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Renewable Energy Policy and Wind Energy Development in Germany

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List of Abbreviations

BMBF	*Bundesministerium für Bildung und Forschung* (Federal Ministry for Education and Research)
BMFT	*Bundesministerium für Forschung und Technologie* (Federal Ministry for Research and Technology)
BMU	*Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit* (Federal Ministry for Environment, Nature Conservation, and Nuclear Safety)
BWE	*Bundesverband Windenergie e.V.* (German Wind Association)
CDU/CSU	*Christlich Demokratische Union/Christlich Soziale Union* (Christian Democratic Union/Christian Social Union)
CHP	Combined heat and power (Cogeneration)
DENA	*Deutsche Energieagentur* (German Energy Agency)
EEG/RESA	*Gesetz zur Regelung der Erneuerbaren Energien* (Renewable Energy Sources Act)
ETR	Ecological Tax Reform
FIT	Feed-in tariff
FRG	Federal Republic of Germany
FDP	*Freie Demokratische Partei* (Free Democratic Party)
HTDP	*Hunderttausend-Dächer-Programm* (100,000 Roof Program)
HVDC	High-voltage direct current transmission
RES	Renewable energy sources
RES-E	Electricity from renewable energy sources
RWE	*Rheinland-Westfalen Energie*
SPD	*Sozialdemokratische Partei Deutschlands*
StrEG	*Stromeinspeisungsgesetz* (Electricity Feed-in Law)
VDEW	*Verband der deutschen Elektrizitätswirtschaft*
VEBA	*Vereinigte Elektrizitäts- und Bergwerks AG*
VIAG	Vereinigte Industrieunternehmungen AG

1. Introduction

Germany is one of the leading countries in the world for renewable energy research and development, with one of every two wind power generators and one of every three solar panels in the world coming from Germany. Over the past twenty years the German *Bundestag*, the national parliament, has erected a series of innovative laws promoting renewable energy that has allowed wind energy to grow at incredible rates. This paper is an historical overview of those renewable energy policies and their effects on the implementation of wind energy in Germany. The main purpose of this research was to discover what lessons could be learned from Germany's development of renewable energy technology through policy support to use as examples for creating an effective model of renewable energy policy for other countries.

The research was directed by following questions:

1. How did Germany's energy policy come to include a significant priority placed on renewable energy?
2. How has the German policy towards renewables affected development of wind energy?
3. What approach did the government take toward creating a market for renewable energy and what role has economics played in that choice?
4. What challenges to acceptance of renewables exist and how are these being addressed?
5. Can the German renewable energy policy be considered a success? "Success" in this case is defined as setting the country on track for meeting or exceeding its greenhouse gas emissions reductions pledges according to the Kyoto Protocol and its goals for increasing the proportion of renewables in the energy mix as laid out in the country's energy plan "Roadmap 2020."[1]

The goals of the research were:

1. To trace the development of German renewable energy policy to learn what policy measures are most effective and to determine their effects on wind energy development.
2. To determine what challenges lie ahead for renewables in Germany, specifically for wind energy.

[1] The goals include reaching contributions of 50% of primary energy consumption by 2050, 18% of final energy consumption by 2020, and 30% of net electricity consumption by 2020 (BMU, 2009a, 6). Primary energy is energy prior to conversion, still stored in natural sources, whereas final energy is after conversion, i.e. into electricity or heat (Kydes, Cleveland, 2007)

2. Development of Renewable Energy Policy in Germany

The production of electricity from renewable energy sources (RES-E) is a familiar topic in Germany, largely accepted by the public and promoted by both provincial and federal government. In 2007 more than 14% of the gross electricity consumption was covered by RES-E, exceeding the federal government's goal of generating 12.5% of electricity needs from RES-E by 2010 (BMU, 2009a, 12; BMU, 2006a, 3). Renewable energy sources did not become a major topic of discussion in the Federal Republic of Germany (FRG) until the 1970s, however, when a combination of events brought environmental issues to the forefront. This section first details the evolution of renewable energy as a theme in German politics and describes the major current policies regarding renewable energies. Thereafter specific domestic and international influences upon Germany's approach to RES-E will be discussed. Although now a major issue in federal politics, the path to the prominence of RES-E in German politics today was by no means a straight and easy journey to the top. More so, it was an evolutionary journey that occurred without a master plan and faced continual roadblocks.

