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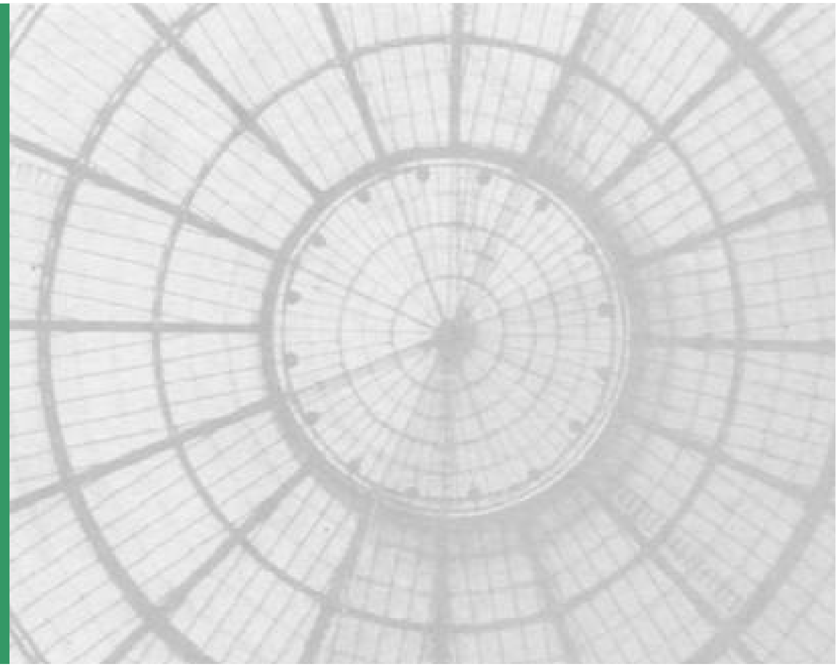

Green Energy Market Development in Germany:

Effective Public Policy and Emerging Customer Demand

Rolf Wüstenhagen and Michael Bilharz

IWOe Discussion Paper No. 111

June 2004

ISBN Nr. 3-909502-07-5

University of St. Gallen
Institute for Economy and the Environment (IWOe-HSG)
Tigerbergstrasse 2
CH-9000 St. Gallen, Switzerland

Tel. +41-71-224 25 87
Fax +41-71-224 27 22

http://www.iwoe.unisg.ch
E-Mail: rolf.wuestenhagen@unisg.ch

Abstract

Achieving a socially desirable goal such as increasing the use of renewable energy is usually considered as a public policy issue. In addition to public policy, however, green marketing responding to customer demand has been an important driver in "greening" other industries, e.g. in the case of organic food. This paper reviews the development of renewable energy in Germany from the 1970s until 2003, including the evolution of public opinion, energy policy, industry development and technological change. It particularly investigates the relative importance of energy policy and green power marketing in growing the German market for renewable energy. More than a decade of consistent policy support for renewables under the feed-in law (StrEG) and its successor (EEG) has been a very 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 in Germany 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, Germany, Energy Policy, Feed-in Law,
Green Power Marketing, Eco-Labelling.

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1 Introduction[1]

1.1 Background

The share of renewable energy as a proportion of total German electricity generation has doubled from 4 % to 8 % within the past decade. With this figure, Germany still ranks relatively low in terms of the total share of renewables, which is higher in countries with large hydropower resources like Norway (99 %), Austria (70 %) and Switzerland (60 %). Also, Germany is still far from a sustainable electricity supply, relying heavily on coal (50 %) and nuclear (28 %). No other country has, however, been successful in growing new capacity as quickly as Germany, particularly in the wind sector where Germany accounts for 39 % of worldwide installed capacity, and 55 % of the incremental capacity installed worldwide in 2002.[2] Therefore, Germany can be considered as an interesting success story for renewable energy development. This paper aims at understanding the drivers and dynamics behind this growth, which may also help other countries to design successful policies for developing markets for green energy.

While growth of renewable energy in Germany can justifiably be portrayed as a policy success story, we will take a closer look at the complex set of factors that has influenced development over the past decades. In particular, we analyze the emergence of a domestic renewable energy industry, innovative coalitions across political parties, available renewable resources, and customer demand for green electricity as factors that may have had a positive influence on market development. After providing a basic overview of events that have led to the current market situation, we will investigate two of these factors in detail, namely the prime public policy instruments driving green energy supply – which are the Renewable Energy Law (EEG) and its predecessor, the Feed-in Law (StrEG) – and green power marketing as a concept to increase demand. We will also take a closer look at interdependencies between public policy and marketing, and finally draw conclusions for other countries that are in the process of designing their renewable energy policies.

[1] The research behind this paper was funded by the Research Council of Norway under the project "Green Electricity for Sustainable Energy Development: A Comparative Analysis of European and U.S. Experiences and implications for Norway". The German case study described here was conducted under a subcontract to CICERO within the framework of the international project. The authors wish to acknowledge the support from the CICERO team, particularly Lin Gan as the project manager, as well as very valuable comments from the following external reviewers: Lori Bird, Veit Bürger, Ed Holt, Ruth Kile, Gero Lücking, and Ryan Wiser. All remaining errors are the sole responsibility of the authors.

[2] AWEA 2003

1.2 Methodology

This paper is mainly based on a review of existing literature on renewable energy policy in Germany between 1973 and 2003, including both academic literature and policy documents. In order to understand the quantitative fundamentals of both supply and demand for renewable electricity, we have reviewed available data and 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 (chapter 4), 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 in the renewable energy policy making process. This included asking for those people and institutions that have had a decisive influence on the legislative process for StrEG, EEG and the upcoming EEG amendment; for the most disputed issues in drafting these laws; and for the importance of public opinion. The questionnaire also included a section about the role of green power marketing and eco-labelling[3]. For an in-depth analysis of green power marketing (chapter 5), we have surveyed all the 16 marketers currently offering green power products nationwide across Germany, thus gathering information about products offered, development of customer numbers, electricity sales, and new capacity created as a 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 that we have compiled here provides interesting insights about market development.

[3] 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).

2 Background: Understanding the German Renewable Energy Trajectory

2.1 Historical development of public opinion

The discussion on sustainable electricity in Germany can be traced back to the early 1970s. The oil crisis in 1973 led to an emphasis on reducing dependence on energy imports (Hauschildt and Pulczynski n.d.). In 1974, the controversy on nuclear energy reached its first peak when civil society organisations campaigned heavily against a planned nuclear power plant in Wyhl (South-western Germany). One of the consequences of this controversy was the foundation of Öko-Institut (Institute for Applied Ecology) in Freiburg, which today is one of the leading think-tanks for sustainable energy in Germany. In 1980, a group of scientists from Öko-Institut published a book featuring alternative energy scenarios.[4] The formation of the Green Party, which has been part of the federal government since 1998, also had its roots in the anti-nuclear movement of the 1970s. The nuclear debate was followed by a discourse on *Waldsterben* (environmental damages to forests) in the 1980s, which again highlighted the undesirable consequences of traditional forms of power generation. However, most of these early discourses on alternative energy focused on energy conservation rather than renewable energy sources. In 1986, the Chernobyl nuclear accident was another important trigger for seeking new ways of power generation.

In 1988, Hermann Scheer, a social democrat and Member of the German Parliament, initiated the foundation of Eurosolar, as a non-profit European Association for Renewable Energy. Eurosolar was one of the first organisations to actively promote the total replacement of nuclear and fossil energies with renewable energy sources, and Hermann Scheer, together with other Members of Parliament, became a key player in designing renewable energy support policies in Germany, such as the Feed-in Law that became effective in January 1991.[5]

The UN Conference on Environment and Development at Rio in 1992, which saw the adoption of the UN Framework Convention on Climate Change[6], followed by the Kyoto Protocol in December 1997 marked another important step in the development of the renewable energy discourse in Germany. Since the Rio summit, concern about climate

[4] Krause et al. 1980

[5] See chapter 4 below.

[6] http://unfccc.int/

change has become a new important driver for promoting renewables. In the context of its Kyoto commitments, the German government has passed legislation[7] that explicitly aims at achieving the European Union target to double the share of renewable energy by 2010, which is an important foundation for consistent support policies.

The changing public opinion on renewable energy is reflected in public perception of different energy sources. These perceptions have been analyzed within a large representative survey that has been carried out in Germany six times between 1984 and 2003.[8] As Figure 1 shows, 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, from just 16 % in 1987 to 46 % in 2003. Nuclear energy, in contrast, used to be seen as an important energy source of the future by a majority of Germans until 1991, but has lost popularity throughout the 1990s. Following a slight rebound, possibly due to increasing concerns on climate change caused by fossil power generation, 42 % of Germans attribute an important future role to nuclear energy in 2003, which is, for the first time, less than for wind energy. Consistent with other surveys, solar energy seems to be the most attractive energy source in public opinion. 52 % of Germans expect solar energy to play an important role in the energy supply of the next 20-30 years.[9]

The survey also reveals a number of other interesting aspects about public opinion in Germany regarding renewable energy. First, the importance that people attach to renewable energy is strongly dependent on their age. While an average of 45 % think that renewables will make a key contribution to future energy supply, this view is shared by 57 % of Germans below 30 years old, 42 % of 45-59 year-olds and only 36 % of over 60 year-olds. On the other hand, an average of 41 % think that they will continue to cover only a small portion of the energy needs.

Second, 55 % of the population says that they know that wind energy is being subsidized, while only 46-48 % think that coal is being subsidized. In fact, coal receives more than twice the level of support. Hard coal subsidies alone were 3.99 billion Euro of tax money in 2001, while mandated support for renewable energy was 1.54 billion Euro in that same year, [10] notably not from government sources but paid by all electricity

[7] Section 1 of the Renewable Energy Law (EEG), BMU (2000)

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

[9] 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 %), hydro power (36 %), oil (34 %), electricity imports (17 %), coal (15 %), other (1 %), don't know (4 %).

