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Green energy market development in Germany: effective public policy and emerging customer demand

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Abstract

This paper reviews the development of renewable energy in Germany from 1973 to 2003. It investigates the relative importance of energy policy and green power marketing in shaping the renewable energy market. More than a decade of consistent policy support for renewables under the feed-in law (StrEG) and its successor (EEG) has been an important driver for increasing renewable electricity generation to date, putting the country in a better position than most of its peers when it comes to achieving European Union targets for renewable energy. Green power marketing driven by customer demand, on the other hand, is growing, but has had limited measurable impact so far. We discuss potential intangible benefits of green power marketing and scenarios for future market development. The paper concludes with lessons that can be learned from the German case for policy design and market development in other countries.

Keywords: Renewable energy; Feed-in law; Green power marketing

1. Introduction

1.1. Background

The share of renewable electricity in Germany has more than doubled within the past decade. While Germany is still far from a sustainable electricity supply, relying heavily on coal (50%) and nuclear (28%), no other country has been successful in growing new capacity as quickly as Germany, particularly in the wind power sector. Germany accounts for 39% of installed world wind power capacity, and 55% of the incremental capacity installed worldwide in 2002 (AWEA, 2003). The country is an interesting success story for renewable energy development. This paper aims at understanding the drivers and dynamics behind this growth. After providing an overview of events that have led to the current market situation, we will investigate two factors in detail, namely the prime public policy instruments driving green energy supply—the Renewable Energy Law (EEG) and its predecessor, the Feed-in Law (StrEG)—and green power marketing driven by customer demand.

1.2. Methodology

This paper is based on a review of existing literature on renewable energy policy in Germany between 1973 and 2003. To understand the quantitative fundamentals of both supply of and demand for renewable electricity, we have compiled a database including time series of renewable energy development since 1990, which has also allowed us to run calculations on growth rates, market shares, comparisons to other European countries and plausibility checks for future trends. In two specific parts, the paper is also based on new empirical research. For the analysis of public policy (Section 3), we have performed a written survey among a dozen key energy policy players from various political parties, electric utilities and associations who have been involved

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in the renewable energy policy making process. For an in-depth analysis of green power marketing (Section 4), we have surveyed all the 16 marketers currently offering green power products nationwide, gathering information about products, customers, electricity sales, and new capacity created as the result of green power sales. For the few marketers who did not disclose their customer numbers to us, we made own estimates based on publicly available information and data we gathered for a similar survey that we have performed worldwide in 2001 (Bird et al., 2002). Information about individual marketers is confidential, but the summary data provides insights about market development.

2. Background: renewable energy trajectory

2.1. Public opinion

The German sustainable electricity discourse started during the oil crisis in 1973 demonstrating dependence on energy imports (Pulczynski, 1991). In 1974, the controversy on nuclear energy reached a first peak when civil society organisations campaigned heavily against a planned nuclear power plant in Wyhl (South-western Germany). The Green Party, which became part of the federal government in 1998, originated from the 1970s anti-nuclear movement. In 1980, scientists from Öko-Institut (Institute for Applied Ecology) in Freiburg published a book featuring alternative energy scenarios (Krause et al., 1980), with particular emphasis on energy conservation. In the 1980s, *Waldsterben* (environmental damages to forests) became the centrepiece of the public discourse. The Chernobyl nuclear accident in 1986 recalled the nuclear dispute. In 1988, Hermann Scheer, a social democrat and Member of the German Parliament, initiated the foundation of Eurosolar, the first organisation to actively promote a vision of 100% renewable energy supply. The Rio Conference in 1992 added climate change as a new important driver for promoting renewables.

A large representative survey carried out six times between 1984 and 2003 provides a picture of shifting public perception of energy sources in Germany (BPA (Federal Public Relations Office), 2003, Fig. 1)[1]. The percentage of Germans who expect wind energy to make an important contribution to the energy supply in the next 20–30 years has consistently increased since the late 1980s.[2] Nuclear energy, in contrast, has lost popularity throughout the 1990s, with a slight recent rebound. For the first time in 2003, wind energy scored higher than nuclear. The most attractive energy source in public opinion is solar energy.[3]

The survey also reveals that young people attach more importance to renewable energy than old people. Fifty-seven per cent of under 30-year-old Germans think that renewables will make a key contribution to future energy supply, while this view is shared by only 36% of over 60 year olds. Future support for renewable energies is widely accepted—49% think support should continue at current levels, 47% think it should be increased, and only 14% think that subsidies should be reduced. The government's decision to phase out nuclear energy is being increasingly supported by the public (61% in 2003 vs. 46% in 2000).

2.2. Technology change and industrial development

The wind power sector is a particularly good example for technological change and the emergence of a renewable energy industry in Germany. The development of wind turbines had two very different roots (Durstewitz et al., 1999). The GROWIAN project in the late 1970s and early 1980s was a top-down approach by government and established research and industry players aimed at building a large (3 MW) wind turbine from scratch. This eventually failed (Pulczynski, 1991; Hoppe-Klipper, 2003). On the other hand, a more successful approach to wind turbine development, although much less visible in the beginning, has been pursued by several small new entrants entering in the mid-1980s. The size of newly installed turbines increased from 10 to 50 kW in the 1980s to an average of 182 kW in 1992. This is mostly due to the introduction of the 300–500 kW class in Europe (Durstewitz et al., 1999), finally reaching over 1500 kW in the first half of 2003 (BWE, 2003). While some of the new entrants from the early days are still active as independent players, others have been sold or merged during the recent industry consolidation. Lately, technology development shifted towards offshore turbines. Manufacturers are currently testing 2–5 MW prototypes. Commercial offshore projects in the North Sea are expected to be completed towards the end of the decade.

The renewable energy sector has become an important economic factor in Germany, providing for revenues of €8.2bn (BMU, 2003) and an estimated 120,000 direct and indirect jobs in 2001.[4] This includes 35,000 jobs in the wind industry (of which 4700 are direct jobs), 40,000

[1]There is some inconsistency in the 1999 and 2003 data that is included in BPA's summary. We used the data from Table 3 in the confidential original report from Institut für Demoskopie Allensbach for Fig. 1.

[2]$N = 2059$. Respondents were asked to name up to three energy sources. Survey carried out by Institut für Demoskopie Allensbach in September/October 2003, on behalf of the German Federal Ministry of the Environment, summary published by the Federal Public Relations Office (BPA (Federal Public Relations Office), 2003).

[3]For comparison: In the same 2003 survey, other energy sources were named as significant contributors in the next 20–30 years as follows. Natural gas (46%), hydropower (36%), oil (34%), electricity imports (17%), coal (15%), other (1%), don't know (4%).

[4]This figure includes solar thermal collectors.

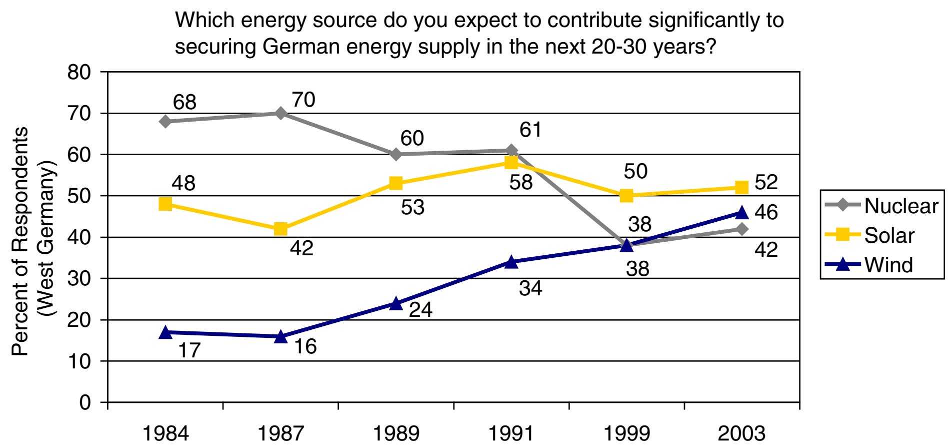

Fig. 1. Public Opinion in Germany has shifted in favour of renewable energy.