2.1 The 1970s and 1980s

At the beginning of the 1970s Germany's energy mix consisted predominantly of coal, oil, and nuclear energy. Coal is the only domestic conventional fuel of any significant amount, forming then and still today the backbone of the German energy supply. Fossil fuels and nuclear power were deemed to be reliable and the government gave little thought to alternatives. Atomic energy was especially central to the FRG energy policy in the 1970s. Money for energy technology research was given almost exclusively to atomic research, a fact which even the oil crises of the 1970s failed to fully rectify.

Lacking a significant domestic supply of oil, West Germany was importing 94% of its oil from the OPEC (Organization of the Petroleum Exporting Countries) countries at the time of the first oil crisis in 1973 (FAZ, 2008). The dramatic financial and security effects of the crisis put into question the country's dependency upon foreign oil imports. Rather than spur a turn to renewables, however, the energy crisis resulted in a strengthened interest in atomic energy and coal at the federal level. In 1979, 59.9% of the money spent on energy research in the FRG went to nuclear fission, 16.8% to nuclear fusion, and only 4.4% and 4.3% respectively to renewable energy and energy efficiency. In comparison, the United States allocated 30.4% of energy research funds to nuclear fission, 12.6% to nuclear fusion, 16.5% to renewable energy

technologies, and 5.6% to energy efficiency (Heymann, 1995, 344). Given the large coal reserves in Germany – the most important domestic energy source – a move toward energy self-sufficiency was deemed possible by a greater utilization of coal rather than a revolutionary transition to RES-E. The federal government of the FRG in the 1970s therefore maintained a strong path dependency on fossil and nuclear energy sources.

At the same time, environmental awareness was growing among the population, resulting among other factors from the realization of the devastating effects on Germany's old growth forests of acid rain caused by air pollution from burning coal (Runci, 2005). As a result, environmentalist groups and anti-nuclear energy organizations pushed for clean renewable energy sources and demanded more environmental responsibility in the government. Interest in renewable energy sources came initially from the citizenry. Nevertheless, the FRG government continued to depend upon fossil fuels and atomic energy. It expended small amounts of money for research in renewable technologies – for instance, $103.3 million for wind energy from 1975 to 1988[2] – but did not consider RES-E a serious alternative. As British energy scientist Nigel Lucas wrote of the West German government's attitude toward renewable energy: "'to say that support for renewable energy in West Germany is lukewarm would be something of an exaggeration'" (in Heymann, 1995, 362). The announcement by the minister of Research and Technology (BMFT, later BMBF) in July of 1974 that wind energy would have, at most, a limited, local effect provided clear evidence that the German government was not planning on disbursing large sums of money for research in RES-E technology (Heymann, 1995, 362).

Non-parliamentary environmental, peace, human rights, and women's rights groups did not agree with the government's stance on environmental policies and RES-E. In 1980 a number of these groups joined together and sought to form their own political party. Members stemmed from both conservative citizen's groups and more radical organizations of the "New Left" which had evolved after the student movement of 1968 (Bündnis 90/die Grünen, 2009). Initially a movement that went through several series of reorganizations, the group eventually became known as the Green Party and has played an important role in bringing renewable energy issues to the table in national politics. Although the party had difficulties gaining office in the Bundestag and on regional level, it exerted a strong indirect influence on the larger parties, the *Christlich Demokratische Union/Christlich Soziale Union* (Christian Democratic Union-Christian Social Union, or CDU-CSU), *Sozialdemokratische Partei Deutschlands* (Social

[2] Adjusted for the year 1990. BMFT, 1990, Windenergie für die Bundesrepublik Deutschland, Zusammenstellung der gesamten bisherigen Projektförderung durch das BMFT, P. 13, in Heymann, 1995, 345.

