union renewable energy R&D are Italy, The Netherlands, Spain, Sweden and the United Kingdom. The breakdown to technologies is: about one third for photovoltaics and one quarter for wind energy and bio-energy each. This package is more diversified than in the US and Japan, that have an even stronger focus on photovoltaics.

In the 1990s of the last century, the emphasis shifted gradually to actual implementation. Until now, the national policies have led the market penetration of renewable energy, e.g. wind energy by Denmark, Germany and Spain, solar photovoltaics by Germany, solar heating by Austria and Greece and biomass by Sweden, Finland, Austria and Germany. Many of them will be discussed further on in this special issue.

The share of the European Union in renewable energy application is still limited. Figures on the deployment of renewable energy in the European Union compared to OECD totals are given in Table 1. Renewable electricity production in the OECD is dominated by hydropower; the share of the EU within OECD is 26%. Renewable heat production is dominated by biomass; the EU share within OECD is 22%.

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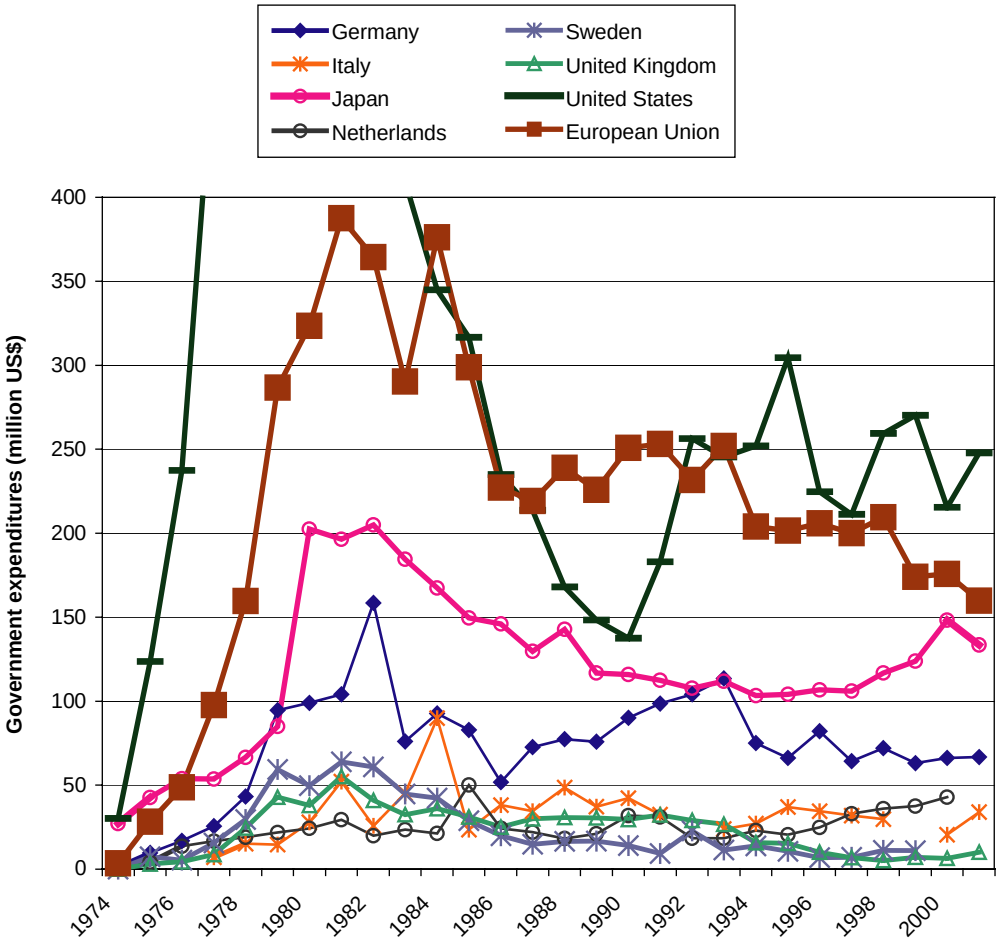

Fig. 1. Government funding for renewable energy research and development for the European Union and some major member states, compared to funding in the US and Japan. Note that in the period around 1980 US expenditures exceeded 1000 million US$ per year.

Table 1
Renewable energy production in the European Union compared to other OECD countries

	OECD production 2000	EU production 2000	EU share of OECD	EU annual growth rates 1990–2000[a] (%)	Other OECD annual growth rates 1990–2000[a] (%)
Hydropower	1386	346	25%	2.2	1.0
Wind electricity	29	23	78%	40	7
Solar photovoltaic electricity	0.2[b]	0.1	[b]	25	20
Geothermal electricity	33	5	15%	4	1.2
Geothermal heat	8	0.4	6%	1.7	2.3
Biomass electricity	145	46	32%	10	5
Biomass heat	787	174	22%	8	[c]

All amounts are in TWh. *Source*: IEA, 2002.
[a]For biomass, solar photovoltaics and geothermal heat, growth rates are from 1991 to 2000 because of lack of data for 1990.
[b]Japan did not report figures, so the OECD total probably is highly underestimated and no reliable EU share can be estimated.
[c]No figure provided as data for the USA are wildly fluctuating from year to year.