[10] Bundesregierung (2002), p. 7

consumers through an average increase in electricity prices of about 0.25 Cent/kWh. Future support for renewable energies is widely accepted – 14 % think that subsidies should be reduced, 49 % think they should continue at current levels, and 47 % think that public support for renewables should be increased. Even 42 % of the voters of the conservative parties (CDU/CSU) and 38 % of liberals (FDP) are in favour of the idea of increasing public support for renewables.

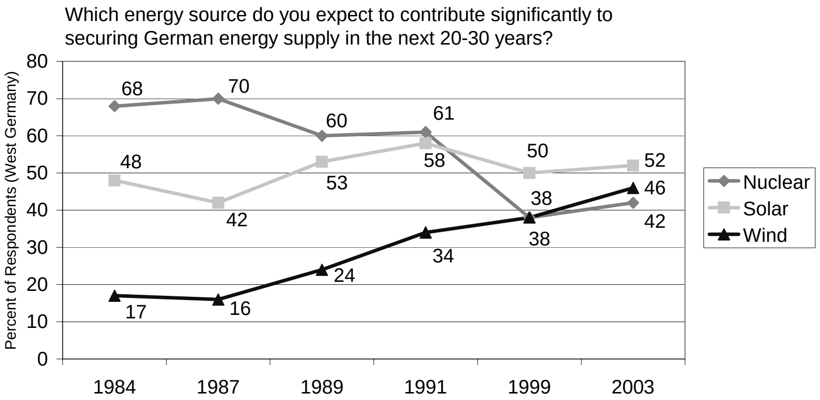

Figure 1: Public Opinion in Germany has shifted in favour of renewable energy[11]

Thirdly, in the 2003 survey, 61 % thought that the government's decision to phase out nuclear energy was correct. In 2000, only 46 % thought that it was right, 31 % wrong, and 23 % were undecided.

2.2 Technology change and industrial development

The developments in public opinion described above were accompanied by technological change and the emergence of a renewable energy industry in Germany. This section will focus on wind turbine technology as this is the sector in which most of the growth has taken place.

The development of wind turbines has two very different roots in Germany.[12] On one hand, there was a top-down approach by government, and established research and

[11] There is some inconsistency in the 1999 and 2003 data that is included in BPA's summary. We used the data from table 5 in the confidential original report from Institut für Demoskopie Allensbach for Figure 1.

[12] Durstewitz et al (1999)

industry players that was aimed at building a very large wind turbine from scratch. This eventually failed. On the other hand, several smaller players started off building small turbines in a bottom-up approach, then gradually increasing size and finally becoming commercially very successful.

Probably the highest-profile German wind turbine technology R&D project in the late 1970s and early 1980s was the GROWIAN (Large Wind Energy Converter). The GROWIAN project was initiated in 1976 by experts meeting at the Nuclear Research Centre Jülich.[13] The project was supported by the German federal Ministry of Research, with total costs of about 30 million Euro.[14] The project promoters' ambition was to build the largest wind turbine in the world. It was decided to aim at a rated power output of 3 MW, which was huge compared to typical 30-50 kW serial production turbines available at the time. The design of the plant started in 1977, and construction began in 1980. While GROWIAN was officially inaugurated in 1982, the construction phase continued until February 1987. In May of the same year, the wind turbine was decommissioned after only 420 hours of operation. The plant was eventually dismantled in 1988. The plant had faced a number of technical problems that were caused by over-ambitious specifications made by politicians.[15] It turned out that a more successful approach for development of wind turbines was to gradually increase turbine size. Not surprisingly, the failure of GROWIAN was interpreted differently by supporters and opponents of wind energy. While supporters pointed to poor design and lack of commercial discipline as main reasons for failure, traditional utilities saw it as confirming their sceptical attitude towards alternative energy sources.[16]

A more successful approach to wind turbine development, although much less visible in the beginning, has been pursued by several small new entrants. More than a dozen firms entered the wind turbine sector in the mid 1980s, experimenting mainly with smaller wind turbines. The initial market success was somewhat limited, with only 20 MW of installed capacity by 1989. One significant feature of technology development was the increase in turbine size. Starting from 10-50 kW in the 1980s, the average size of newly installed turbines increased to 182 kW in 1992 thanks to the introduction of the 300-500 kW class in Europe,[17] and finally reached over 1500 kW in the first half-year of

[13] Pulczynski (1991), Hauschildt and Pulczynski (n.d.)

[14] Hoppe-Klipper (2003)

[15] For example, the request to realize a rotor that exceeded the symbolic size of 100 m diameter caused various material problems, which in the end led to a rotor weight of 420 tons, 50 % more than originally planned.

[16] Interviews led by Pulczynski (1991), pp. 42 and 86 f., reveal that at the time enthusiasm about wind energy was rather limited among the utilities who were involved in the project.

[17] Durstewitz et al. (1999)

2003.[18] While some of the new entrants from the early days of the German wind turbine industries are still active as independent players, others have been sold or merged during the recent industry consolidation. The most prominent independent player is still market leader Enercon, a privately-held company founded in 1984 that accounted for 34 % of all new installations in 2002. Among those who have been subject to consolidation are Tacke (acquired by Enron, now GE Wind), Jacobs and Husumer Schiffswerft (merged to REpower), and DeWind (acquired by FKI plc).

The latest shift in wind turbine technology development is a move towards offshore turbines. Many manufacturers are currently experimenting with turbines in the 2 to 5 MW range in order to supply offshore projects. Most of these large turbines are still under development, and first prototypes are being tested at onshore locations. Commercial offshore projects in the North Sea are expected to be completed towards the end of the decade.

The renewable energy industry provides significant employment opportunities. In the review report to the Renewable Energy Law (EEG), the German government estimates the total employment effects at 120'000 jobs in 2001. [19] This can be broken down into 35'000 jobs in the wind industry (of which 4'700 are direct jobs), 40'000 direct and indirect jobs in the biomass sector, 5'000 for PV, and 2'000 for hydro.

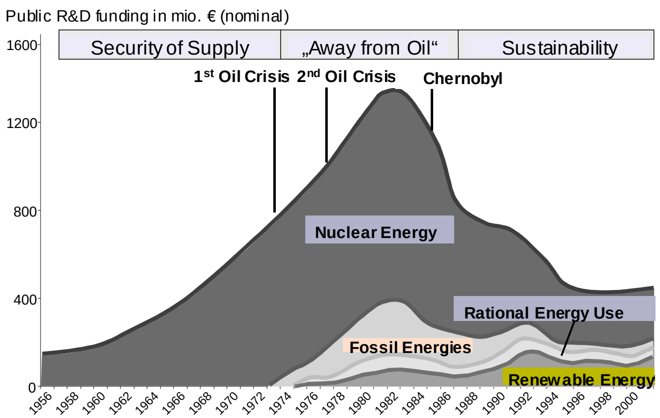

Figure 2: German energy R&D funding slowly shifting towards renewables (Source: Winje 2003)

[18] BWE (2003)

[19] Bundesregierung (2002), p. 5. This figure includes solar thermal collectors.

In terms of research and development, the government has clearly not been leading the way towards the success of renewable energy in Germany. As Figure 2 shows, public R&D funding has been focussed on nuclear energy throughout the last 50 years. After the oil crises in the 1970s, R&D funding became more diversified, also addressing efficient technologies for using fossil energies, rational use of energy on the demand side, and renewable energy. However, it took until the 1990s before renewable energy became a substantial target of public R&D funding, and even in 2001, 80 % more government money went into nuclear energy research than into renewables.

2.3 Structure of the electricity sector

The structure of the electricity sector is another important background variable for understanding developments in the German green energy market. 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 in 1998, there were about 1000 electric utilities, 8 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, including a large number of municipal utilities. Municipal 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, which opened them to political influence by local parliaments. An example for such political influence was the emergence of local feed-in tariffs for solar energy in several German communities 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 finally caused a wave of mergers and acquisitions. Within a few years, the number of large players in the German market were halved from eight to four, namely RWE, E.On, Vattenfall Europe and EnBW (majority-owned by EdF). The large utilities have not only increased in size, but also become horizontally diversified by acquiring gas companies. On the regional and local level, there were several mergers between local utilities as well as acquisitions by the four major companies. A number of new players had entered the market after 1998, but most of them have withdrawn due to strong market power of the incumbents and continued absence of a strong regulatory authority. Only a small number of green electricity marketers remain after 5 years of a deregulated market. On the customer side, switching rates have remained low. Only 3.7 % of residential customers had changed suppliers between 1998 and 2001.[20] It remains to be seen whether the announced introduction of a market regulator in 2004[21] will lead to a revival of true competition in the German electricity market.

With regard to the **power generation mix**, Germany relies heavily on coal and nuclear, accounting for 50.6 % and 28.3 % of electricity production respectively in 2002.[22] Natural gas contributes 9.3 % and renewables just under 8 % of electricity generation. Following negotiations between the government and the electricity industry that led to a "nuclear consensus" on June 11, 2001, the federal parliament passed a law in 2002 that phases out nuclear energy over the next two decades. Not taking replacement of existing coal plants into account, this alone means that 22'000 MW of power generation capacity will be retired by 2025, and almost 30 % of today's generation capacity will need to be replaced. At the same time, climate protection targets must be considered.[23] 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 first started in the 1970s. The federal government's framework programme for energy research (1974-1977) aimed at exploring the opportunities for new energy sources.[24] The GROWIAN wind project mentioned above was an indirect consequence of this research programme. Following the failure of this large-scale project, support was concentrated on smaller wind turbines (up to 250 kW) in a programme running from 1986-1988. This was followed by the first "100 MW wind" programme in 1989, providing an incentive of 3 Cent/kWh to wind energy generators. 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. This programme helped to create a unique database on operating behaviour of wind turbines in Germany.[25] Also in 1991, the Feed-in Law (StrEG) came into effect, introducing fixed tariffs for generation of renewable electricity which were tied to the market price of electricity.[26] The introduction of the StrEG marked a shift in support policies from R&D funding to incentives targeting actual generation of renewable

[20] Öko-Institut (2003)

[21] BMWA (2004)

[22] Source: AG Energiebilanzen

[23] UBA (2003)

[24] Pulczynski (1991), p. 36 f.