Democratic Party, or SPD), and the *Freie Demokratische Partei* (Free Democratic Party, or FDP) in the areas of environment and gender equality. Before the reunification of East and West Germany, environmental concerns – and hence also renewable energy – stood near the top of political agendas thanks to the Green Party (Kern, et al., 2003, 1).

In contrast to the FRG, the German Democratic Republic (GDR) – former East Germany – expressly stated in its constitution of 1968 the responsibility of state and society for the protection of nature and the environment. In 1970 it was the second country in Europe, following Sweden, to pass a comprehensive environmental protection law, and in 1972 it established a Ministry of Environmental Protection and Water Management. Despite these detailed legal arrangements, however, little action regarding environmental protection took place in the GDR. From the mid 1970s onward in the GDR environmental policy was subordinated to economic, foreign, and social policy. The GDR's response to the oil crises was in 1979 to press for greater usage of domestic brown coal for electricity, which resulted in increased acid rain and poor air quality in industrial areas (Jänicke, 2003). By the time of the reunification of East and West Germany in 1989 the quality of the environment in the GDR was very poor, just one of many reasons for a renewed push for RES-E in Germany.

Several events in the mid- and late-1980s focused public attention on RES-E. While the failures of government-sponsored wind projects (see section 3.1) gave the impression that RES-E would never develop into a thriving market in Germany, RES-E had growing numbers of supporters among the public and in the Bundestag. The Chernobyl nuclear power plant disaster in April of 1986 had a strong impact upon German citizens' views of nuclear energy and renewed their push for renewable energy development. By 1988 public opposition to nuclear power had reached 70% (Lipp, 2007, 5487). FRG Chancellor Helmut Kohl responded to citizens' environmental concerns by forming in 1987 the Enqueté Commission on Preventative Measures to Protect the Earth's Atmosphere. The Commission's first recommendations included a decrease of the 1987 carbon dioxide and methane emission levels by of 30% by 2005 and a decrease of 80% by 2050. In addition, the Commission recommended the adoption of an electricity feed-in tariff (FIT) for electricity generated by renewables.[3] While members of parliament (MPs) from all parties increasingly saw the need for market creation programs for renewable energy

[3] The FIT is classified as a "political price/amount market model," as prices are set politically but quantities are market driven. It guarantees RES-E generators a fixed price for the electricity they produce. The first FIT policy was developed and implemented in the United States in response to the oil crises of the 1970s through the Public Utility Regulatory Policies Act of 1978 (PURPA), which introduced guaranteed prices based on the long-term anticipated cost of fossil energy (Lipp, 2007, 5482).

technologies, the federal government – the Ministry of Economic Affairs in particular – was hesitant to take action (Lauber, Mez, 2006, 106).

In response to growing pressures from both the Bundestag and the public, two market creation programs were designed by the BMBF in 1988: the 1,000-Roof Program for photovoltaic (PV) and the 100MW Mass Testing Program for wind turbines. The 1,000-Roof Program, which ran from 1991 to 1995, offered applicants 70% of the investment costs – 50% from the federal and 20% from the state government in former West German states and 60% from the federal and 10% from the state government in former East German states. The program resulted in the installation of solar panels on 2,250 roofs (Lauber, Mez, 2006, 106). Begun in 1989, the 100MW (increased to 250MW in 1991) Wind Program, also in place until 1995, had two purposes: First, to gather practical experience with wind power plants at economic scales; and second, to create incentives for increasing the number of wind park installations (Bechberger, Reiche, 2004, 49). It offered investors a tax subsidy initially amounting to 4 Euro cent/kWh. With the enactment of the *Stromeinspeisungsgesetz* (StrEG, Electricity Feed-in Law) in 1990, the amount for the 100MW Program was reduced to 3 Euro cent/kWh since it was combinable with the feed-in tariff of the StrEG. According to Green Party Energy and Technology Policy Spokesperson Hans-Josef Fell, the combination of these two support systems made wind power on the coast profitable and marked the beginning of the wind energy boom in Germany (Fell, 2009, 5).