Most impressive are the high growth rates achieved in the European Union. Production of wind energy grew by 40% per annum in the period 1990–2000 and growth continued thereafter. Nearly 80% of the OECD wind energy production is now in the European Union. But also for solar photovoltaics and biomass electricity production growth rates are high.

The success of the European Union is partial. The growth in wind electricity production has led to a strong European wind turbine industry, with a worldwide market share of 90% (EWEA, 2004). But in another area, photovoltaics, the Japanese are still the market leaders. In module production, Europe has a market share of just 22% (Jäger-Waldau, 2002).

At the European Union level, the White Paper (European Commission, 1997) can be considered as a landmark. For the first time, a target for the contribution of renewable energy was formulated: the contribution was to double, from 6% in 1997 to 12% in 2010. Except for a so-called Campaign for Take-Off, there was little concrete policy announced in the White Paper. Concrete policy-making came later; in recent years a number of directives were accepted, e.g. on renewable electricity (European Commission, 2001) and on biofuels (European Commission, 2003). In both directives targets are set for the year 2010: the share of renewable sources in electricity consumption should be 22% (differentiated by country); the share of biofuels in total automotive fuels should be 5.75% (for all countries). These directives have to be translated into national policies by the European Union Member States and will probably lead to active implementation in the years to come.

There is probably no world region where the emphasis has shifted so much from technology development to technology implementation, although it should be noted that also in other regions substantial programs exist, e.g. the renewable energy portfolio standard issued in 1999 in Texas (Langniss and Wiser, 2003) and the support program for photovoltaic solar energy (including a 50% investment subsidy) in Japan (Sakuta, 2002).

3. Major findings

This special issue starts with the good news. Renewable energy policy in Germany really was a success and led to rapid deployment of wind turbines and photovoltaic systems. Jacobsson and Lauber describe how institutional change occurred. Strong support instruments (although modest compared to the support for nuclear and coal) were implemented and survived over a long time period, thanks to the formation of an ever stronger advocacy coalition. The renewable energy industry now employs 120,000–150,000 people in Germany. The bad news is that the German example is not followed by many other countries. Sweden was quite early with supporting wind turbine technology development, but deployment has been limited over the years. Åstrand and Neij describe how the success of wind power development and diffusion was limited due to policy programs that have been too focused, inflexible and non-continuous.

These studies are related to an important question for governments that wish to stimulate the introduction of new technologies: where to find the balance between the support of technological development on the one hand and the support of market introduction on the other hand? It seems to be attractive to wait with market introduction and first support technological development. The latter will lead to more cost-effective technology, and subsequent market introduction will become cheaper. But waiting with market introduction will also postpone the learning process that needs to be gone through anyway, and this includes both technological learning and institutional learning. A cost analysis by Åstrand and Neij suggests that the Germans and the Spanish were more timely with starting the massive support of market introduction than the Swedes—at least their costs were smaller relative to the amount of wind energy installed. Nevertheless, the costs in Germany have been perceived as quite high, but the analysis by Jacobsson and Lauber shows that these are justified if all benefits (including avoided external costs) are taken into account.

In recent years another debate has emerged between what could be called two different policy paradigms: "subsidies or quota". Germany and other countries, like Spain, provide fixed feed-in tariffs for renewable electricity delivered to the public grid. Others, like the United Kingdom, Belgium and Poland, apply renewable energy obligations—also called renewable portfolio standards—where a certain fraction of the electricity delivered to customers should come from renewable sources. An argument for the latter system is that it would stimulate competition and lead to quicker cost reduction. Mitchell et al. analyze the consequences of both systems and conclude that feed-in systems have one big advantage: they reduce risks in terms of price, sold volume and market balancing costs. This is a structural reason why renewable energy obligations have not been successful so far. It may be too early to make a final judgement—e.g. no renewable energy obligation scheme has existed continuously for a long period yet—but for the time being the first strike is for the feed-in system.

A third way to stimulate the uptake of renewable electricity is to stimulate the voluntary market for renewable energy. Markard and Truffer analyze the market for green electricity products in European Union countries and find that the direct impact of green electricity schemes has been limited so far. However, the authors identify indirect benefits of green energy

schemes related to learning processes among different actors. Green electricity products have the advantage that they involve the whole production chain—including the final consumers—in the development of renewable energy, thus giving rise to broader awareness and acceptance of renewable energy.