[25] Hoppe-Klipper (2003), p. 49

[26] For PV and wind, the feed-in tariff was 90 % of the average retail price for electricity (ca. 8.5 Cent/kWh), while it was 80 % for hydropower and other renewables.

energy. The system of guaranteed long-term prices also helped to minimize the commercial risk for operators of wind turbines. This planning security was key to the successful market penetration of wind energy in Germany.[27] In addition to the feed-in tariffs, 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.[28] The stop-and-go element in many of these support policies, however, meant that none of them was equally effective as the StrEG.

Following the 1998 federal elections, a new government was formed by the Social Democrats and the Green Party. The new coalition introduced new support schemes, including a 100'000 roof-programme for solar energy (1999-2003). Photovoltaics had not previously received sufficient support to make it commercially viable. The attractive debt finance available under this programme changed this, particularly in combination with the new Renewable Energy Act (EEG) that came into effect in 2000 as a follow-up to the previous Feed-in law (StrEG). These two pieces of legislation have been key for the development of renewable energy in Germany, and as such, they will be discussed in more detail in chapter 4 below.

It is a remarkable feature of the German energy policy framework that market deregulation almost coincided with new regulation to support renewable energy. One of the results of this fortunate timing was that the 0.25 ct/kWh burden caused by the EEG to refinance the feed-in tariffs was hardly felt by consumers as it came at a time when market prices for electricity decreased much more substantially.

At the same time, market liberalisation led to the emergence of new, specialized green power marketers as well as new green power products offered by incumbent utilities, so that customers could now choose the way that their electricity was generated (see chapter 5).

[27] Hoppe-Klipper (2003), p. 165

[28] Grotz (2002), Hoppe-Klipper (2003), p. 77ff.

3 Renewable Energy Generation in Germany: Status and Perspectives

The previous chapter provided an overview of key events that influenced the development of renewable energy in Germany. Before exploring the causal relationships that explain this development (see chapters 4 and 5), this chapter presents the facts in terms of new capacity and energy generated based on renewables, as well as the economic implications of this.[29] This chapter will focus on the supply side of the market (electricity generation). This is because demand for renewable energy has only a short history in Germany, and therefore rather than including a separate chapter we will discuss the data on green energy demand in the chapter on green power marketing below. Historic and current data will be complemented by estimates of future potential.

3.1 Wind Power

In 2002, installed capacity for wind power in Germany exceeded 12'000 MW.[30] This represented about half of all capacity in Europe and more than one third of installed capacity worldwide. Starting from only 27 MW installed capacity in 1989,[31] German wind power has grown at a 59.8 % compound annual growth rate for 13 consecutive years (see Figure 3). About 17.2 TWh of electricity were generated by wind turbines in Germany in 2002, representing 3 % of German electricity consumption.[32] In Germany's northern-most state, Schleswig-Holstein, wind energy accounted for more than 25 % of electricity consumption in 2002.[33] Industry revenues reached 3.3 billion Euro in 2002.[34] The average cost of wind power generation in Germany dropped by about 30 % between 1990 and 2000.[35] Investment cost per kW installed capacity has remained more or less constant since 1996, at about 1200 Euro/kW including grid connection and other costs (900 Euro/kW for the wind energy converter alone).[36] At the same time, total cost of wind power generation has decreased from 5.2 Cent/kWh to 4.8 Cent/kWh between

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

[30] BWE (2003)

[31] BWE (2003), http://wind-energie.de/informationen/zahlen-zur-windenergie/deutschland-in-zahlen.htm

[32] BMU (2003b)

[33] BWE, Press Release, 08.04.2003, http://wind-energie.de/aktuelles-und-aktivitaeten/presse/2003-04-08-pm.htm

[34] BMU (2003b)

[35] Bundesregierung (2002), p. 17

[36] Bundesregierung (2002)

1998 and 2001 according to a survey of 400 operating wind projects by DEWI (2002).[37] It is important to note however, that the cost of wind power generation is dependent on site specifics. Moving from a good wind site with 3000 hours of full load operation per year to a poorer site with only 1500 hours (which is representative for large parts of Southern Germany), costs will increase to about 11-12 Cent/kWh.[38]

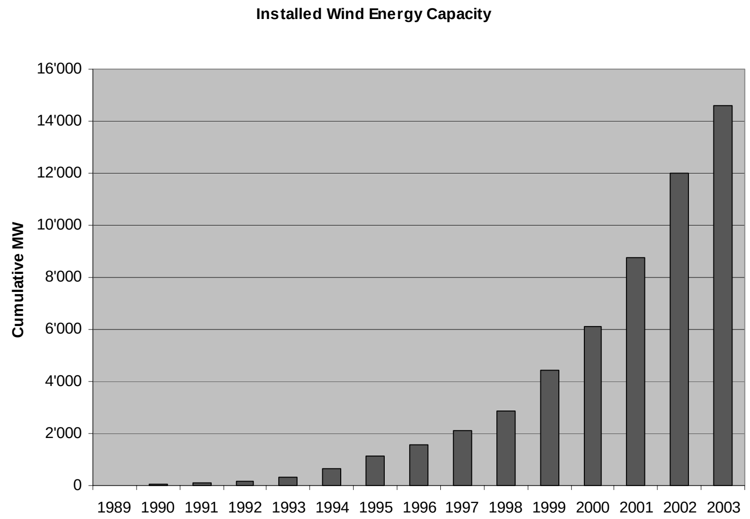

Figure 3: Cumulative installed wind energy capacity in Germany 1989-2003 (Source: BWE 2003)

3.2 Hydropower

Hydropower accounts for about 4 % of electricity consumption in Germany (24'000 GWh in 2002). Annual revenues of the hydropower industry (including turbine manufacturing, planning, project development, construction and operation) are about 220 million Euro. Seasonal fluctuation aside, growth has been relatively limited in recent years. While the number of large hydropower plants has been stable over the last decades, about 50'000 small hydro power plants (< 5 MW) have been decommissioned in Germany throughout the 20th century. Introduction of the feed-in law in 1991 has reversed that trend. Since then, the number of small hydro plants has increased again from 4'600 to about 6'000, producing 4'200 GWh in 2001.

[37] BWE (2003), http://www.wind-energie.de/images/zahlen/kosten.gif

Average electricity generation cost is competitive for large hydropower, while small hydropower plants generate electricity at between 6 Cent/kWh (5 MW) and more than 15 Cent/kWh for very small plants (< 250 kW). Re-activating decommissioned plants is often substantially cheaper (up to 70 % lower cost). Cost reductions similar to some of the newer renewable technologies are not expected in the case of hydropower, and meeting environmental regulations may even increase cost. Refurbishment of existing hydropower plants with careful environmental impact management therefore looks like the most promising option.

3.3 Biomass

With about 4'200 GWh, electricity generation from biomass accounted for just under 1 % of electricity consumption in Germany.[39] Because a variety of resources and technologies with varying environmental impacts can be used for biomass power generation, the German federal government has introduced a separate law on biomass[40] defining those resources that are eligible for support through the renewable energy law, excluding for example toxic wood waste. As a result of the new law, several players have announced plans to build new power plants using solid biomass. Identifying a continuous flow of resources within a useful geographical proximity is key for competitive operation of larger biomass plants (5-20 MW), which have recently been built by both the wood processing industry and electric utilities.

The cost of electricity generated from biomass varies widely from about 9-15 Cent/kWh for biogas and 7-18 Cent/kWh for wood waste. There are some economies of scale providing for lower cost in larger power plants; however there is a trade-off with increasing cost of fuel logistics and distribution of heat. Revenues in the biomass sector have been about 2.3 billion Euro in 2000.

3.4 Photovoltaics (PV)

Compared to hydropower, wind energy and biomass, PV has a much smaller market share in Germany, with about 176 GWh or 0.03 % of electricity consumption in 2002. However, growth rates have been very high at about 50 % annually throughout the past decade. In terms of installed capacity, Germany ranks 2nd behind Japan at the end of 2003 with about 350 MW. The total cost of a PV system has decreased from 15'339

[38] Bundesregierung (2002)

[39] BMU (2003b)

[40] BMU (2001)

Euro/kW$_p$ to 6'012 Euro/kW$_p$ between 1990 and 2000.[41] With an average 1'600 sun hours in Germany, this still results in an unsubsidized average cost of electricity generation of 0.63-0.84 Euro/kWh in 2001. Since only about half of the cost is for solar modules, and the other half for inverters, mounting, cabling etc., larger plants tend to have lower cost. Therefore, the average size of PV installations doubled to 5.1 kW$_p$ between 1999 and 2001, also indicating an increased activity of commercial PV operators.

3.5 Geothermal Energy

To date, geothermal energy has only been used for heat supply and not for electricity generation in Germany. The only exception is a small 250 kW$_e$ geothermal power plant that was inaugurated in the North-Eastern German region of Mecklenburg-Vorpommern in November 2003.[42] Eight pilot and demonstration plants between 1 MW$_e$ and 12 MW$_e$ are currently being planned, with financial support from the Ministries for Economic Affairs and the Environment. Apparently, feed-in tariffs available through the renewable energy act have not been sufficient to compensate for the risk associated with drilling for geothermal resources. In commercial plants, geothermal electricity generation is expected to be relatively cost competitive at 7-15 Cent/kWh,[43] with a technical potential that is comparable to PV and onshore wind energy, even if only sites with useful heat demand for cogeneration are taken into account.[44]

3.6 Summary for all Renewables and Outlook

Figure 4 summarizes the status of renewable electricity generation in Germany up to the year 2002. The diagram clearly shows the dynamic development in the wind energy sector throughout the past decade on top of a relatively stable share of supply from hydropower. Biomass has also seen an increase, especially since the biomass law was passed in 2001, and is now the third largest source of renewable electricity in Germany. Solar PV has strong growth rates, but is still only a minor contributor compared to the other renewables. 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 European neighbours. In economic terms, the renewable energy sector has become an important factor in Germany,

[41] Bundesregierung (2002), p. 10f.