2.2 Developments in the 1990s: The Electricity Feed-in Law and "Liberalization" of the Electricity Market

Although the 1,000-Roof and 100MW programs were successful in increasing the amount of renewable electricity from solar and wind sources in Germany, they were not enough to make RES-E profitable and attractive to investors. MPs from the Green Party and the CDU-CSU continued to push for a FIT. Delegates Hermann Scheer (SPD), Wolfgang Daniels (Grüne), and Matthias Engelsberger (CSU) in particular played key roles in the creation of the StrEG. The StrEG was approved by all parliamentary parties and enacted in 1991. It is important to note that the development of the law stemmed not from the federal government under Kohl, but rather from the actions of a multi-party coalition in the German parliament (Fell, 2007; Lauber, Mez, 2006, 116). Even as RES-E began to trickle into the electricity market in Germany, the Kohl government did not take action to help stimulate and support the fledgling technologies.

The StrEG "required electric utilities to connect RES-E generators to the grid and to buy the electricity at rates ranging from 65% to 90% of the average tariff for final customers" (Lauber, Mez, 2006, 106). The StrEG supported solar and wind energy, hydro power, biomass, sewage and landfill gas. Wind and solar received 90% remuneration, whereas for the other sources remuneration was 80% for plants with an output of fewer than 500 kW and 65% for plants from 500 kW to 5 MW. The StrEG had very positive effects for the development of wind power. For photovoltaic and other RES-E, however, the StrEG was not enough to result in significant market penetration. Specifically for PV the StrEG came nowhere near to covering operation costs. Additional support for wind power projects was provided by soft loans from the state-owned *Deutsche Ausgleichsbank* (DtA). Between 1990 and 1998 nearly DM 6 billion (approx. 3 billion Euro) in loans was given out (Bechberger, Reiche, 2004, 50). The StrEG was a major step in the right direction, but it faced much opposition and did not do enough to help RES-E become serious competitors to conventional electricity producers.

From the start, conventional power generators and utilities challenged the StrEG. As Lauber and Mez wrote, the German energy supply industry has an enormous amount of financial clout and political power, with "its powerful ownership links with major financial and industrial interests" serving as an example of what Andrew Shonfeld in 1965 termed "German 'alliance capitalism'" (Lauber, Mez, 2006, 108). Four energy giants in Germany – RWE (*Rheinland-Westfalen Energie*), Vattenfall Europe, E.ON[4], and EnBW (*Energie Baden Württemberg*) – operated as monopolies and controlled electricity supplies in different regions, from power production to grid operation and distribution. These giants have political links to state bodies at all levels and thus could exert their will upon various governing bodies. For these reasons the entry of renewables into the electricity market and the obligation to purchase renewably-generated electricity were unpopular developments for the utility companies. Despite the priority given to RES-E for grid connection, they did everything they could to prevent the entry of RES-E into the energy grid, including accusing the StrEG of being unconstitutional. Before enactment of the StrEG the European Commission had to be notified regarding compliance with state aid provisions. The Commission initially did not raise objections, but this position would later be reevaluated (Lauber, Mez, 2006, 106).

Despite the difficulties RES-E faced, the financial support of the StrEG was enough to result in a surge in wind turbine erection in Germany. In 1990 there was a total installed capacity for

[4] Comprised of formerly separate energy concerns–*PreussenElektra, Vereinigte Elektrizitäts- und Bergwerks AG* (VEBA) and *Vereinigte Industrieunternehmungen AG* (VIAG)–which joined together in 2000.

wind energy in Germany of 68 MW, whereas by 1996 the installed capacity had increased to 1,546 MW (Reiche, 2004, 66). This prompted a change in the building laws (*Baugesetzbuch, BauGB*), §35, in 1996 which privileged the constructing of wind turbines outside of settlements. Haphazard erection of wind turbines in unsuitable locations and a desire to promote rational and organized wind power development in Germany were cited as the reasons for the §35 BauGB revision. Local communities were required to reserve zones in their land-use plans appropriate for wind turbines; later, the task of reserving land for wind turbines came under the jurisdiction of the regional planning bodies (Wieser, 2005, 364). This was designed to speed-up the permitting of projects and additionally to reduce conflicts between wind power contractors and local communities. However, from the view of the wind turbine contractors, the §35 BauGB revision has resulted in a worsening of conditions for the erection of wind turbines. These and other issues specifically related to wind power are discussed in sections 3.1 and 3.2. Suffice it to say that the §35 BauGB marked the beginning of fine-tuning in the development of RES-E in Germany.