Many policy studies in the area of renewable energy focus on wind energy and solar photovoltaics. Biomass is a much more important renewable energy source, both in terms of current contribution and expected growth in absolute terms for the coming decades. Hence, the development of this source deserves more attention in energy policy studies. Faaij maps the developments of bio-energy in Europe, both in terms of technology and policy programs. Bio-energy use has increased between 1990 and 2000 for the production of heat, electricity and fuels. Expansion mainly took place in the form of conventional conversion technologies (combustion) and traditional bio-fuels (like ethanol and rape seed oil). Promising technologies—like gasification and advanced bio-fuel production—are underway, but need much stronger international R&D incentives.

But will all this policy effort lead us to the targets set out for 2010? Harmelink et al. have made an ex ante analysis of the current policies for the European Union. They make a quantitative assessment and conclude that with the policies introduced so far, the share of renewable energy in the current Union will not increase from 6 to 12%, but only to 8–10%, depending on whether current policies will be continued until 2010 or not. The development of wind energy is above the 1997 expectations, but all other renewable energy sources are performing substantially below target. This means that anyway a substantial strengthening of policies is needed.

Voogt and Uyterlinde show that the European Union target for renewable electricity in 2010 can be reached jointly against costs of electricity that go up to about 9 eurocent/kWh (about half of the additional production should come from biomass sources). But, as said before, policies still have a very national character. This better change: Voogt and Uyterlinde show in their contribution that the Union may save 2 billion euro in 2010 only for electricity generation from renewable energy sources if a European-wide system for trading of green certificates would be in place.

The other important challenge for the European Union is of course the accession of ten new member states in 2004. The European Union land area will be increased by about one quarter, bringing about new potentials. Reiche shows that in these countries the forces supporting conventional electricity production are still very strong. New impulses for the implementation of renewable energy sources need to come from European Union regulations.

4. Outlook for renewable energy in the European Union

Overlooking all these studies we see that—despite the European Union framework that has been implemented since the adoption of the White Paper in 1997—renewable energy policy in the community is still very much national policy. European Union common policy mainly consisted of three elements: (i) supporting technology R&D; (ii) setting medium and long-term targets; and (iii) providing boundary conditions (like a system for guarantees of origin). Actual incentives for market penetration of renewable energy were hardly present.

Saving money is one good reason to strive to a European policy for supporting the implementation of renewable energy sources. Another strong driver will be the expected changes in the European institutions. In the proposed new constitution for the European Union, it is explicitly stated that for energy policies there will be so-called shared competence: both "… the Union and the Member States shall have the power to legislate and adopt legally binding acts in that area. The Member States shall exercise their competence to the extent that the Union has not exercised, or has decided to cease exercising, its competence" (European Convention, 2003). This makes it likely that policy initiatives for the implementation of renewables will be more and more taken at the Union level.

How would a future common system of renewable energy support look like? It is most likely that, -for the short term, -national support systems, including feed-in tariffs and tax exemptions, are still needed. However, such policies cannot be free of commitment from the side of the governments. Continuity of policies is an important prerequisite for effectiveness. As the market for renewable energy is gradually becoming more mature, it might be necessary to let the support system gradually evolve to a European support system based on renewable energy obligations and tradable green certificates. But in the short and medium term continuity seems to be more important than speed as several problems will be encountered (see e.g. Morthorst, 2003; Meyer, 2003).

For the short term, it seems more important to focus on the areas in which little progress was made so far: production of heat and production of fuels.

5. Further policy analysis needed

This special issue shows the present state of analysis of renewable energy policies in the European Union. With the expertise available in the various research institutes we are able to analyze policies from a variety of viewpoints.

However, there are also mismatches. There is a strong focus on wind energy and solar energy, whereas the analysis of bio-energy policy developments seriously lags behind. The same is valid for the areas of production of heat and fuels (it seems as if there is a correlation between policy success and the intensity of policy analysis!). Also, not much attention has been paid to some regions, e.g. the countries in southern Europe.

A special challenge is the analysis of costs of policies. In the articles by Jacobsson and Lauber and by Åstrand and Neij, policy costs were analyzed; in both articles useful conclusions could be drawn. Nevertheless, more needs to be done, e.g. on the matter of allocation: which costs should be allocated to what production of renewable energies.

6. Conclusions

The analyses in this special issue show a mixed picture. Policies are ambitious, substantial successes have been achieved, and institutional changes have occurred that probably are irreversible. But success remains still limited to specific countries and specific renewable energy sources. Much more policy effort is needed to reach the European Union targets set out in 1997. It remains an area to be critically followed by policy analysis.

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