[42] http://www.geothermie.de/ueb_seiten/ueb_neustadtglewe.htm

[43] BMU (2002), S. 74

[44] BMU (2003b)

providing for an estimated 130'000 direct and indirect jobs in 2001, and revenues of 8.2 billion Euro.[45]

With regard to the future potential of renewable energy, further growth is expected particularly in wind energy and photovoltaics. According to a study commissioned by the German Federal Ministry of the Environment and the Federal Environmental Agency, 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.[46] In terms of realizing this potential, the Federal Environmental Agency has investigated a Sustainability scenario which would put special emphasis on renewable energy and energy efficiency and aims at reducing CO_2 emissions by 80 % in 2050 compared to 1990 levels. With regard to electricity generation, this would result in a 63 % share of renewables, consisting of 46 % domestic generation and 17 % imports (mainly for hydrogen production).[47]

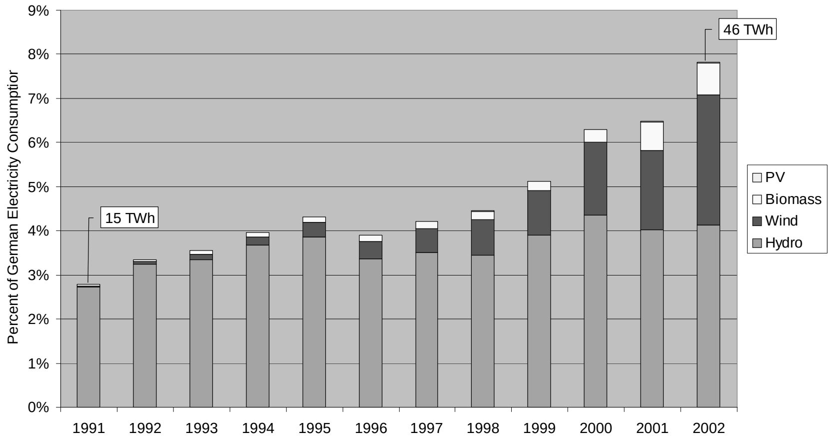

Figure 4: Electricity Generation from Renewables in Germany 1991-2002
(Source: BMU 2003b, AG Energiebilanzen 2003, own calculations)

[45] BMU (2003b). These figures include jobs and revenues in all renewable energy sectors, including electricity, heat and biofuels.

[46] DLR et al. (2000)

[47] UBA (2002), p.3

4 Promoting Renewables through Public Policy

4.1 Concept and Objectives of the German Feed-in Mechanism

As indicated in chapter 2.4 above, 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 currently under revision with regard to the EEG amendment of 2004 is really the key element of renewable energy policy in Germany. Therefore, this chapter will discuss this mechanism in more detail. The following chapter 4.2 will then focus on the policy process that has characterized the genesis of these laws.

Renewable energy support schemes can basically be divided into price- and quantity regimes. In **quantity regimes**, such as the UK renewables obligation or the Renewable Portfolio Standard in Texas, the regulator determines the amount of renewables that needs to be achieved and leaves it up to the market to determine the right price. In **price regimes**, such as the German feed-in tariff, the regulator determines the price ex ante, leaving the quantity of renewables that will be generated up to the market.

Price regimes that work in practice have three key features:[48]

- A purchase obligation for the local grid operator
- Compensation for renewable generators at guaranteed minimum prices (fixed for 20 years)
- A nationwide cost settlement system to balance out regional disparities

While the name feed-in tariff suggests that the fixed price is the key element of this kind of regulation, the first element, namely **the purchase obligation** is an important pre-requisite for the entire system to work. In the initial StrEG, which was introduced in the age of regional monopolies, this 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**, investment risk is effectively minimized, especially as these prices are fixed for a period of 20 years.[49] In Germany, the StrEG initially linked the compensation for renewable generators to avoided cost, taking average utility revenues

[48] cf. Madlener/Stagl (2001), p. 54f.

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

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. This compensation model has not eliminated the risk completely, and particularly became a concern when electricity prices started to erode in 1999 due to market liberalisation.[50] The EEG, therefore, has changed to a system with prices that are fixed in the law. While prices were relatively similar in the StrEG, the EEG has introduced stronger price differentiation by technology, reflecting current cost levels. Since renewable technologies are expected to become more mature and therefore cost-effective, the EEG also included a reduction of tariffs over time. In the draft EEG amendment of 2004, prices have been further differentiated in light of previous experiences with technology and market development. As an example, the Federal government in its 2002 review report on the EEG realized that no geothermal power generation project had come online despite the availability of feed-in tariffs.[51] Since a number of planned projects were smaller in size and had higher anticipated cost, new categories with higher tariffs for small-scale geothermal power generation were introduced. Similarly, compensation for (building-integrated) photovoltaics has been substantially increased due to the phasing out of the 100'000 roofs-program which had previously provided additional investment support. Several new details have been included to make sure that growth of renewables does not cause unintended environmental impact. For example, the list of eligible sources of biomass has been specified, and wind turbines will not receive funding on sites with poor wind resources. A new feature is the inclusion of large-scale hydropower. Refurbishment projects for hydropower plants between 5 and 150 MW will get funding under the amended EEG for the additional amount of electricity that they generate as a consequence of the efficiency improvement, provided that environmental impacts are minimized. Special provisions have also been made for offshore wind. To accommodate the higher risk of offshore installations, as well as delays in the ongoing planning processes, the government has decided to grant a higher support of 9.1 Cent/kWh for nine years for offshore wind projects going online before 2010. Afterwards, the feed-in tariff will be reduced to 6.19 Cent/kWh, which is still higher than the basic rate for onshore wind. A summary of feed-in tariffs paid under the three laws is provided in Table 1.

[50] Bechberger (2000), p. 9

[51] Bundesregierung (2002)

		StrEG	**EEG**			**EEG Am.**		
		Pre-1999[1]	2000-01	2002	2003	2004E	Annual Reduction	
			Cent/kWh				2002 ff.	2005 ff.
Hydropower	< 500 kW	6.5	7.67			9.67	0%	1%
	500 kW-5 MW		6.65			6.65		
	5-150 MW	0.0	0.0			3.7-7.67[2]	N/A	
Landfill Gas, Sewage Gas, Coal Mine Methane	< 500 kW	6.5	7.67			7.67-9.67	0%	1.5%
	500 kW-5 MW		6.65			6.65-8.65		
	> 5 MW[8]	0.0	0.0			6.65-8.65	N/A	
Biomass	< 150 kW	7.1	10.23	10.1	10.0	11.5-17.5	1%	1.5%
	< 500 kW					9.9-15.9		
	< 5 MW		9.21	9.1	9.01	8.9-12.9		
	> 5 MW[9]	0.0	8.7	8.6	8.51	8.4		
Geothermal	< 5 MW	N/A	8.95			15.0	0%	1%[3]
	< 10 MW					14.0		
	< 20 MW					8.95		
	> 20 MW		7.16			7.16		
Onshore Wind	< 5 years	8.2	9.1	9.0	8.87	0.0 or 8.7[4]	1.5%	2%
	> 5 years		6.19	6.1	6.01	0.0 or 5.5-8.7[4]		
Offshore Wind	< 9 years	N/A	9.1	9.0	8.87	9.1[5]	1.5%	2%[7]
	> 9 years		6.19	6.1	6.01	6.19[6]		
PV	stand-alone	8.2	50.62	48.1	45.7	45.7	5%	5%
	building-integr.					54.0-62.4		

[1]) Indicative numbers based on 1998 actual values.

[2]) Applies to refurbishment of existing hydropower plants, depending on size

[3]) Decrease starting 2010

[4]) No compensation paid for projects on poor wind sites (<60 % of average wind resource).

[5]) Applies for 12 years to offshore projects commissioned prior to 2010.

[6]) Applies for all other offshore projects.

[7]) Decrease starting 2008.

[8]) Coal-Bed Methane only.

[9]) Upper limit of 20 MW foreseen in draft EEG amendment 2004.

Table 1: Feed-in tariffs for renewable electricity generation in Germany 1991-2004,[52]
Source: based on Bundesregierung (2002), p. 4, Bundesregierung (2003), Bechberger (2000), p. 9, Bundestag (2004a), Bundestag (2004b).

[52] The tariffs apply to power generation facilities that have become operational in the given year.

An important change between the StrEG and the EEG referred to the beneficiaries of the feed-in tariffs. While under the StrEG, only small independent renewable energy generators were eligible for the guaranteed minimum prices, the EEG extended this to include electric utilities.

While the first two elements of a feed-in system, a purchase obligation and guaranteed prices, were effective in getting the renewable energy market started in the 1990s, increasing growth in some areas, particularly Northern Germany with good wind resources, 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 operator in the area where renewable electricity is generated 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.

With regard to the **objective** of the German feed-in system, this was not explicitly stated in the StrEG of 1990. Implicitly, the StrEG aimed at promoting renewable energy technologies, where small hydro and wind was the initial focus (see 4.2). The EEG of 2000 included an explicit paragraph stating that the purpose of the law was to "facilitate a sustainable development of energy supply in the interest of managing global warming and protecting the environment" (BMU 2000). To achieve this, the law aimed at 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." 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 government in December 2003 – also aims at:[53]

- Reducing the cost of energy supply to the national economy by internalizing external cost;[54]
- Contributing to avoiding geopolitical conflicts about fossil energy resources;
- Promoting development of renewable energy technologies; and

[53] Bundesregierung (2003)

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

- Increasing the share of renewable energy sources to at least 12.5 % of electricity supply by 2010 and at least 20 % by 2020.

It is apparent that renewable energy legislation in Germany has become more sophisticated over time both with regard to the support mechanisms applied as well as its defined objectives.

4.2 Drivers for policy development

After explaining the main concept and objectives of the German feed-in system, the following chapter looks at the policy development from a process perspective. The policy discourse is also examined, with an analysis of the important players, changing drivers and political coalitions behind the three pieces of legislation.