The complaints of the utilities giants continued and indeed, their concerns were far from unfounded. In 1996, the utilities association *Verband der deutschen Elektrizitätswirtschaft* (VDEW) placed a complaint with the Directorate Générale Competition, a subdivision of the European Commission. This time the commission agreed with the concerns of the utilities giants and the finance ministry accordingly suggested adjustments to the StrEG, but several groups – the metalworkers union, farmer and church groups, and environmental and RES associations – joined together to halt the changes. Their demonstration in Bonn on 23 September 1997 revealed a broad coalition of support for environmental energy policy among the public and non-political groups and resulted in a re-evaluation of the StrEG (Hustedt, 1998, 166). The result was the *Gesetz zur Neuregelung des Energiewirtschaftsrechts* (Energy Supply Industry Act, ESIA) in 1998, which tried to solve some of the problems of the StrEG (Lauber, Mez, 2006, 107).

The liberalization of the German electricity sector in 1998 under the ESIA negatively affected the development of renewable energy technologies. The act was a “response to long-standing criticism of monopolistic practices in the electricity industry,” a powerful industry which stood in the way of the development of renewables (Lauber, Mez, 2006, 108). The expectation was that the deregulation of the market would lower the price of electricity and allow for greater competition. Instead of allowing for greater competition, however, the liberalization “favored the expansion strategies of the energy giants, leading to mergers and higher yields”

(Lauber, Mez, 2006, 109). Even today the four electricity giants control over 80% of electricity production in Germany (Judzikowski, Koberstein, 2008). Since the subsidies for renewables were linked with the market price of electricity for consumers, a liberalization resulting in cheaper electricity costs meant a reduction in subsidies for RES-E.

The ESIA also attempted to improve the distribution of renewably-sourced electricity fed into the network. Utilities and conventional electricity generators had serious complaints about the StrEG and had attempted "a rollback of this law via both politics and the judiciary" since it's inception in 1991 (Lauber, Mez, 2006, 107). In the initial StrEG there was no clause for spreading the burden of utility payments evenly among utilities from all regions of Germany, some of whom – particularly those in the northern states where strong winds meant a greater development of wind power – were facing higher amounts of feed-in electricity than others. This was corrected in the ESIA by a new "ceiling" mechanism. Once the amount of renewably-produced electricity exceeded 5% of the total amount supplied by a utility, the upstream network operator was responsible for compensating the initial utility for supplementary costs caused by this excess amount ("first ceiling"). A second ceiling allowed the upstream network operator to ask for compensation from a network operator further upstream when the compensation paid exceeded 5% of the output (Lauber, Mez, 2006, 107). Even with these measures, however utility companies remained dissatisfied and it was clear that further changes would need to be made for RES-E to continue to grow in Germany.

2.3 Environmental Policies of the Red-Green Coalition and the Renewable Energy Sources Act (RESA)

In 1998 a new governing coalition came to power. For sixteen years a conservative-liberal coalition of the CDU and the FDP had held federal power, but now a Red-Green coalition of the SPD and the Green Party, under the chancellery of Gerhard Schroeder, took over. Environmental policy and promotion of renewables held a prominent place in the aims of the new federal government. While the previous CDU/FDP coalition under Chancellor Helmut Kohl had in the 1990s eventually begun to support renewable energy technology development, it was not a major part of the federal policy and the governing parties remained loyal to the utility giants and conventional power generators. With the new governing coalition the expectation among the public and parliament members was that renewable energy would become a significant part of federal policy, instead of just being supported among MPs and the public.