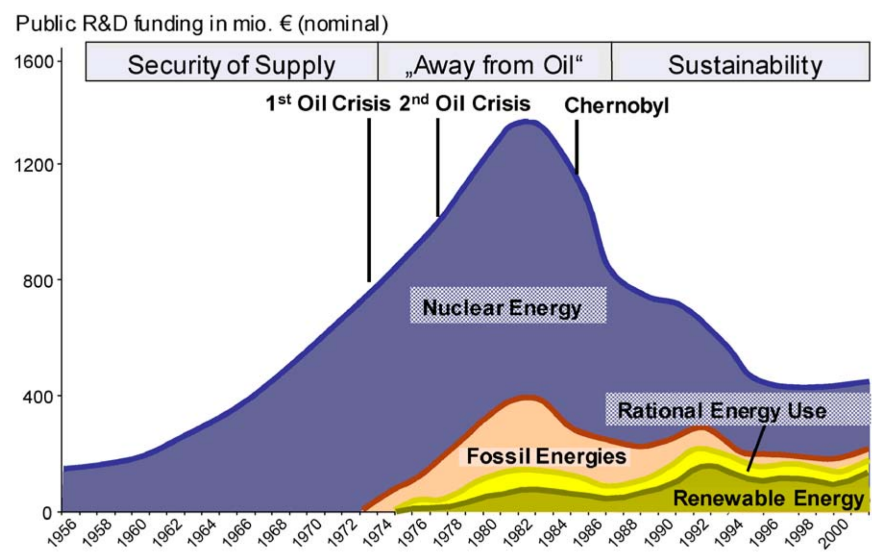

Fig. 2. German energy R&D funding slowly shifting towards renewables (*Source*: Winje, 2003).

direct and indirect jobs in the biomass sector, 5000 for PV, and 2000 for hydro (Bundesregierung, 2002).

The success of renewable energy in Germany has happened despite a strong focus of government R&D funding on nuclear energy throughout the last 50 years (Fig. 2). After the oil crises, R&D funding became more diversified, addressing efficient fossil energy technologies, rational energy use, and renewable energy. However, even in 2001, 80% more government money went into nuclear energy research than into renewables.

2.3. *Structure of the electricity sector*

Throughout most of the 20th century, the German power industry was structured based on the *Energy Industry Act of 1935*, which provided for monopolies in power generation, transmission, distribution and supply. Prior to market liberalisation, there were about 1000 electric utilities, eight of which were involved in large-scale power generation and high voltage transmission, about 80 in regional distribution with some generation, and more than 900 in local distribution. Local utilities were often horizontally diversified, not only supplying electricity but also gas, district heating and/or public transport. In many cases, a profitable electricity division served to cross-subsidize local public transport. In terms of ownership, the largest utilities were typically private companies with some public ownership, whereas local utilities were often owned by the communities. This opened the door to local political influence, as in the case of local feed-in tariffs for solar energy emerging in several German municipalities in the 1990s.

Following the *liberalisation of the electricity market* in 1998, a massive restructuring took effect. Intense initial price competition led to an erosion of profit margins and a wave of mergers and acquisitions. Within a few years, the number of large players was halved from eight to four, namely RWE, E.On, Vattenfall Europe and EnBW (majority-owned by EdF). The large utilities have also diversified horizontally by acquiring gas companies. Several local and regional utilities merged or were acquired by the four major companies. A number of new players had entered the market, but most of them have withdrawn due to market power of the incumbents and continued absence of a strong regulatory authority, which also led to recently re-increasing electricity prices. The only competitive innovation that survived 5 years of a deregulated market is a small number of green electricity marketers. On the customer side, switching rates have remained low. Only 3.7% of residential customers changed suppliers between 1998 and 2001 (Öko-Institut, 2003). It remains to be seen whether the announced introduction of a market regulator in 2004 (BMWA, 2004) will lead to a revival of true competition in the German electricity market.

Coal and nuclear dominate the *power generation mix* with 50.6% and 28.3% of electricity production, respectively, in 2002.[5] Natural gas contributes 9.3% and renewables just under 8%. Based on the 2001 "nuclear consensus" between the government and the electricity industry, the federal parliament passed a law in 2002 that phases out nuclear energy over the next two decades. As a result, 22,000 MW of power generation capacity or almost 30% of today's generation capacity will need to be replaced by 2025 (UBA (Umweltbundesamt), 2003). At the same time, CO_2 targets must be considered. This creates a strong additional impetus for renewable energy policies in Germany.

2.4. Policies for promotion of renewable energy

Support for renewable energy in Germany started in 1974 with the federal government's framework programme for energy research (Pulczynski, 1991). Following the failure of GROWIAN, support was concentrated on smaller wind turbines (up to 250 kW) from 1986 to 1988. In 1989, the "100 MW wind" programme introduced an incentive of 3 ct/kWh for wind energy generators, marking a shift from R&D funding to production incentives. This programme was upgraded to 250 MW in 1991, and required generators to participate in a Scientific Measurement and Evaluation Programme (WMEP) for wind energy, which helped to create a unique database on operating behaviour of wind turbines in Germany (Hoppe-Klipper, 2003). In addition to feed-in tariffs available under the Feed-in law (StrEG) of 1991, a large number of dispersed federal, regional and local support programmes were available to support investment in renewable energy generation by means of subsidies, tax incentives or soft loans (Grotz, 2002). Solar energy was specifically targeted by the 100,000 roof-programme providing attractive debt finance for solar energy (1999–2003) making PV commercially viable for the first time, particularly in combination with the new Renewable Energy Act (EEG). StrEG and EEG as two key pieces of legislation will be discussed in more detail in Section 3 below.

[5]*Source*: AG Energiebilanzen (http://www.ag-energiebilanzen.de).

2.5. Status and perspectives of renewable energy generation in Germany[6]

Fig. 3 summarizes the status of renewable electricity generation in Germany 1991–2002, showing the dynamic development in the wind energy sector on top of a relatively stable share of hydropower. Biomass has increased especially since the biomass law was passed in 2001 (BMU, 2001). PV, despite high growth rates, is still only a minor contributor. Overall, the share of renewables in electricity generation has almost tripled from 2.8% (15 TWh) in 1991 to 7.8% (46 TWh) in 2002, putting Germany in a more favourable position with regard to achieving the EU target of doubling the share of renewables between 1999 and 2010 than most of its peers.

A study commissioned by the German Federal Ministry of the Environment and the Federal Environmental Agency investigated future potential of renewables and concluded that wind (onshore and offshore) and solar energy (PV in the built environment) have a long-term technical potential to generate 250 TWh of electricity per annum, which represents more than 40% of German electricity consumption in 2002 (DLR et al., 2000). In its Sustainability scenario aiming at 80% CO_2 reduction by 2050, the Federal Environmental Agency estimates a 63% renewable share in electricity supply, consisting of 46% domestic generation and 17% imports (mainly for hydrogen production) (UBA (Umweltbundesamt), 2002).