4.2.1 Feed-in law of 1991 (StrEG)

The initial feed-in law (StrEG) originated as the result of a broad coalition support across different political parties represented in the Federal parliament (Bundestag) at the time. According to the policy makers surveyed, the list of **promoters** spanned almost the entire political spectrum, including conservative members of parliament such as[55] Matthias Engelsberger (CSU) and Peter Carstensen (CDU), as well as representatives of the Green Party such as Wolfgang Daniels, who wanted to promote renewables with a focus on wind, and Hermann Scheer representing the Social Democrats (SPD). The Association of Small Hydro Generators, which had a strong foothold in the conservative South of Germany, including Bavaria and Baden-Württemberg, and had a natural interest in getting support for their members, 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), possibly because they might have seen support for renewables as an interventionist approach that did not conform to their political stance. Despite the fact that FDP was part of the governing conservative-liberal coalition together with CDU/CSU, the federal parliament unanimously[56] adopted the StrEG on October 5, 1990, so that it could come into force on January 1, 1991.

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), represented by their Managing Director, Joachim Grawe. Prior to the adoption of the StrEG, grid access

[55] We are listing individuals who have been named by at least two interviewees as being part of the ten most influencial actors. A full list of promoters would of course be longer than the examples mentioned here.

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

for renewable generators as well as their compensation was at the discretion of the industry and its associations under a voluntary agreement. Regulating this in a new law therefore represented a reduction of the influence of VDEW and the large utilities, and this, in part, explains their opposition. VDEW also argued with the high cost involved in supporting small hydro power plants.[57]

In terms of **issues** that played an important role in the policy formulation process, the two constituent elements of a feed-in system were also at the core of these early debates: clarifying grid access by introducing a purchase obligation for utilities, and determining a fair value for compensation of renewable electricity generation. With regard to compensation, the parliamentarians finally went for the 80/65/90 % of average revenue model described above as a pragmatic – yet somewhat arbitrary – compromise between the utilities' avoided variable cost as a lower limit and the full cost of small hydro or solar power generators as the upper end of the spectrum of possible solutions.

While conservative StrEG promoters had probably expected small hydro to be the main beneficiary, it soon became clear that the new law became particularly effective in promoting wind energy, simply because among all renewables, wind energy had the most competitive cost structure. The somewhat unexpected success of the law brought opponents back into the arena and led to an extensive discussion about hardship clauses. In the original law, utilities were exempt from their purchase obligation if this would have required them to raise prices significantly above the levels of similar utilities, as well as if providing grid access for a renewable generator was technically or legally not feasible. In its 1998 amendment, the hardship clause was specified to a twofold 5 % cap.[58] This meant that as soon as the share of renewables reaches 5 % in a utility's supply area in any given year, it can pass the additional cost on to the upstream grid operator. If renewables reach 5 % in the service area of a grid operator on the high voltage level, the respective utility is no longer obliged to purchase from and compensate renewable generators. The amended law also included an obligation for the legislator to find a new solution before the second 5 % cap was reached. 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.

[57] Bechberger 2000, p. 5

[58] cf. Bechberger (2000), p. 10 f.

In the meantime, following the federal elections in 1998, there was a change in government and the new coalition of Social Democrats and Green Party quickly recognized the need to improve the feed-in law, reinforced by the fact that the local monopoly utilities who were subject to the purchase obligation under the old StrEG had ceased to exist following formal liberalisation of the electricity market in April 1998. This is how the Renewable Energy Law (EEG) originated.

4.2.2 The Renewable Energy Law of 2000 (EEG)

The political process that led to the adoption of the EEG had a number of similarities, but also differences to the process leading to StrEG in 1990.[59] Similarly to 1990, a **parliamentary initiative** rather than the responsible ministry was a key catalyst for the relatively fast adoption of EEG. In their coalition agreement of October 1998, the governing parties declared as part of their commitment to "Ecological Modernisation" their will to promote renewable energy and energy efficiency to achieve a sustainable energy supply of the future. The agreement also makes reference to the goal of reducing CO_2 emissions by 25 % between 1990 and 2005, and the removal of barriers to an accelerated use of renewable energies and combined heat and power generation (CHP) through the amendment of energy legislation, securing grid access and fair cost allocation. It also explicitly mentions a 100'000 roof program for solar energy.

Following this agreement, the Ministry of Economic Affairs, responsible for energy, took the lead in 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 new government from the utility industry, for not taking a progressive lead on the issue. In parallel, renewable energy advocates from both the Green Party and the Social Democrats were making suggestions for an amended StrEG in early 1999.

After many discussions between energy experts from the Ministry and the coalition parties, including occasional debate about 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 feed-in tariff for photovoltaics. The Ministry of Economic Affairs had suggested only 25 Pf/kWh (12 Cent/kWh) in its first draft and completely dropped PV in its second draft, while the parliamentary proposal in December 1999 took up the solar associations' claim for 99 Pf/kWh (50.62 Cent/kWh).

The decision on PV was influenced by discussions in a related policy area, namely

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

ecological tax reform. A dispute arose between the coalition parties over a tax exemption for combined cycle gas power plants. Wolfgang Clement (SPD), at the time prime minister of North Rhine-Westphalia and later (2002) succeeding Werner Müller as Minister of Economics in the federal government, opposed the ecotax exemption for gas because he feared that this would lead to strong competition for domestic coal – with coal miners being a traditional voter group of social democrats in his home state. The federal government then adopted a compromise in November 1999, attaching high efficiency requirements and a very tight time limit to the tax exemption for natural gas. As this was a major defeat for the Green Party, their coalition partner offered, in exchange, to support a cost-based compensation for PV at 99 Pf/kWh, initially capped at 350 MW.

While a strong role of parliament versus the administration was a similarity in the genesis of StrEG, the clear difference was that there was **less of an all-party consensus** behind the policy making leading to EEG. With one small exception, a common press release in December 1999 involving energy policy experts from CDU, CSU, FDP, Green Party and SPD, the EEG was very much a project of the governing coalition with little influence by the opposition. 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. Some of the issues raised by the opposition were support levels for wind energy; general concern about the "interventionist" nature of the policy; and concerns about the impact on consumer prices for electricity. While it was eventually the governing coalition who pushed the EEG, there continued to be some support from conservatives, too. The Bundestag, the 1st chamber of the federal parliament, adopted the law in February 2000 with a clear majority of 328 to 217 votes. In the Bundesrat, the 2nd chamber, the state of Thuringia, which had a conservative government, also supported the EEG alongside the red-green[60] *Länder*, leading to another clear result (41 out of 69 votes) in March 2000. The EEG came into force on April 1st, 2000.

As the feed-in law had been surprisingly successful, 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. Interestingly, however, some representatives of these groups took a different standpoint. While, for example, BDI as the parent organisation of German industry opposed the law, the Association of the German Machinery Industry (VDMA), where some of the successful wind turbine manufacturers

60 "Red-green" refers to a coalition between the German Social Democrats (SPD) and the Green Party.

were members, supported the introduction of the EEG. Similarly, the major utilities such as RWE, Bayernwerk and EnBW were against the law, while in the parliamentary hearing in February 2000, there were apparent differences between the fundamental opposition from the RWE representative, Ulrich Beyer, and a more differentiated stance of the representative of Preussen Elektra[61], Wolf Hatje. Possibly as a consequence of 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. The key concern of the Association of German Industry (BDI), alongside large industrial energy consumers organised in the VIK, was about the cost implications of the feed-in system for their member companies. After all, support for renewables under the feed-in system does not come from government budgets, but is paid by all electricity consumers, representing a particular burden for large industrial consumers. This was partly addressed by introducing a hardship clause that exempted energy-intensive industries from contributing to EEG compensation if their annual consumption exceeded 100 GWh, or their electricity bill was higher than 20 % of their gross value added.

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. Other issues of debate were the details of the planned nationwide settlement mechanism and the allocation of cost.

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 chapter 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.

61 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.

4.2.3 The EEG amendment of 2004

The trend from all-party consensus to a more polarized 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. A relatively new "member" of the supporting camp is represented by the Farmers' Association, who sees 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, as responsibility for renewable energies has shifted to the Ministry of the Environment following the success of the Green Party in the 2002 elections, this has less impact on the legislative process. Partly also as a consequence of this government reorganisation, the process for EEG amendment is less dominated by the parliament and has become more administration-led. The fact that many of the rules and mechanisms described in the law have become much more sophisticated compared to the original EEG certainly reflects this shift.

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, which points to the fact that opposing renewable energy does not seem to be an attractive arena to gain widespread 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 realized that the opportunity to pass prices on to consumers does not hurt them commercially. As a reflection of this, some of the major utilities have even started to position themselves as active players in the development of renewables, thus joining the camp of beneficiaries of renewable energy support. Finally, the coal lobby including the Trade Union of Miners and the Chemical Industry, is among the opponents.

In terms of **issues** that have come up in the policy process, discussions focus once again on the level of compensation for wind energy and solar energy, as well as the degression of the compensation. With regard to wind energy specifically, some players perceive a shift in public opinion, marked by increasing scepticism in some parts of the country. For PV, solar associations argued that the old tariff has not been sufficient to cover the cost of operating PV, particularly following the end of the 100'000 roofs program. A new issue is the inclusion of large hydro power, which has been promoted most actively by one utility with a specific refurbishment project for their large

hydropower plant. The cost to consumers has been another contentious issue, 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.[62] 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 at least 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, with an annual consumption exceeding 10 GWh or an electricity bill north of 15 % of their gross value added.