Renewable energy and environmental policy in general did indeed hold a place of key importance in the policy goals of the Red-Green coalition. Three reasons were cited for promoting the development of renewable energy sources: energy supply security, economic efficiency/profitability, and environmental sustainability (BMU, 2006b, 17). An additional important factor for promoting renewable energy technology development within Germany was job creation. Since unemployment is a serious problem in Germany, particularly in the former eastern German states, developing a new market with plenty of new job opportunities has been a key factor garnering in support of RES-E at the federal level.

Right away the Red-Green coalition government took action, establishing a 100,000 Roof Program (HTDP) to promote solar photovoltaic technology, development and implementation of which had lagged since the expiration of the 1,000 Roof Program in 1995. The new program aimed to install 100,000 new PV installations at 3 kW each, resulting in an increase of installed PV capacity from 50 MW at the end of 1998 to 350 MW in 2003 (Bechberger, Reiche, 2004, 50).

Additionally, the federal government set targets for RES-E in the electricity supply, aiming for 12.5% contribution by 2010 and 50% by 2050. A further act was the Ecological Tax Reform (ETR) in April of 1999, which raised taxes on motor fuels, fuel oil, and natural gas and introduced a tax on electricity. By 2003 the tax on electricity consumption had reached €0.0206/kWh for private households. Industry and public transportation paid a reduced tax of 20% and 50% respectively. The ETR benefitted biofuels, as they are exempted from taxation, but RES-E electricity is not exempted from the electricity tax, except for customer-generated RES-E. The reason for the non-exemption of RES-E is the difficulty of tracing the exact production process and source of the electricity. Coal and nuclear fuels have not been affected by the ETR. Part of the revenue from the ETR is earmarked for the Market Incentive Program for increased use of RES-E (*Marktanreizprogramm*, MAP) (Bechberger, Reiche, 2004, 50-51; Lauber, Mez, 2006, 109).

Discussions over a new and improved feed-in tariff began in the autumn of 1999 as MPs from both parties in the governing coalition desired improved support and conditions for RES-E. These discussions were led by Hermann Scheer and Dietmar Schütz for the SPD and Michaele Hustedt and Hans-Josef Fell for the Greens (Fell, 2007). The final decision was to continue with a feed-in tariff, although the utilities continued to protest. Parliament members from the FDP and CDU-CSU also hesitated on approving a new feed-in law, some desiring a quota or certificate

system, both free market systems that have shown lesser success in promoting RES-E development.[5] Support for the Red-Green decision to stick with a feed-in tariff came from the association of the investment goods industry (VDMA) and the metalworkers union. A draft law was quickly written up and read in the German parliament in December of 1999. As Andreas Wagner, Managing Director of the *Fördergesellschaft Windenergie* (FGW),[6] wrote, "This public debate sent a clear signal to investors and renewable energy developers alike that the government coalition of Social Democrats and Greens is committed to continue the boom of wind energy and extend it to other renewables as well" (Wagner, 2000). The *Gesetz für den Vorrang Erneuerbaren Energien* (EEG, Renewable Energy Sources Act, RESA) was signed into law on April 1, 2000.

While the RESA maintains the form of the 1990 Feed-In Law, it improved conditions for all RES-E by providing more specific regulations for compensation and improved rates and security. Instead of having feed-in rates tied to the market value of electricity, specific rates were established for each type of RES-E based on investment costs. These rates were fixed for twenty years but declined for most sources each year for new installations. For instance, a biomass facility with a capacity of 10 MW built in 2002 would receive a compensation rate of 8.60 Eurocent per kilowatt hour (kWh), whereas one built in 2003 would receive a rate of 8.52 Eurocent per kWh. Rates were raised for all RES-E, although the greatest increase was for solar PV, which has continually lagged in development due to high investment costs. Specifically for wind power, the quality of the turbine site was taken into account. All sites would receive the initial remuneration amount (9.1 euro ct/kWh in 2002) for five years. After that, the rate for all locations would be reduced based on their yield; for locations with faster wind speeds, such as coastlines, the decline would occur more rapidly than for inland sites with slower wind speeds. The reason for these specific stipulations was to "avoid payment of compensation rates that are higher than what is required for a cost-effective operation … and to create an incentive for installing wind energy converters at inland sites" (Bechberger, Reiche, 2004, 52). (See Table 1 for wind energy remuneration rates.)