3. Promoting renewables through public policy

3.1. Concept and objectives of the German feed-in mechanism

The system of feed-in tariffs introduced with the feed-in law (StrEG) of 1991, updated in the renewable energy law (EEG) of 2000 and the EEG amendment of 2004 is

[6]Unless indicated otherwise, information in this chapter refers to the German federal government's report on experiences with the renewable energy act (Bundesregierung, 2002).

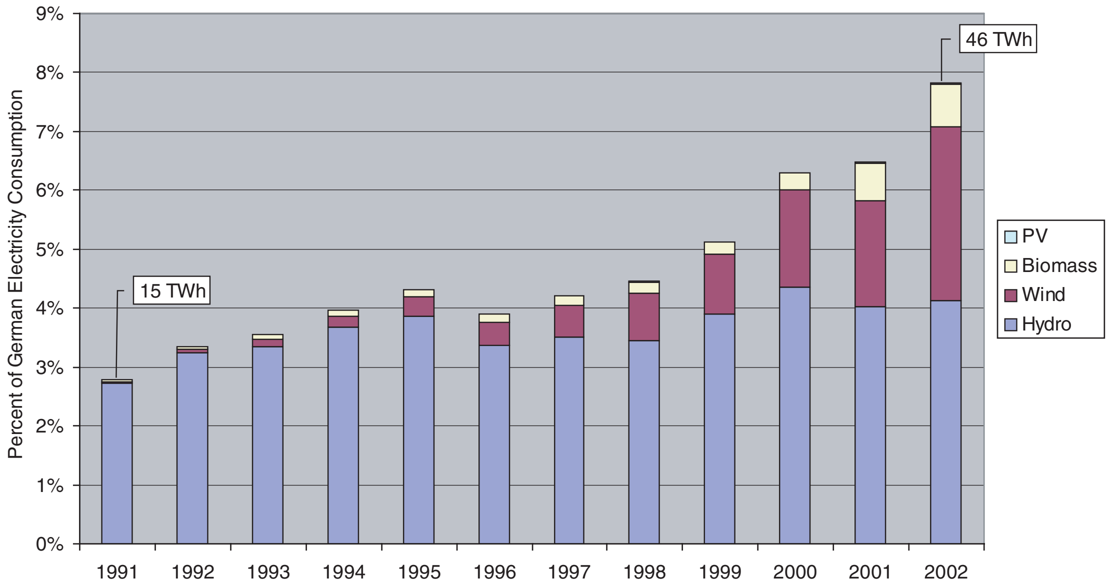

Fig. 3. Electricity generation from renewables in Germany 1991–2002 (*Source*: BMU 2003, AG Energiebilanzen 2003, own calculations).

the key element of renewable energy policy in Germany. The system has three key features (Madlener and Stagl, 2001): (1) A purchase obligation for the local grid obligator; (2) guaranteed minimum prices; and (3) a nationwide cost settlement system to balance out regional disparities. In the initial StrEG, which was introduced in the age of regional monopolies, the *purchase obligation* was on the local monopoly utility. When the electricity market was liberalized in 1998, this had to be changed. Under the EEG, the obligation is now on the local grid company, which continues to be a regulated monopoly.

With *guaranteed prices* for 20 years,[7] investment risk is effectively minimized. Under the initial StrEG, compensation for renewable generators was linked to avoided cost, taking average utility revenues per kWh as a proxy. The level of the feed-in tariff was set at 80% of average electricity prices for small hydro, sewage gas, landfill gas, and biomass (65% for 500 kW–5 MW), and 90% for wind and solar. When electricity prices started to erode in 1999 due to market liberalisation, renewable generators faced decreasing levels of compensation (Bechberger, 2000). The EEG, therefore, has changed to a system with prices that are fixed in the law. The EEG has also introduced stronger price differentiation by technology, and a reduction of tariffs over time. In the draft EEG amendment of 2004, prices have been further differentiated in light of experiences with technology and market development. A summary of feed-in tariffs paid under the three laws is provided in Table 1.

As it became clear that the feed-in system was effective in getting the renewable energy market started in the 1990s, increasing growth of wind power in Northern Germany resulted in a discussion about regional disparities. Utilities in this area demanded a burden sharing mechanism, which led to the development of a *nationwide settlement system* under the EEG. Under this system, the local grid operators can transfer the cost of their EEG payments to the next higher grid level, and at the high voltage transmission line level, costs are balanced out across Germany.

The *objective* of the German feed-in system was not explicitly stated in the StrEG of 1990. Implicitly, it aimed at promoting renewable energy generation, where small hydro and wind was the initial focus. The EEG of 2000 said that its purpose was to "facilitate a sustainable development of energy supply in the interest of managing global warming and protecting the environment", by achieving a "substantial increase" in the percentage of electricity supplied by renewables, "in order at least to double the share of renewable energy sources in total energy consumption by the year 2010" (BMU, 2000). The EEG also made explicit reference to corresponding EU objectives.

The EEG Amendment of 2004 is even more explicit with regard to its objectives. While retaining the EEG objective of achieving a sustainable energy supply to achieve protection of climate and the environment, the new law—according to the draft adopted by the

[7]The EEG amendment of 2004 limits this period to 15 years for large hydropower, biomass and landfill gas, sewage gas and coal mine methane.

Table 1
Feed-in tariffs for renewable electricity generation in Germany 1991–2004[i]

		StrEG	EEG			EEG Am.	Annual reduction	
		Pre-1999[a]	2000–01	2002	2003	2004E	2002 ff.	2005 ff.
		Eurocents/kWh						
Hydropower	<500 kW	6.5		7.67		7.67	0%	1%
	500 kW–5 MW			6.65		6.65		
	5–150 MW	0.0		0.0		3.7–7.67[b]	N/A	
Landfill gas, sewage gas, coal mine methane	<500 kW	6.5		7.67		7.67–8.67	0%	2%
	500 kW–5 MW			6.65		6.65–7.65		
	>5 MW[g]	0.0		0.0		6.65–7.65	N/A	
Biomass	<150 kW	7.1	10.23	10.1	10.0	11.5–15.0	1%	2%
	<500 kW					9.9–13.4		
	<5 MW		9.21	9.1	9.01	8.9–12.4		
	>5 MW[h]	0.0	8.7	8.6	8.51	8.4–11.9		
Geothermal	<5 MW	N/A				15.0	0%	1%[c]
	<10 MW			8.95		14.0		
	<20 MW					8.95		
	>20 MW			7.16		7.16		
Onshore wind	<5 years	8.2	9.1	9.0	8.87	8.7	1.5%	2%
	>5 years		6.19	6.1	6.01	5.5		
Offshore wind	<9 years	N/A	9.1	9.0	8.87	9.1[d]	1.5%	2%[f]
	>9 years		6.19	6.1	6.01	6.19[e]		
PV	Stand-alone	8.2	50.62	48.1	45.7	45.7	5%	5%
	Building-integr.					54.0–62.4		

Source: Based on Bundesregierung (2002, p. 4), Bundesregierung (2003), Bechberger (2000, p. 9).
[a]Indicative numbers based on 1998 actual values.
[b]Applies to refurbishment of existing hydropower plants, depending on size.
[c]Decrease starting 2010.
[d]Applies for 12 years to offshore projects commissioned prior to 2010.
[e]Applies to all other offshore projects.
[f]Decrease starting 2008.
[g]Coal-bed methane only.
[h]Upper limit of 20 MW foreseen in draft EEG amendment 2004.
[i]The tariffs apply to power generation facilities that have become operational in the given year.

government in December 2003—also aims at (Bundesregierung, 2003):

- reducing the cost of energy supply to the national economy by internalising external cost;[8]
- contributing to avoiding geopolitical conflicts about fossil energy resources;
- promoting development of renewable energy technologies; and
- increasing the share of renewable energy sources to at least 12.5% of electricity supply by 2010 and at least 20% by 2020.