Summarizing drivers for renewable energy policy development in Germany, we have observed shifting advocacy coalitions and a number of key turning points. While the introduction of the feed-in system in 1990/1991 was a somewhat accidental result of an all-party coalition of parliamentarians ranging from conservative small hydro interest groups to green wind supporters, the shift from StrEG to EEG in 1999/2000 and even more so the current EEG amendment 2004 bears the mark of politicians from the new red-green government. While from today's perspective, resistance from the utility industry never seems to have had a serious impact on the development of the feed-in system, this was relatively close to changing towards the end of the period of the conservative-liberal government in 1998, where introduction of the twofold 5 % cap, coinciding with the liberalisation of the electricity market, led to significant uncertainty in the market. Even under the new government elected in 1998, a lack of momentum on the side of the Ministry of Economics could have harmed the emerging renewable energy industry. Eventually, a parliamentary initiative from the Green Party and Social Democrats led to the rapid adoption of the new EEG, thereby securing continued investment and turning the beginning of the new decade into a phase of tremendous growth for renewables. Nevertheless, as examples from other countries have demonstrated, this could easily have become a time of complete standstill. Introducing the nationwide settlement system to balance out cost among the utilities, and also entitling them to benefit from feed-in compensation for their own renewable capacity were two smart moves of the EEG architects that helped to break up the opposing utility front. In 2002, re-election of the red-green government was on razor's edge. The challenging conservative parties, after sending a series of mixed signals, had eventually declared that they would stick to the feed-in system in case of their victory. The strong election result particularly of the Green Party and the subsequent shift of responsibilities

[62] BMU (2003a): Eckpunkte der Novelle des Erneuerbare-Energien-Gesetzes (EEG), Stand: August 2003

from the Ministry of Economics to the Ministry of the Environment helped to build further momentum for renewables in Germany.

4.3 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.

4.3.1 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.[63] 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 PV have the lowest shares in new capacity; however, growth of photovoltaic capacity has been impressive starting from almost zero in 1990 and achieving 260 MW in 2002. Hydropower has grown from 4403 MW in 1990 to approximately 4620 MW at the end of 2002, mainly because support for small hydro schemes was reactivated under the feed-in system.

Germany has seen much stronger growth in renewables than the EU average. Between 1991 and 2000[64], 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,[65] 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. 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 are some of these issues. These latter aspects point to another indicator for effectiveness, namely cost reduction for renewable technologies.

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

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

[65] Data based on BMU (2003b).

4.3.2 Cost reduction

As detailed in chapter 3 above, the cost of wind and solar power decreased by about 30 and 60 %, respectively, from 1990 to 2000. 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.[66] This situation can only partly be explained by PV companies facing high capital expenditures for new manufacturing capacity, therefore retaining their profits rather than passing cost reductions on to customers. It seems that this reflects a common phenomenon in immature markets: In the absence of high initial margins, investors will not see an opportunity and a market will not develop. Only after a new industry has reached some level of maturity will cost efficiencies be passed on to consumers.

Looking at the overall level of support gives an indication as to the order of magnitude that German electricity customers spend on funding renewables through the EEG. In 2001, compensation for renewable electricity generation under the EEG totalled 1'540 million Euro, which equates to a cost of 0.18-0.26 Cent/kWh.[67] Table 2 gives a breakdown of EEG compensation to the different renewable energy sources.

	Electricity Generation		Compensation	
	GWh	Percent	Million Euro	Percent
Small Hydro	4'209	23.6%	322.0	20.9%
Landfill, Sewage Gas, Coal-Bed Methane	1'700	9.5%	104.2	6.8%
Biomass	1'393	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%	1'540.0	100.0%
Non-EEG supported[68]	20'127		0.0	
Total Renewable Electricity	37'945			

Table 2: Renewable electricity generated and compensated under the EEG in 2001 (by energy source); Source: Bundesregierung 2002, p. 42[69]

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

[67] Bundesregiergung (2002). The interval is a result of different assumptions for the cost for conventional power generation that has been avoided thanks to renewable electricity.

[68] The majority of the "non-EEG supported" is large hydro.

[69] In a study on 2002 EEG compensation, Leprich et al (2003), p. 2, estimate the cost of EEG for electricity consumers in Germany at 0.29 Cent/kWh.

5 Promoting Renewables through Customer Demand: Green Power Marketing

5.1 Concept and Objectives of Green Power Marketing

The liberalisation of the German electricity market has made it possible for customers to directly influence the way that their electricity is generated by demanding specific forms of electricity, especially green power. The first German electric utilities offered green pricing programs to their customers in the mid-1990s.[70] Following market liberalisation in 1998, a number of competitive marketers introduced products, and incumbent utilities repositioned their programs for the newly competitive market environment. While green marketing is a relatively common phenomenon in some other markets such as organic food and energy-efficient appliances, the idea of buying green electricity may seem odd at first sight since the electricity that customers get out of their wall socket does not change physically when they switch to a green supplier. Rather, the change lies in the money flows underlying the electricity purchase, and a green power customer can make sure that his money does not support energy sources he or she considers environmentally damaging or hazardous, such as coal or nuclear. If products are properly designed – i.e. if it can be guaranteed that part of the revenue is used to support new capacity rather than just existing renewables being repackaged and double-sold – the purchasing decision of a green electricity customer will also ultimately contribute to a change in the electricity mix towards more renewables. Green electricity has search and credence attributes,[71] i.e. consumers cannot directly examine whether the supplier really produces or purchases renewables and contributes to new capacity development. This is a case of information asymmetry, which can be overcome by signalling such as the supplier's reputation or an independent labelling scheme including third-party certification.[72] In the absence of such a scheme, adverse selection will ultimately lead to crowding out high quality products.

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 realize for a homogeneous commodity like conventional electricity. Depending on whether the supplier is a specialized green power marketer or

[70] Markard (1997)

[71] Akerlof (1970)

an incumbent utility, their objective might either be to achieve strong growth in customer numbers, revenue and market share, or simply to round off the product range, thereby supplying a perceived small niche of dark green customers, increase loyalty among light green customers and convey an environmentally responsible image to other

Figure 5: Green Power Advertising in Germany (Sources: LichtBlick, Greenpeace Energy)[73]

stakeholders. 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 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.

[72] Truffer et al. (2001)

[73] English translation of headlines: „Save yourself nuclear power... and save money!" (Lichtblick), "Hydropower can now also be used sensibly" (Greenpeace Energy; Picture showing a water cannon being used against a crowd protesting against nuclear power)

5.2 Status of Green Power Marketing in Germany[74]

Today, more than 135 marketers supply 1'700 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*.[75] 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.[76] The green power market as a whole has grown at a rate of about 28 % p.a. in 2001 and 2002 (see Figure 6).

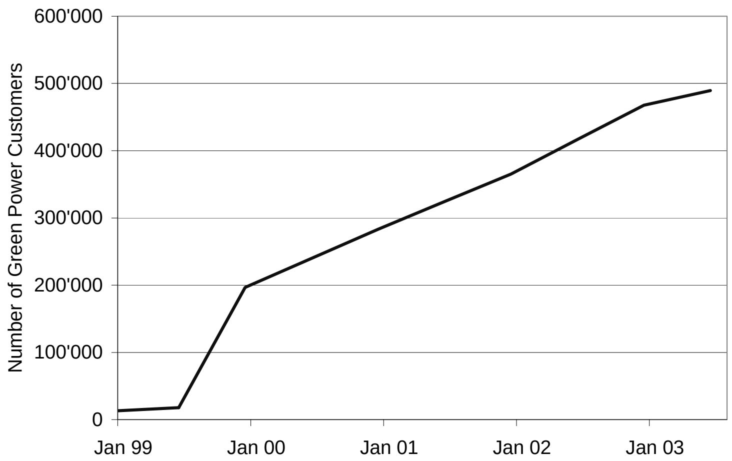

Figure 6: Demand for green power products in Germany (1999-1H2003)
Source: Data provided by suppliers, own estimates

[74] 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 chapter 1.2 above for a description of our methodology.

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

[76] von Tschischwitz (2003)

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, although more recently they have been offered as premium products. The renewables & CHP blends, which contain up to 50 % electricity from high-efficiency gas-fired cogeneration, have seen the strongest growth recently. 100 % renewable energy products, especially as they contain a minimum share of new capacity, are higher in price and have somewhat lower customer response.

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 Strom, 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, BEWAG OekoPur, Naturstrom, energreen
Total				490,000	135	

Table 3: Classification of German Green Power Products

5.3 Drivers for Green Power Market Development

The drivers for green power market development are related to the objectives of different actors discussed above (5.1). Five important drivers can be identified, which can have decisive influence (positive or negative) on green power markets.[77] We will briefly discuss each of them in the order of relevance in the German case.

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

5.3.1 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. In their attempt to identify opportunities on the liberalized electricity market, they tried a number of things to differentiate themselves and address perceived customer needs. With a relatively homogenous product like electricity, green power was one of the few things that looked promising to make a relevant difference in consumers' minds.

5.3.2 Willingness of retail consumers to pay more for renewables

Opinion polls and market research has consistently shown that a significant portion of consumers has a positive willingness to pay for renewable energy. As an example, a recent Eurobarometer survey conducted in February/March 2003 found out that 34 % of Germans say they are willing to pay more for renewables[78], while 59 % were unwilling to pay more. In a similar representative survey conducted by Allensbach in September/October 2003 on behalf of the federal public relations office, 21 % declared a willingness to pay more, while 62 % were unwilling and 17 % did not know.[79] 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. At the same time, the actual decision to purchase is also influenced by other factors, such as general switching behaviour in the electricity market.[80] Even customers who say they are willing to pay more for renewables might eventually not do so if this would require changing their electricity supplier and they just do not want to go through the hassle of doing so.

5.3.3 Emerging demand from business customers and government authorities

Apart from retail customers, businesses and government authorities are emerging as another important buyer group for green electricity. Motivation for these potential customers includes: conveying an environmentally responsible image;[81] improving their environmental performance in the context of an environmental management system (such as EMAS or ISO 14'001); and "walking the talk" in the case of government

[78] This compares to 57% of Dutch, 53% of Danes, 29% of French, 28% of Spaniards and 17% of Portuguese (Eurobarometer 2003). Among the 34 % in Germany, 24 % said they would be willing to pay up to 5 % more, 9 % were willing to pay 6-10 % more, and 1 % were willing to pay 11-25 % more.