[5] Several advantages of the FIT include: its ability to encourage development in a range of locations, fostering regional development, and its inclusiveness of a range of technologies and project sizes. The quota or certificate system, on the other hand, defines the amount of RES-E to be produced but lets the market determine the compensation amount based on the market electricity price and the price of certificates that must be purchased by producers. This system has proven to be the more expensive approach for RES development and provides generators and investors little security about the price paid or the duration of the contract. This insecurity results in a stalling of investment and limits the diversity of technologies supported, plus it also limits the type of participants in the market to large players who can achieve economies of scale. (Lipp, 2007, 5493).

[6] A non-profit organization supporting wind energy development in Germany, founded in 1985 and having approximately 100 members as of 2004 (Reiche, 2004, 105).

Table 1. EEG remuneration rates (in Euro ct/kWh) for wind power for 2002-2004 and the latest revision in January 2009

	2002	2003	2004	2009 Amendment
Onshore wind energy initial	8.96	8.83	8.70	9.2 [1]
Onshore wind energy final (basic)	6.09	6.00	5.91	5.02 [1]
Bonus: start-up year 2000-2008	-	-	-	0.70 [1],[2],[3]
Bonus: start-up year 2009-2014	-	-	-	0.50 [1],[3]
Repowering	-	-	-	0.50 [4]
Offshore wind 9 years	8.96	8.83	8.70	-
Offshore wind initial	-	-	-	13.0 [5]
Offshore wind final (basic)				3.5 [5]

Sources: BMU, 2003b; Staiß, 2003, p. II-24 (cited in Bechberger, Reiche, 2004, 54); BMU BMU, KI III 1, 2009, 7.

Notes

1. Regressive remuneration of 1.0 % for new plants from 2010 on.
2. For turbines retrofitted until 1 January 2011.
3. Bonus limited to five years.
4. For period of initial subsidy.
5. Regressive remuneration of 5% from 2015 on.

In addition to the more specific, regressive remuneration rates, the RESA improved grid connection conditions for RES-E. It introduced a priority purchase obligation, to be met by the nearest grid operator. To address the complaints of utilities and grid operators regarding the unfairness of purchase obligations – a problem which had arisen in the 1990s with the uneven distribution of wind power turbines – the new law also included a national equalization scheme. Under this scheme, distribution of renewable electricity purchases will be equalized so that grid operators in regions with high production of RES-E will not be overburdened (Bechberger, Reiche, 2004, 52-53).

Renewable energy planners, developers, and investors were not the only ones to benefit from the RESA. Under the new law utilities were also eligible for the FIT for constructing their own RES-E facilities. Previously, utilities were expected to establish RES-E plants without support from the FIT. With the inclusion of utility companies as eligible recipients of the FIT compensation rates, the hope was to end utility opposition to renewable energy legislation and to spur RES-E installations requiring very large-scale investments, such as offshore wind parks. (Wagner; Lauber, Mez, 2006, 110).

The Renewable Energy Sources Act was not passed without resistance from the utilities sector, however. As with the StrEG, they continued to lobby against the subsidization of RES-E production. While the RESA was under construction a lawsuit against the feed-in tariff under the StrEG which had been presented before the European Court of Justice in 1999 was awaiting judgement. The utilities and the Directorate Générale Competition had argued that a feed-in tariff

for RES-E was state aid and thus went against European law (Max-Planck, 2000). The EU court released its opinion in 2001 in support of the FIT. With this statement the utilities had to back down. While still not willing to accept or believe in the possibility of an electricity supply based almost wholly on RES, the four major utility companies have become important investors in renewables and gradually increase their presence in the field of RES development. All four have accepted the reality of the feed-in of renewably-sourced electricity in their grids, but the question is whether they see the necessity. They continue to emphasize the necessity of maintaining large coal and nuclear power plants to provide regulating power for renewably-generated electricity, citing the unreliability of wind energy – "the wind doesn't blow all the time" is the typical excuse. While there is truth to the unreliability of wind, a nationwide distribution of wind turbines linked together with other RES in a national grid takes care of the problem.