Renewable energy legislation in Germany has become more sophisticated over time both with regard to the support mechanisms as well as its defined objectives.

[8]Strictly speaking, the EEG internalizes the external benefit of renewables rather than directly internalizing the external cost of conventional forms of energy.

3.2. *Drivers for policy development*

We now analyse the policy development from a process perspective, including important players, changing drivers and political coalitions behind the three pieces of legislation.

3.2.1. *Feed-in law of 1991 (StrEG)*

The initial feed-in law (StrEG) was supported from a broad coalition across political parties. According to the policy makers surveyed, the list of *promoters* spanned almost the entire political spectrum, including conservative (CDU/CSU) members of parliament (Bundestag) as well as representatives of the Green Party and the Social Democrats (SPD). The Association of Small Hydro Generators, which had a strong foothold in the conservative South of Germany, played an important role in obtaining support from a majority of parliamentarians. The only party that does not appear on the list of key promoters is the liberal party (FDP). Despite the fact that FDP was part of the governing conservative–liberal coalition together with CDU/CSU, the federal parliament unanimously[9] adopted the StrEG in October 1990.

Opposition to the introduction of the StrEG came predominantly from the electric utility industry, including both large utilities such as Preussen Elektra (now part of E.On) and RWE, as well as the German Association of Electric Utilities (VDEW). Prior to the adoption of the StrEG, grid access for renewable generators as well as their compensation was at the discretion of the industry and its associations under a voluntary agreement. VDEW also argued with the high cost involved in supporting small hydropower plants (Bechberger, 2000).

In terms of *issues* that played an important role in the policy formulation process, a key discussion point was the fair value for compensation of renewable electricity generation. Parliament finally went for the 80/65/90% of average revenue model described above as a pragmatic—yet somewhat arbitrary—compromise.

Opponents came back into the arena when the StrEG became somewhat unexpectedly successful in the late 1990s, pushing for an amendment of the existing *hardship clause* which exempted utilities from their purchase obligation if it would put an undue economic, technical or legal burden on them. In the 1998 StrEG amendment, the hardship clause was redefined as a twofold 5% cap (Bechberger, 2000). As soon as the share of renewables reached 5% in a utility's supply area in any given year, it could pass the additional cost on to the upstream grid operator (first cap). If renewables reached 5% in the service area of a grid operator on the high voltage level (second cap), the respective utility was no longer obliged to purchase from and compensate renewable generators. This amendment created uncertainty in the market, and the utilities who were particularly concerned due to high levels of wind power generation, Schleswag and PreussenElektra decided to take legal action. Their lawsuit against the German government was finally decided by the European Court of Justice on March 13, 2001, ruling that the StrEG conformed to European regulation and did not represent undue state aid.

In the meantime, the new government of Social Democrats and Green Party elected in 1998 quickly recognised the need to improve the feed-in law, also because the local monopoly utilities that were subject to the purchase obligation under the old StrEG had ceased to exist upon deregulation of the electricity market in April 1998.

[9]With several abstentions, including the Socialist Party (PDS).

3.2.2. The renewable energy law of 2000 (EEG)[10]

Similarly to 1990, a *parliamentary initiative* rather than the responsible ministry was a key catalyst for the relatively fast adoption of EEG in 2000. Achieving a sustainable energy supply and cutting CO_2 emissions was an important part of the coalition agreement of October 1998. Consequently, the Ministry of Economic Affairs took responsibility for the reform of renewable energy policy. However, parliamentarians from the two coalition parties soon criticized the Ministry, led by Werner Müller, who had joined the government from the utility industry, for not taking a progressive lead on the issue. After many discussions between energy experts from coalition parties and the Ministry, who even considered a fundamental change in the support system from feed-in tariffs to quota systems, parliamentarians finally decided to take the lead in December 1999 and bring up their own proposal for a Renewable Energy Law (EEG). One of the major differences between this proposal and the Ministry's draft was the suggested feed-in tariff for photovoltaics of 99 Pf/kWh (48 ct/kWh) vs. the initial 25 Pf/kWh (12 ct/kWh).

A clear difference to the policy process leading to StrEG in 1990/1991 was that there was *less of an all-party consensus*. The Green Party and the Social Democrats were clearly in the driver seat, while conservatives for the most part did not fundamentally disagree with the target of doubling the share of renewables but rather on details of the draft EEG. The law was adopted with clear majorities in both chambers of the federal parliament in spring 2000, including support from some oppositional parliamentarians.

In the policy process, some of the electric utilities, their industry association (VDEW) and the Association of German Industry (BDI) came out in stronger *opposition* than ten years prior. However, these groups also became more heterogeneous. For example, BDI as the parent organisation of German industry opposed the law alongside large industrial energy consumers organised in the VIK. On the other hand, the Association of the German Machinery Industry (VDMA) including some of the successful wind turbine manufacturers supported it. Similarly, in the parliamentary hearing in February 2000, there were apparent differences in the utility camp between the fundamental opposition from the RWE representative, Ulrich Beyer, and a more differentiated stance of the representative of Preussen Elektra,[11] Wolf Hatje. Possibly inspired by

[10]Unless explicit reference is made to our own survey or other literature, information in this paragraph refers to Bechberger (2000).

[11]Preussen Elektra was in the process of merging with Bayernwerk to form E.On. In hindsight, one could hypothesize that the ongoing merger processes between the major electric utilities in 1999/2000 created a window of opportunity for EEG promoters by absorbing management capacity that might otherwise have been devoted to more organized resistance in the legislative process.

this emerging differentiation in the utility industry, the final version of the law was changed to include electric utilities as potential beneficiaries of EEG compensation.

Among the *contentious issues* discussed in the legislative process, the level of support, particularly for wind energy and photovoltaics, stood out. Opponents, including the European Union's competition authority, criticized the anticipated feed-in tariffs as excessive subsidies—a view that was finally rejected by the European Court of Justice. Concerns about the cost implications of EEG support were partly addressed by introducing a hardship clause that exempted energy-intensive industries.

With regard to the *role of public opinion in the policy process*, both for StrEG and EEG, there are striking differences in the responses we received in our survey, ranking from a perceived "very high" impact of public opinion all the way to "very low". There seems to be a pattern where the role of public opinion in policy formation is perceived as more important by renewable energy supporters than by opponents of these policies. An explanation could be that renewable energy advocates refer to the contribution that these energies make to the public good (in terms of climate protection, etc.), while others, including utility representatives, have experienced the policy process as being dominated by a small circle of insiders. A view to the opinion polls reviewed in Section 2.1 above suggests that in both cases (StrEG and EEG) it was policy makers (and more specifically: parliamentarians) taking the lead rather than reacting to overwhelming public pressure, but after the fact, their decisions were backed by a strong majority of the population.