[79] BPA (2003)

[80] 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)

[81] This includes communicating green power purchasing as part of their marketing strategy

authorities promoting sustainable development.[82] Business customers tend to be more price sensitive then retail customers, but the sheer size of their purchases makes them an attractive market segment nonetheless. We estimate that business customers and public authorities currently account for about 10 % of green power sales in Germany.

5.3.4 Eco-Labelling by Environmental NGOs

In countries such as some US states (green-e[83]) and Sweden (Bra Miljöval[84]) and in other industries such as the Swiss organic food sector (Bio-Knospe[85]), the early existence of a recognized eco-labelling scheme has helped to shape the market by giving guidance to consumers, thereby reducing their information cost and providing credibility, and also by helping marketers design good products. In Germany, three competing eco-labelling schemes had been launched,[86] which counteracts the basic function of an eco-label to reduce complexity and give guidance to consumers.[87] Also, compared to other countries with lower public policy support for renewables, German labelling organisations are spending quite some creativity on defining rules that prevent EEG-supported electricity from being part of green power offerings. The result is a double-edged sword: Customers are assured that what they buy is something additional in the sense that it has not been supported through EEG, but on the other hand, these labelling schemes provide little guidance 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.

5.3.5 Government Policy

Finally, government policy also has an impact on green power marketing, however the direction of this impact is harder to understand and therefore discussed in more detail in chapter 6 below. The absence of strong public policy has certainly been a positive driver for green power marketing in some countries outside Germany, such as in some US states or Switzerland. In the German case, public policy has traditionally had a clear supply-side focus, and a demand-side concept such as green power marketing seems hard to reconcile with the dominant paradigm of German renewables policy. As a

[82] see Wüstenhagen (2000), pp. 120 ff.

[83] http://www.green-e.org/

[84] http://www.snf.se/bmv/english-more.cfm

[85] http://www.bio-suisse.ch/en/consumer/index.php

[86] 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)

[87] Interestingly, Germany has a track record of creating several competing labels also in other sectors such as organic food, whereas other countries like Switzerland have been more successful in introducing a widely accepted single label both for organic food and green electricity.

consequence, regulation has not been designed to integrate supply- and demand-side approaches to promoting renewables.

5.4 Impacts and Effectiveness

5.4.1 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. However, while some suppliers emphasize that their numbers exclude capacity that would have been created anyway due to the favourable feed-in tariffs, determining this baseline is clearly not an easy task. Therefore, our estimate gives an indication rather than an exact number for the amount of power plants that have been created due to green electricity marketing. Compared to 13'000 MW of new wind capacity in Germany, which have resulted from 13 years of public policy support, this is roughly 1 %.[88] 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.[89] We will discuss both aspects, the potential for green power marketing to become more important over time as well as indirect benefits that the existence of a viable green power market can have for renewable energy development, in more detail in chapters 6.2 and 6.3 below.

5.4.2 Cost reduction

It is too early to quantify the impact of green power marketing on cost reduction in Germany to date as new capacity as a result of green power marketing has been limited. 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

[88] Also, the 100'000 roofs program, combined with EEG support, has increased PV capacity by about 200 MW in the 1999-2002 period.

[89] see Markard and Truffer (forthcoming)

willingness to pay. Cost efficiency in sourcing renewables, as well as careful product design 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. As with any policy mechanism that provides strong incentives for cost reduction, there is a concern that green power marketers might be prohibitively cost-driven, which involves too high a risk or too low compensation for generators to provide sufficient incentive for investment in new capacity. This is particularly an issue in an emerging market, and in the presence of another, well-established support scheme that provides 20 years of security such as the EEG.

6 Comparing Public Policy and Customer Demand

After providing an overview of both public policy for renewables and customer demand for green power in Germany, the aim of this chapter is to compare the influence of both on the development of the green energy market in Germany. We will do so by first taking a look at past impact (6.1); second trying to assess future impact (6.2); and thirdly elaborating on some of the indirect effects of green power marketing that make it not directly comparable to public policy (6.3).

6.1 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. 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. With regard to new capacity development, supply-side policies have been remarkably successful in Germany.

6.2 Assessing future impact – "Will customer demand ever matter in Germany?"

6.2.1 Scenarios for green power market development

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 characterized the German green power market in 2001 and 2002.[90] For the **low growth case**, we assumed a more pessimistic rate of 10 % per annum. While 28 % and 10 % may seem like aggressive growth rates, compared with similar emerging sectors, they are not unrealistic. For example, 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.[91] In the same period, installed capacity in the German wind sector grew at an average 49 % p.a.[92] We also compared our assumptions to forecasts compiled by Datamonitor, a leading market intelligence company in the UK.[93] 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 4'470 and 20'345 TWh, respectively (see Table 4).

Year	Assumed Growth Rate p.a.	Customer Number	Market Share[1]	Green Power Sales (GWh)	Total Renewable Electricity Generation (GWh)[2]	Green Power Demand as % of supply	Green Power Marketing Capacity Impact[3]
2003		490'000	1.3%	1'723	48'311	3.6%	ca. 1-3 %
2013 Low Growth	10%	1'270'934	3.3%	4'470	84'091	5.3%	10%
2013 High Growth	28%	5'784'899	15.2%	20'345	84'091	24.2%	44%

[1]) Customer number relative to number of German households.

[2]) 2003: Own estimate based on 2002 data from BMU (2003b). 2013: government target (linear extrapolation between 2010 and 2020 targets).

[3]) in % of 2002 New Capacity, 2003 figure own estimate based on our survey.

Table 4: Scenarios for green power demand in Germany in 2013 (Low and High Growth) (Source: own calculations)

[90] 28 % 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 where more or less successful, the range of growth rates in this period was from slightly negative in the case of some incumbent utilities to more than 100 % for the most successful marketer.

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

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

[93] Datamonitor (2003)

What do these figures tell us about the **relative importance of green power marketing** in supporting renewables? To answer this question, we make a comparison with the official government target, which is 12.5 % of renewable electricity in 2010 and 20 % in 2020. This requires 6 % annual growth in renewable electricity generation in the 2003-2010 period and 5 % annual growth thereafter. Therefore the government target implies renewable electricity generation of 84 TWh in 2013. If our scenarios hold, this would mean that green power demand would still be substantially smaller than available domestic supply ten years from now, representing 5.3 % and 24.2 % of this number, respectively. Looked at differently, especially in the high growth case, demand from green power marketers reaches much more significance than today, with 1 out of 4 kilowatt hours sold to green power customers.

The **capacity impact** of this development 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. So one option is that there will be no capacity effect at all, which means that demand from green power customers will not lead to a single new wind turbine being built that would not have been built anyway. This, however, is not a realistic assumption, since customers will only buy green power if their purchasing decision makes a meaningful difference, i.e. if marketers invest in new capacity. Also, eco-labelling schemes for green electricity demand a minimum share of new capacity to be included in the product (for example 33 % from less than 6 year-old plants in the case of OK-power[94]). The definition of "new" poses some additional questions, but 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 renewable power plants that have been built not more than 12 months ago, then 447 or 2'035 GWh would have to be supplied by new capacity in 2013 in the low and high growth cases, respectively. Based on current characteristics of wind energy in Germany, which had 1'433 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.[95]

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

[94] ok-power criteria; version 6.0 (October 2003), http://www.energie-vision.de/downloads/kriter_6_0.pdf

[95] New wind turbine capacity was 3'247 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 2'794 MW of new capacity that would be required each year in the 2010-2020 period.

Germany ten 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 potentially important contribution can be fully realized. 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 will conclude our scenario discussion with a qualitative **sensitivity analysis**, presenting a few thoughts on limitations of the work presented here, which can also be read as issues for further research:

- When we compared green power demand to government targets, we implicitly excluded that public policy may also lead to exceeding targets. This would reduce the relative impact of green power marketing.
- Looking at residential customers only is a significant simplification. Demand from commercial and industrial customers as well as public authorities can spur additional demand, and has become an important driver for green power demand in other countries like the US.[96]
- While we did some cross-checks to validate our growth rate assumptions, adoption rates might nevertheless be lower than for example in the organic food and wind turbine cases. We tried to account for this by including a substantial discount to these growth rates, but more pessimistic diffusion curves are still conceivable, right down to a complete collapse of retail markets for electricity, such as in California.
- Successful diffusion of any new product will only take place in the presence of sustained marketing. If important players in the German power market turn out to be unwilling or unable to develop successful green power marketing strategies, growth rates will end up being lower.
- Development of the green power market in reality is not independent of regulation. Unfavourable regulation, such as the provision to completely exclude EEG-funded electricity from green power products, 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 marketing. Whether requiring a 10 % share of new capacity per year is feasible

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

and how it impacts the economics of green power products needs to be analyzed in more detail.

- More thinking needs to go into understanding how mandated demand due to the purchase obligation in the current EEG versus "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 – what if two thirds of German renewable electricity is bought up by the Dutch, or if two thirds of German green power demand would be supplied from Switzerland?
- Both green power marketing and public policy imply that renewables are more expensive than conventional electricity. What happens when this starts to change? The Dutch experience seems to suggest that removing the price premium by means of a tax break leads to a market potential of 30-40 % for green power in the residential sector.
- What are the implications of EU guidelines on Guarantee of Origin for the green power market?
- Looking at the next decade may not provide the full picture. Even if the government targets are going to be reached, this still means that most of the remaining 87.5 % of electricity generation comes from fossil and nuclear power in 2010, and replacing the current 28 % share of nuclear power by 2025 will only be realized at these growth rates if electricity consumption does not increase, but rather slightly decreases compared to current levels. These considerations underline that 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.

6.2.2 Managing the interface between EEG and green power marketing is key

As we pointed out, the significance of the role of green power marketing in the future crucially depends on the regulatory environment, including both government policies such as the EEG amendment as well as eco-labelling criteria. For a properly designed green power market to play a useful role in the transformation towards sustainable energy supply, a number of aspects need to be considered in designing policies and labelling criteria.

The current interaction between the development of public policy (EEG) and of eco-labelling criteria in Germany reminds of the race between the hare and the hedgehog in Grimm's famous fairy tale. In their understandable attempt to make sure that customer Euros for green power purchases lead to environmental benefits that would not occur otherwise, labelling organisations in Germany have decided to require certified green power products to be "additional" to the EEG. In other words, green power marketers who wanted to get their products eco-labelled had to rely on renewable electricity generated from facilities that are not subject to EEG support. The basic idea was that customers would otherwise pay twice – once through the EEG surcharge on their electricity bill, once directly to the green power marketer. However, in reality finding renewable electricity that is not EEG-supported in Germany has been a difficult task and is getting more difficult with the evolution of the feed-in system that is becoming more and more sophisticated. In the market, this leads to a trend where green power marketers are in the role of the hare, who runs across the field looking for niches that are not yet covered by EEG support (among the few ones left are foreign hydropower, CHP from natural gas, and biomass co-firing), while policymakers play the hedgehog's role, who says ever more often "I'm already there", for example by including large hydropower in the latest amendment. One wonders how long it will take before the poor hare follows his counterpart in Grimm's tale and collapses on the middle of the field.

Back from fairy tales to reality, if we look at the challenge for green power labelling organisations as a trade-off between avoiding double-counting and creating a micro-niche, it seems questionable whether reducing the scope for green power product design to the odd things left uncovered by the wisdom of the policymakers is an appropriate interpretation of customer preferences for green power. An alternative and possibly simpler way of securing additionality would be to have a requirement for new capacity in each given year that is beyond the 6 % business-as-usual scenario of the government. If, for example, green power suppliers would be required to supply at least 10 % of their sales from new plants each year, then this could lay the ground for additional growth of renewables, even if there is support available on the supply side of the market.

Amending the criteria in this way would have risks and opportunities compared to the current system. Short-term, green power customers would lose some of the certainty that their money actually makes a difference. This is particularly relevant in a country like Germany that starts from a higher base of renewable supply,[97] compared for

[97] It is, however, also relevant in countries that have a high share of hydropower like Switzerland or Norway. Interpreting the additionality requirement as excluding all hydropower in these countries would

example to the state of Pennsylvania in the US, which only has 2 % renewables and no feed-in tariff, and therefore existing supply will be sold out quite rapidly as green power demand grows, ensuring that green power demand contributes to new capacity development even without specific provisions about minimum quota for new capacity.[98] Longer-term, labelling criteria that allow for EEG-inclusion but require a minimum quota of new capacity each year may provide for a more dynamic development of the market, since there would still be a built-in mechanism to ensure that new things happen,[99] but liquidity would be much higher.

6.3 Indirect benefits of green power marketing: Leveraging private marketing Euros for the public good

While the previous chapters 6.1 and 6.2 assess the impact of public policy and green power marketing using the same yardstick, namely the resulting new capacity of renewable power generation, we also pointed out that green power marketing is a complex phenomenon that includes a multidimensional set of objectives and actors involved. Therefore, we are now leaving the level of direct comparison and turn to analyzing ways in which green power marketing indirectly contributes to the development of renewables.

As we have discussed above (5.3), 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 probably continue to be for the foreseeable future – a more effective driver for renewable electricity generation in Germany, this desire is not going to go away.[100] 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 have spent

mean defining green power as a micro-niche product in these countries. Simply including all hydropower is not an appropriate solution either, so again a minimum quota for new renewables in a blended product seems to be a reasonable approach.

[98] While Pennsylvania has no feed-in tariff and therefore customer demand is one of the most important drivers for renewable energy development, the existence of an RPS in neighbouring states like New Jersey has also had a positive impact (Bird et al. 2003, pp.28-31). This reiterates the importance of combining public policy and marketing.

[99] One might compare this to the case of organic food in Switzerland, where there is also a co-existence of government subsidies on the supply ("generation") side with "voluntary" demand for green products from consumers willing to pay a premium for organic food.

[100] 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.

on advertising consistently since 1999, with 2002 spendings reaching 119 million Euro.[101] E.On alone has spent 59.4 million Euro on advertising in 2001,[102] and reportedly more than a third of this amount was directly related to the "Mix it" campaign featuring Arnold Schwarzenegger, advertising "Mix Power", 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 subsequently 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 contributing to effective education of customers about how they can and cannot influence the way electricity is made.

More positive and insightful examples of how green power advertising can contribute to consumer education about renewables can be found in the US and the Netherlands. Green Mountain Energy, a pioneer in US green power marketing, as well as Nuon and Essent, two large Dutch utilities, have spent similar amounts on advertising as E.On in Germany, but have put a lot of effort into finding ways to effectively increase customers' understanding of green power issues. As a conclusion, successful green power market development may pay off for renewable energy stakeholders beyond the hard facts of installed Megawatts.

This result is underlined by comparing utility marketing spending to the means that are available to public policy institutions. As an example, the communication budget of the German Federal Ministry of the Environment was just 6 million Euro in 2002,[103] 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.

[101] Source: Nielsen Media Research GmbH

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

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

7 Conclusions and Implications for other Countries

This paper has provided a comprehensive review of the developing green energy market in Germany. We have demonstrated that Germany has been particularly successful in increasing the share of renewable electricity over the past decade, and that this has largely been achieved by effective public policy. Within the public policy mix, the feed-in system introduced through the feed-in law (StrEG) of 1991 and extended through the renewable energy law (EEG) of 2000 and the EEG amendment of 2004 has had the most significant impact. Demand from green power customers has also started to pick up, but impact on new capacity so far has been limited compared to public policy.

In terms of implications for designing appropriate renewable energy policies drawing on the lessons learned in Germany, we conclude by proposing a number of facilitating factors that helped the policy process in Germany. Transferring the German experience to another country, one should keep a close eye on the extent to which these factors apply. We then give a number of 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 decentralized power through strong state governments or referenda, the introduction of a mandatory nationwide 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 here.

- **A critical mass of interest groups in favour of renewables**

  To gain acceptance for public policy support for renewables, broad coalitions need to be formed. Interest groups will only support such a policy when there is something to gain for them. The combination of small hydro and wind energy interest groups was key in getting the feed-in system started in Germany, and local

  solar-initiatives had a significant influence on EEG's provisions regarding PV. As in any emerging industry, innovative players will always face very well organized opposition from incumbents, so it is important to stress common grounds rather than get caught up in intra-industry struggles between the different renewable technologies.

- **A critical mass of politicians with strong will 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:

- **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, in the more recent past seconded by the federal Ministry of the Environment.[104]

- **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. One of the reasons for its success is probably the fact that costs are widely distributed among a disperse group of people, while over time beneficiaries have been able to create a visible lobby. Also, funding the feed-in tariffs through people's electricity bills rather

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

than through a government budget has probably contributed to the resilience of this system even in times of constrained public finances. Finally, the nationwide settlement system that led to burden sharing among utilities was decisive in overcoming resistance against continued growth of renewables.

- **Market liberalisation creates opportunities for new coalitions**

  The process of electricity market liberalisation creates a window of opportunity, because typically (1) it leads to temporary price reductions that leave some room for compensation of renewable generators, and (2) it changes the rules of the game, dissolves existing power camps, enables new coalitions, and weakens the homogeneity of established associations. The policy discourse around the EEG in 2000 was a good example, when the influence of the Association of the Electric Utility Industry decreased and utilities started to take slightly differentiated opinions. At the same time, the growing importance of wind turbine manufacturers led to the dissolution of the previously homogeneous opposition from the Germany Industry Association, when in a quick turnaround, the Machinery Industry Association started to support renewable energy policy.

- **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 now, 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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9 Annex

Annex 1: List of energy policy experts responding to our survey

- Hans-Josef Fell, Member of Parliament, Green Party (since 1998); President of the German Section of Eurosolar (The European Association for Renewable Energies e.V.).
- Ulrich Lenz, co-founder (1993) and CEO of the Ostwind Group (Regensburg/Bockelwitz), a German wind park developer.
- Dr. Wolfgang Daniels, Member of Parliament, Green Party (1987-1990), CEO of Sachsenkraft GmbH, since 1994 President of the Saxonian Renewable Energy Association (Vereinigung zur Förderung Erneuerbarer Energien in Sachsen e.V.).
- Gerd Sonnleitner, since 1997 President of the German Farmers' Association (Deutscher Bauernverband - DBV), President of the Committee of Agricultural Organisations in the European Union COPA (2001-2003).
- Wolf von Fabeck, director of the Solarenergie-Förderverein Deutschland e.V. (since 1986).
- Dr. Otto Majewski, CEO of Bayernwerk AG (1988-2000), Vice-Chairman of E.ON Energie AG. Formerly President of the German Atomic Forum (Deutsches Atomforum, 1999-2001).
- Dr. Hermann Scheer, Member of Parliament, Social Democratic Party; President of Eurosolar (The European Association for Renewable Energies e.V.).

Annex 2: List of green power marketers responding to our survey

Company	**Product(s)**
best energy GmbH	ÖKO PUR, Wasser PUR, FIFTY FIFTY
Bürgerinitiative Umweltschutz e.V.	ÖkostromPool "S", ÖkostromPool "M"
E.ON Bayern AG	e.on Aquapower
Elektrizitätswerke Schönau GmbH	Watt Ihr Volt (= Donation contract), Watt Ihr Spart
EWE NaturWatt GmbH	NaturWatt-Strom, NaturWatt Strom plus
GGEW Gruppen-Gas- und Elektrizitätswerke Bergstrasse	(different kinds)
Greenpeace energy eG	Greenpeace energy
Grün-Strom e.V.	Vertragsmodell "S", Vertragsmodell "M"
HEAG NaturPur AG	NaturPur-Strom light, NaturPur-Strom premium
LichtBlick	Lichtblick
NaturEnergie AG	NaturEnergie Silber, NaturEnergie Gold (= Silber plus Zuschuss)
Naturstrom AG	Naturstrom
unit energy stromvertrieb GmbH	unit [e] naturstrom
ASEW Energie und Umwelt Service GmbH & Co. Kommanditgesellschaft	Energreen
Bewag AG & Co. KG	Ökopur
Hamburgische Electricitäts-Werke AG	Newpower