3.2.3. The EEG amendment of 2004

The trend from all-party consensus to a more polarised policy style has been accentuated by the drafting of legislation for the EEG amendment of 2004. *Support* for the draft law now comes mainly from members of the governing coalition, as well as the various renewable energy technology manufacturers and their associations, who have grown to be a relevant lobby group. The Farmers' Association has joined the supporting camp, seeing opportunities for their members in both biomass and wind energy. Similar to the EEG process, the Minister of Economic Affairs (now Wolfgang Clement) is again rather at the more conservative end of the spectrum within the coalition. However, responsibility for renewable energies has shifted to the Ministry of the Environment following the success of the Green Party in the 2002 elections. As a consequence of this government reorganisation, the process for EEG amendment has become more administration-led. This is reflected in a higher level of sophistication in many of the law's rules and mechanisms.

Opposition comes to some extent from members of the conservative (CDU/CSU) and liberal (FDP) parties, however, their opposition was qualified as being "half-hearted" by one of the respondents in our survey. Apparently, opposing renewable energy is not an attractive arena to gain popularity among voters. The electric utilities are again among opponents of the EEG amendment, but their criticism seems to have shifted from the more fundamental opposition in the 1990s to disagreement with the detail. The industry may have realised that the opportunity to pass prices on to consumers does not hurt them commercially. Some of the major utilities have even started to actively develop renewables, thus joining the camp of beneficiaries of renewable energy support. Finally, opposition comes from the coal lobby including the Trade Union of Miners and the Chemical Industry.

In terms of *issues* that have come up in the policy process, discussions focus once again on the level of compensation for wind and solar energy, as well as the reduction of compensation over time. A new issue is the inclusion of large hydro, which has been promoted most actively by one utility with a specific refurbishment project for their hydropower plant. The cost to consumers is also controversially discussed, but as one respondent pointed out, the underlying true dissent was about defining a quantified target for the long-term share of renewable energies. In fact, an early draft of the Ministry of the Environment had included a 50% target for renewables by 2050. Following resistance from the Ministry of Economic Affairs, the government finally adopted a version that includes targets of "at least 12.5%" for 2010 and "at least 20%" for 2020, which has some consistency with the government's decision to phase out nuclear (currently supplying 28%) by 2025. With regard to energy-intensive consumers, the existing hardship clause was extended to medium-sized industrial customers.

3.3. Impacts and effectiveness

To assess the result of 13 years of feed-in policies in Germany, we will take a look at the resulting new capacity and at the consequences on cost of renewables.

3.3.1. New capacity

Between 1990 and 2002, about 13,000 MW of new capacity have been created in Germany largely thanks to the feed-in system introduced in the StrEG and further developed under the EEG scheme.[12] With more than 90% of the new capacity, wind energy has been the backbone of renewable energy growth in Germany, while biomass accounts for about 5%. Hydropower and

[12]Source for installed capacity data in this paragraph: BMU (2003). See there for further references.

PV have the lowest shares in new capacity; but PV growth rates are still impressive.

Germany has seen much stronger growth in renewables than the EU average. Between 1991 and 2000,[13] power generation from renewables grew by 141.5% (from 15 to 37 TWh) in Germany compared with only 25.1% (from 269 to 337 TWh) in the European Union outside Germany (BMU, 2003), partly due to successful wind power development in Denmark and Spain. In the same period, the share of renewables has also more than doubled in Germany (from 2.8% to 6.3%), while it has only grown by 12.6% (from 12.7% to 14.3%) in the EU as a whole. Given the additional doubling of German wind energy capacity since 2000, the gap has widened further since then. There is little doubt that German renewable energy policy has been effective in increasing electricity generation from renewables.

Within this positive overall picture, there are of course a few critical issues, which have largely been addressed under the 2004 EEG amendment, namely the lack of geothermal power generation development; the controversy about adequate support levels for wind energy; and a still substantial distance to cost competitiveness in the case of photovoltaics.

3.3.2. Cost reduction

Between 1990 and 2000, the cost of wind and solar power decreased by about 30% and 60%, respectively (Bundesregierung, 2002). More recently, cost reductions have been less significant in the German market. For PV in particular, market prices in Germany are higher than for example in Japan or the US.[14]

Table 2 gives a breakdown of EEG compensation to the different renewable energy sources. In 2001, German electricity customers spent 1540 million Euro for renewables under the EEG, which equates to a cost of 0.18–0.26 Eurocents/kWh (Bundesregierung, 2002).[15]

Table 2
Renewable electricity generated and compensated under the EEG in 2001

	Electricity generation		Compensation	
	GWh	Percent	Million Euro	Percent
Small hydro	4209	23.6	322.0	20.9
Landfill, sewage gas, coal-bed methane	1700	9.5	104.2	6.8
Biomass	1393	7.8	131.8	8.6
Geothermal	0	0.0	0.0	0.0
Wind	10,456	58.7	951.6	61.8
PV	60	0.3	30.4	2.0
Subtotal EEG supported	17,818	100.0	1540.0	100.0
Non-EEG supported[a]	20,127		0.0	
Total renewable electricity	37,945			

Source: Bundesregierung (2002, p. 42).
[a]The majority of the "non-EEG supported" is large hydro.

4. Promoting renewables through customer demand: green power marketing

4.1. Concept and objectives of green power marketing

Market liberalisation has made it possible for customers to directly influence the way their electricity is made by demanding specific products, especially green power. The first German utilities offered green pricing programs to their customers in the mid-1990s (Markard, 1997). In 1998/1999, a number of competitive marketers introduced products, and incumbent utilities repositioned their programs. Unlike in the case of buying organic food or other green products, a green power customer does not get a physically different product, but the difference lies in monetary flows. If products are properly designed—i.e. double-selling is avoided—the purchasing decisions of green consumers will translate into a change in the electricity mix. Product attributes of green electricity are hard to verify for consumers. This inherent information asymmetry can be overcome by signalling based on the supplier's reputation or an independent labelling scheme including third-party certification (Truffer et al., 2001). In the absence of such a scheme, adverse selection will ultimately lead to crowding out high quality products (Akerlof, 1970).

Defining the *objective* of green power marketing is a complex task because different actors have different objectives. For *suppliers*, the prime objective is product differentiation in a liberalised market environment, and ultimately they aim at higher margins than they would realise for a commodity product. In the case of an incumbent utility, the objective may be to round off the product range, supply a perceived small niche of dark green consumers, increase loyalty among light green customers and convey an environmentally responsible image to other stakeholders. A specialised green power marketer will typically aim at strong growth in customer numbers, revenue and market share. For green power *customers*, their objective may either be to make sure that their money does not support unsustainable energy sources ("do their own personal nuclear phase-out"), or

[13]No comprehensive data on EU renewables is available for years after 2000.

[14]Regular updates for comparing the level of retail prices for PV modules in Europe and the US are provided by Solarbuzz, Inc. (http://www.solarbuzz.com).

[15]The interval is a result of different assumptions for the cost for conventional power generation that has been avoided thanks to renewable electricity.

to contribute to climate protection and growth of renewable energy by means of their purchasing decision. In the latter case, they will expect some additional environmental benefit (such as new capacity being created by the marketer or environmental upgrades of existing hydropower plants) in return for their willingness to pay more for green power. For *policymakers*, including both government institutions, environmental NGOs and labelling organisations, the objective is to increase the share of renewables by harnessing consumers' willingness to pay, and to raise environmental awareness among energy consumers. This differentiated view of objectives of the different actors shows that while there is some overlap with renewable energy policies, the success of green power marketing is a multidimensional concept that can be measured differently by different stakeholders.

4.2. Status of green power marketing in Germany[16]

Today, more than 135 marketers supply 1700 GWh of green power to an estimated 490,000 customers in Germany, which represents a market share of about 1.3% of residential customers. More than half of German green power customers buy 100% hydropower products offered by one of two companies, Naturenergie or E.On. About 95 of the 900 municipal utilities in Germany offer one or more green power products, 75 of them under the cooperative brand *Energreen*.[17] In addition, a number of competitive marketers, including subsidiaries of existing utilities, such as Naturenergie AG, as well as start-ups with roots in the environmental community, such as Naturstrom AG, and Greenpeace Energy, offer green power. Lichtblick, another independent start-up, has recently seen the most consistent growth rates, now supplying 90,000 residential customers (von Tschischwitz, 2003). The green power market as a whole has grown at a rate of about 28% p.a. in 2001 and 2002 (see Fig. 4).

In Germany, green power products can be divided into three general categories: pure large hydro, blends of renewables and combined heat and power generation (CHP), and 100% renewable energy products (see Table 3). The pure hydropower products still represent the largest category today, partly because one large marketer switched almost its entire customer base to a hydro product in late 1999. Initially, marketers priced these products below generic electricity. More recently they have been offered as premium products. The renewables and CHP blends, which contain up to 50%

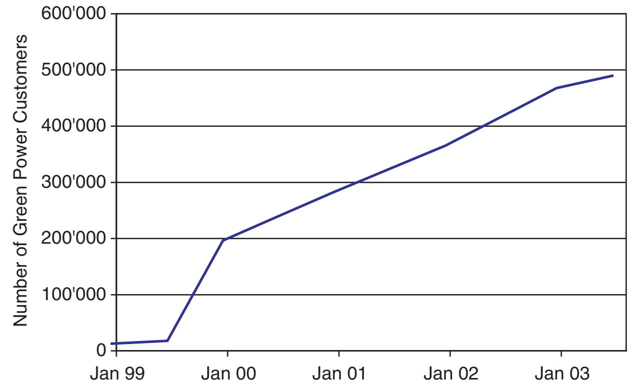

Fig. 4. Demand for green power products in Germany (1999-1H2003). *Source*: Data provided by suppliers, own estimates.

electricity from high-efficiency gas-fired cogeneration, have seen the strongest growth recently. Hundred per cent renewable energy products, especially as they contain a minimum share of new capacity, are higher in price and have somewhat lower customer response.

4.3. Drivers for green power market development

The drivers for green power market development are related to the objectives of different actors. In the order of relevance in the German case, factors influencing the green power market (positively or negatively) include:[18]

- *Desire of power marketers to differentiate their offerings*: Probably the strongest impetus for the emergence of a green power market came from electricity marketers, both new start-ups and some of the incumbent utilities, looking for opportunities to differentiate themselves and address perceived customer needs. With a relatively homogenous product, green power was one of the few things that looked promising to make a relevant difference in consumers' minds.
- *Willingness of retail consumers to pay more for renewables*: Opinion polls and market research have consistently shown that 20–35% of consumers have a positive willingness to pay for renewable energy (Eurobarometer, 2003; BPA (Federal Public Relations Office), 2003). While it may be a long way from declaring a willingness to pay to taking the actual purchasing decision, this is an indicator for an existing market potential for green power. The actual decision to purchase is influenced by other factors, such as general switching behaviour in the electricity market.[19]

[16]Unless indicated otherwise, results in this chapter are based on our survey of green power marketers in Germany in the fourth quarter of 2003 and our own estimates where data was unavailable. See Section 1.2 above for a description of our methodology.

[17]http://www.energreen.de

[18]See Wüstenhagen (2004) for a comparative discussion of the relative importance of these drivers in the German, Swiss, Dutch and UK green power markets.

[19]According to a survey on behalf of the news magazine Stern, 28% of respondents would "certainly not", and another 28% "probably not" switch electricity suppliers, even if they could reduce their electricity bills by doing so (cf. Stern, 2002).

Table 3
Classification of German green power products

Category	Fuel mix	Certification	Price premium (%)	Customers (#)	Products (#)	Examples
Large hydro	Pure hydro, mostly existing large-scale	TÜV EE02	5–10	320,000	2	E.On Aquapower, NaturEnergie Silber
CHP and renewable blends	<50% fossil cogeneration, >50% renewables, some new	OK power, TÜV UE01	15–35	130,000	8	Lichtblick, Greenpeace energy, HEAG NaturPur Light
100% renewable	100% renewables, some new	OK power, Grüner Strom label, TÜV EE01	10–40	40,000	125	NaturEnergie Gold, Naturstrom, energreen
Total				490,000	135	

- *Emerging demand from business customers and government authorities*: Non-residential customers are emerging as an important buyer group for green electricity. Non-residential customers tend to be more price sensitive, but the sheer size of their purchases makes them an attractive market segment.
- *Eco-labelling*[20] *by environmental NGOs*: The early existence of a recognized eco-labelling scheme helps to shape the market (Truffer et al. 2001). In Germany, three competing eco-labelling schemes had been launched,[21] which counteracts the basic function of an eco-label to reduce complexity and give guidance to consumers. Also, German labelling organisations have developed a high level of sophistication in distinguishing green power from EEG-supported electricity. The result is a double-edged sword: Customers are assured that they buy "subsidy-free" green power, but little guidance is given for designing products that will successfully compete beyond a small "dark-green" market niche. As a result, eco-labelling does not appear to be a strong positive driver for green power marketing in Germany so far.
- *Government policy*: The absence of strong public policy has been a positive driver for green power marketing in countries like Switzerland or some US states, and demand-side policies like a tax exemption for green power purchases provided fruitful support for the green power market in the Netherlands and the UK. In Germany, renewable energy policy traditionally had a clear supply side focus. As a consequence, regulation has not been designed to integrate supply and demand-side approaches to promoting renewables, but rather sees them as incompatible.

4.4. Impacts and effectiveness

4.4.1. New capacity

In terms of new capacity that has been created as a result of green power demand, our survey among German green power suppliers has led to an estimate of 127 MW of new capacity that have been created by these offerings between 1999 and 2003. It should be noted that this is a rough estimate, since not all suppliers could tell whether their numbers exclude capacity that would have been created anyway due to EEG support.

4.4.2. Cost reduction

Given the limited amount of new capacity, it is too early to quantify the impact of green power marketing on cost reduction in Germany. Therefore, we provide some qualitative considerations. Compared to fixed feed-in tariffs, green power marketing involves a stronger incentive for cost reduction, as marketers live on thin margins between renewable generators and customers with limited willingness to pay. Cost efficiency in sourcing renewables, as well as careful product designs are therefore key for green power marketers to be commercially successful. The large proportion of hydropower and CHP in competitive green power products in Germany is a reflection of this reality. A conceivable "race to the bottom", whereby green power marketers would use cheaper and cheaper renewables, is however limited by two factors: (a) customers' preferences for attractive technologies such as solar and wind and (b) eco-labelling organisations' criteria about product design. Whether this will provide sufficient incentives for generators to invest in new capacity remains to be seen.

[20]We use the term "eco-labelling" in accordance with ISO (1999) for third party certification of environmental product attributes, represented by single sign information (a "seal") at the point of sale. Note that in typical US terminology, this would be referred to as "product certification", while labelling is more commonly used when referring to electricity disclosure labels (referred to as "Guarantee of origin" in the European debate).

[21]OK-Power (http://www.ok-power.de), Grüner Strom-Label (http://www.gruenerstromlabel.de) and TÜV Süd (http://www.tuev-sued.de/industrieleistungen/umweltservice/gprtnkgolycf.asp).

5. Comparing public policy and customer demand

5.1. Assessing past impact—"1:0 for public policy"

If we assess past impact on helping the green power market to grow and take new capacity as an indicator, then there is little doubt about who wins in this match. The impressive success story of more than 13,000 MW of new wind capacity between 1991 and 2003, which has been achieved thanks to StrEG/EEG, versus a mere 127 MW of new capacity thanks to green power marketing between 1999 and 2003 gives a very clear picture. As another indicator for public policy's positive impact on new capacity, the 100,000 roofs program, combined with EEG support, has increased PV capacity by about 200 MW in the 1999–2002 period. Therefore it is not surprising that the architects of German renewable energy policy are convinced of what they have achieved, while they see green power marketing—depending on the political stance—either as a negligible niche or even a dangerous attempt to undermine successful public policy. However, two things need to be considered in this comparison: (1) As growing the market share of green electricity takes time, just as building wind projects with StrEG/EEG-support has taken time, it may be too early to assess the full potential of green power marketing. New capacity as a result will only be realised after sufficient customers have signed up. Adding to this general time lag, some successful marketers such as Lichtblick have announced that they will reinvest their profits in new capacity, but they have not achieved break-even yet. (2) The effect of green power marketing cannot only be measured in terms of new megawatts, as it also causes learning effects for customers and suppliers. These additional benefits are harder to quantify, but may provide for positive feedback loops with regard to future energy policy decisions (Markard and Truffer, Forthcoming).

5.2. Assessing future impact—"will customer demand ever matter in Germany?"

In order to gain a deeper understanding of possible future impacts of green power marketing on new capacity development, we have performed a scenario analysis for green power demand in the next 10 years. In terms of methodology, we have taken 2003 green power customer numbers, sales and market share as the starting point, and calculated 2013 numbers for a low growth and a high growth case. To simplify the analysis, we assumed that residential customers would account for all demand (while in fact we estimate their current share at 90%). For the *high growth case*, we assumed that customer numbers would continue to grow with the 28% annual growth rate that has characterised the German green power market in 2001 and 2002.[22] For the *low growth case*, we assumed a more pessimistic rate of 10% per annum. Compared to similar emerging sectors, these growth rate assumptions are not overly aggressive: Sales of Coop Naturaplan, the green marketing line of a major Swiss retailer, grew at 56% per annum in the first 9 years of its existence, from 21 million CHF in 1993 to more than 1100 million CHF in 2002.[23] In the same period, installed capacity in the German wind sector grew at an average 49% p.a.[24] We also compared our assumptions to forecasts of Datamonitor (2003), a leading market intelligence company in the UK. Their low and high growth scenarios imply annual growth of 16% and 54% annually for the 2003–2008 period. Since our forecasting period is twice as long, it seems justified to use lower growth rates. As a result, we expect green power customer numbers in Germany to grow from their current level of 490,000 to between 1.27 and 5.87 million over the next decade, which would represent an increase from 1.3% in 2003 to 3.3% and 15.2% of all households in 2013, respectively. Compared to the Netherlands, where the market share is approaching 30% today, this seems rather conservative, although the tax exemption for green power is an important supporting factor there. Assuming that average sales per customer remain about the same as today, total green power sales would then amount to between 4470 and 20345 TWh, respectively (see Table 4).

What do these figures tell us about the *relative importance of green power marketing* in supporting renewables? The official government targets for 2010 and 2020 require 6% annual growth in the 2003–2010 period and 5% annual growth thereafter. This implies renewable electricity generation of 84 TWh in 2013. If our scenarios hold, green power demand would represent 5.3% and 24.2% of this number, respectively. In the high growth case, 1 out of 4 kWh would then be sold to green power customers.

The *capacity impact* is dependent on product design. If green power marketers simply repackage existing renewables, then new capacity will only be achieved after demand exceeds existing supply. As our calculation shows, this will probably not happen in Germany by 2013. However, customers will only buy green power if their purchasing decision makes a meaningful difference, i.e. if marketers invest in new capacity. Also, ecolabelling schemes for green electricity demand a minimum share of new capacity to be included in the

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[22] Twenty-eight per cent was the average growth rate in customer numbers for all national green power marketers, based on 2002/2001 and 2003/2002 growth rates. Since different marketers were more or less successful, growth rates in this period ranged from slightly negative in the case of some incumbent utilities to more than 100% for the most successful marketer.

[23] Own calculation based on data provided by Coop (2003).

[24] Own calculation based on DEWI (2003) data.

Table 4
Scenarios for green power demand in Germany in 2013 (low and high growth)

Year	Assumed growth rate p.a. (%)	Customer number	Market share (%)[a]	Green power sales (GWh)	Total renewable electricity generation (GWh)[b]	Green power demand as % of supply	Green power marketing capacity impact (%)[c]
2003		490,000	1.3	1723	48,311	3.6	ca. 1–3
2013 Low growth	10	1,270,934	3.3	4470	84,091	5.3	10
2013 High growth	28	5,784,899	15.2	20,345	84,091	24.2	44

Source: Own calculations.
[a]Customer number relative to number of German households.
[b]2003: Own estimate based on 2002 data from BMU (2003). 2013: government target (linear extrapolation between 2010 and 2020 targets).
[c]In % of 2002 new capacity, 2003 figure own estimate based on our survey.

product.[25] If we assume that eco-labelling schemes would require 10% of kilowatt hours sold as green electricity in any given year to be new in the sense of originating from plants that have been built not more than 12 months ago, then 447 (2035) GWh would have to be supplied by new capacity in 2013 in the low (high) growth case. Based on current characteristics of wind energy in Germany, which had 1433 full load hours in 2002, this translates into demand for 312 or 1420 MW of new capacity in the year 2013. This equals 10% of 2002 new wind turbine capacity in Germany in the low growth case, and 44% in the high growth case.[26]

As a conclusion, under these assumptions, public policy (or cost competitiveness of renewables anyway) would still have to provide for the majority of capacity growth in Germany 10 years from now, but in the high growth scenario, green power marketing would come close to driving half the new capacity in 2013. Actors who share the assumptions behind the high growth scenario therefore have an interest to make sure that the green power market develops in a healthy way so that its contribution can be fully realised. Those who subscribe to the more pessimistic view will be confirmed in their standpoint that green power marketing remains a niche and that continuing on the public policy trajectory should have first priority.

We conclude our scenario discussion by pointing out some of the *limitations* of the work presented here:

- Looking at residential customers only is a significant simplification. Demand from non-residential has become an important driver for green power demand in other countries like the US.[27]
- Adoption rates might be lower than in the organic food and wind turbine cases. We included a substantial discount to these growth rates, but more pessimistic diffusion curves are conceivable.
- Successful diffusion will only take place in the presence of sustained marketing. If important players turn out to be unwilling or unable to develop successful green power marketing strategies, growth rates will decrease.
- Green power marketing is not independent of regulation. Unfavourable regulation might lead to illiquidity of the market, resulting in lower growth rates.
- Eco-labelling criteria have a key influence on capacity impacts of green power products. How a 10% share of new capacity per year impacts the economics of green power products needs to be analysed in more detail.
- More thinking needs to go into understanding how mandated demand due to the EEG purchase obligation vs. "voluntary" market demand from green power marketers would co-exist in 2013.
- We treated demand and supply on an entirely national level. Further research needs to understand how the international perspective will change the picture.
- Looking at the next decade may not provide the full picture. Even if government targets are met, 87.5% of electricity will be generated from fossil and nuclear sources in 2010. Achieving a sustainable energy supply remains a challenging venture which will need continued societal support over several parliamentary terms to come, so an instrument that does not become dominant by 2013 might still make a positive contribution to promoting renewables.

[25]For example 33% from less than 6-year-old plants in the case of OK-power.

[26]New wind turbine capacity was 3247 MW in 2002. Comparing 2013 demand data to 2002 supply data here may seem inaccurate; however, this turns out to be a useful proxy for new capacity going forward. If we go back to the extrapolation between 2010 and 2020 government targets, they imply annual growth of about 4 TWh in renewable electricity generation throughout that decade. Based on typical German wind energy characteristics, this translates into 2794 MW of new capacity that would be required each year in the 2010–2020 period.

[27]Sales to non-residential customers represented 26% of US green power sales in 2002 (Bird and Swezey, 2003).

5.3. Indirect benefits of green power marketing: leveraging private marketing euros for the public good

Up to now, we assessed the impact of public policy and green power marketing using the same yardstick: new capacity. However, green power marketing includes a multidimensional set of objectives and actors involved, so it also provides indirect benefits that cannot be measured in megawatts.

A key driver for the emergence of the green power market is the desire of marketers to establish product differentiation. Even if we conclude that public policy has been and will continue to be an effective driver for renewable electricity generation in Germany, this desire is not going to go away.[28] Contributing to healthy development of the green power market therefore provides an opportunity for stakeholders to influence where energy companies put their marketing efforts. In monetary terms, we are talking about more than 100 million Euro annually that German energy companies spend on advertising since 1999, with 2002 spendings reaching 119 million Euro.[29] E.On alone has spent 59.4 million Euro on advertising in 2001,[30] and reportedly more than a third of this amount was directly related to the ''Mix it'' campaign featuring Arnold Schwarzenegger, advertising a product that suggested to consumers that they could determine their individual power generation mix. Following heavy criticism from consumer organisations and an injunction suit from one of their competitors, E.On had to withdraw Mix Power from the market after gaining only a few thousand customers. If E.On and green electricity stakeholders had found ways to combine their expertise early in the product design process, this failure could probably have been avoided, saving E.On a lot of money and increasing the market share of green power. The campaigns of companies like Green Mountain Energy, a pioneer in US green power marketing, as well as Nuon and Essent, two large Dutch utilities, provide more positive and insightful examples of green power marketing (Wüstenhagen, 2000), while being comparable to E.On in terms of marketing spendings.

In contrast, the means that are available to public policy institutions for consumer education are much more limited. As an example, the communication budget of the German Federal Ministry of the Environment was just 6 million Euros in 2002,[31] which is only 5% of what private energy companies have spent on advertising in the same year. Hence not influencing power marketing strategies might be a missed opportunity for renewable energy stakeholders to leverage private marketing Euros for the public good, i.e. to educate consumers about the benefits of renewables.

[28] We should note that this assumes that there continues to be a liberalised retail market for electricity. If the European Union falls apart or other similar factors lead to reversing the current regulatory environment, then there will in fact be no more need for differentiation. We leave it up to the reader to assess the probability of this happening.

[29] *Source*: Nielsen Media Research GmbH.

[30] http://www.bauermedia.com/pdf/service/medien_trends_2001_4.pdf.

6. Conclusions and implications for other countries

Germany has been very successful in increasing the share of renewable electricity over the past decade, and this has largely been achieved by effective public policy. Within the public policy mix, the feed-in system was most significant. Demand from green power customers has also started to pick up, but impact on new capacity so far has been limited.

In terms of lessons learned, we conclude by proposing a number of facilitating factors that helped the policy process in Germany, followed by recommendations for designing renewable energy policies and markets. In terms of *facilitating factors*, we would argue that the German model has been brought about by:

- *A strong central government and a political culture that is open to government intervention*: The German feed-in system was initially designed by a coalition of conservatives, greens and a few social democrats, and was developed further under a red-green government. We propose that in a country with a liberal government that focuses on customer choice and takes a laissez-faire attitude towards environmental issues, as well as in a system with more decentralised power through strong regional governments or referenda, the introduction of a mandatory nation-wide feed-in system will face more difficulties. In a cultural environment that puts higher emphasis on economic efficiency and trading, such as the UK, the apparent effectiveness of the German scheme may not be sufficient to overcome criticism about potential inefficiencies on the way, and quota systems or RPS schemes may have a better cultural fit.
- *A critical mass of interest groups in favour of renewables*: Interest groups will only support renewable energy policy when there is something to gain for them. As in any emerging industry, a scattered group of innovative players will always face well-organised opposition from incumbents. It is therefore important to stress common grounds and form broad coalitions early on (as in the case of the wind and small hydro collaboration in Germany 1990) rather than getting caught up in intra-industry struggles between the different renewable technologies.

[31] http://www.bundesfinanzministerium.de/bundeshaushalt2003/pdf/ep16/hha160254301.pdf.

- *A critical mass of politicians with momentum and expertise about renewable energy*: Especially in the case of EEG and the EEG amendment of 2004, developing renewable energy policy required both momentum and expertise. Small flaws in the regulation can lead to the collapse of early markets. Therefore, a critical mass of parliamentarians or members of the administration who understand the issues of renewable energy policy are a necessary prerequisite to formulate effective policies.

If these three facilitating factors are sufficiently fulfilled, a country should be able to transfer lessons from the German system. In order to do so successfully, the following *recommendations* should be considered in designing renewable energy policies and markets:

- *The critical role of parliament*: As the German example has shown, the electric utility industry and the federal Ministry of Economics have vested interests and can typically not be expected to be driving forces behind renewable energy legislation. Rather, members of parliament have taken the initiative, recently seconded by the federal Ministry of the Environment.[32]
- *Forming inter-party coalitions*: The German example has shown that support for renewable energy cuts across traditional political camps. Therefore, even in the absence of a particularly environmentally minded government, majorities can be found by combining groups from the conservative (typically small hydro and biomass) and progressive (typically wind and solar) ends of the spectrum.
- *Careful burden sharing*: As any policy measure, the feed-in system has costs and benefits. Distributing costs widely among a disperse group of people was a success factor, while over time beneficiaries have been able to create a visible lobby. Funding feed-in tariffs through people's electricity bills rather than through a government budget contributed to the resilience of this system in times of constrained public finances. Finally, the nationwide settlement system for burden sharing among utilities was decisive in overcoming resistance against continued growth of renewables.
- *Market liberalisation creates a window of opportunity*: When the German power market was deregulated in 1998, temporary price reductions left some room for compensation of renewable generators. The changing rules of the game also led to the dissolution of existing power camps, enabling new coalitions, and weakening the homogeneity of established associations. This was particularly relevant in the policy discourse around the EEG in 2000.

[32]Similarly, on a local level, parliamentarians through their influence on municipal utilities have had a positive influence on promoting renewables.

- *Leaving room for customer demand to play its role*: Even in a country with strong public policy support, there will always be customers who are ready to do their bit in achieving renewable energy targets more quickly or beyond government targets. Given the size of the sustainability challenge in the energy sector, it is important to enable this demand to unfold. Carefully designed eco-labelling schemes are key, and co-operation between renewable energy stakeholders and the marketing departments of energy providers can help to leverage private euros for the public good.
- *A piece of luck*: Despite the fact that looking back, the German success story reads well for renewable energy supporters, we pointed out that the starting point, the adoption of the StrEG under the conservative-liberal government in 1990, was almost accidental, and that there were also several turning points, especially in 1998 and 2002, where it was unclear whether renewable energy growth would continue as smoothly.

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