One significant change made by the Red-Green coalition allowing more favorable conditions for RES-E was the transfer of control over the renewable energy policy in 2002 from the Economic Affairs Ministry (*Wirtschaftsministerium*) to the Ministry for Environment, Nature Conservation, and Nuclear Safety (*Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit*, BMU). With skepticism toward RES-E and close ties to the major energy suppliers and coal interests, the Economic Affairs Ministry did little to stimulate the RES-E industry, keeping RES-E from developing their full potential. In the hands of the BMU, under the ministry of a member of the Green Party until 2005, the environmental and sustainability goals of Germany's renewable energy policy are better protected.

To further aid development of the RES industry the BMU has developed the Market Incentive Program (*Marktanreizprogramm*, MAP). This program was initiated in September of 1999 as a continuation of a "100 Million DM Promotion Program for RES" which was started in 1994 with a yearly amount of 20 million DM (approximately 10 million Euro). The MAP is an additional form of financial support in the form of direct investment subsidies and soft loans for solar thermal, solid biomass combustion, small hydro, geothermal, and photovoltaic. Although originally planned to expire at the end of 2003, in September of 2003 the BMU announced an extension of the program until the end of 2006. Since then it has been further extended and is a key tool for Germany to achieve its joint goals of increased renewable energy penetration, increased energy efficiency, and decreased CO_2 emissions. The MAP has been particularly successful at spurring installation of heat-producing renewable energy technologies. Combination with other financial aid programs is sometimes possible, increasing the attraction to

investors in technologies which otherwise do not receive much investor attention (Bechberger, Reiche, 2004, 51). The amount available for promoting investments in renewables has increased each year since its inception. In the year 2007, the government set aside 965 million Euros for the MAP, which precipitated investments that totalled 8,166 million Euros. In the years of 2009 through 2012 the government intends to make available up to 500 million additional Euros each year (BMU, 2008, 8). In combination with the RESA, the MAP is a powerful tool for promotion of RES-E.

As part of the RESA every two years a review of the law is required. After the transfer of responsibility for the RESA to the BMU in 2002, discussions over the improvement of the compensation rates for PV and biomass began. A lengthy and sometimes heated debate ensued, with the Economic Affairs Minister Wolfgang Clement, a politician from the coal state North Rhine-Westphalia, vehemently attacking the very idea of the feed-in tariff. As Lauber and Mez noted, Clement was able to extract "some major concessions in the government bill, … [including] obtaining reduced rates for wind" (Lauber, Mez, 2006, 112). Additionally, conservatives in both the Bundestag and the Bundesrat (the upper house) opposed the proposed amendment. The RESA 2004 amendment was finally passed, but with only one conservative MP in the Bundestag voting in favor of it. The most significant results of the new RESA were changes in remuneration rates: rates for onshore wind were reduced and low-wind zones excluded, but rates for offshore wind improved and more detailed conditions for small hydro power plants and biomass technologies were laid out. Most importantly, the amendment increased rates for solar PV, compensating for the end of the 100,000 Roof-Program in mid-2003 (Bechberger, Reiche, 2004, 53).

2.4 RESA in the Grand Coalition, 2005 to Today

The lack of consensus regarding the RESA 2004 in combination with the declining support of the Red-Green coalition in a time of economic crisis and rising unemployment put into question the future of renewable energy policy in Germany. While American analyst Paul Runci commented around this time that "The durability of this 'Red-Green' coalition … testifies to the enduring importance and centrality of environmental issues in the consciousness of the German polity," the sentiment in Germany was mixed as Chancellor Schroeder called for national elections a year early (Runci, 2005). The resulting coalition was an unlikely match – the conservative CDU and the SPD – under the chancellery of Angela Merkel, CDU party leader. Merkel was the Environment Minister from 1994 to 1998, and although she showed mixed

interest in the RES-E as party leader, when she entered the role of German chancellor she did not make any drastic changes in disfavor of renewables. Rather, the environmental and renewable energy policies of the Red-Green coalition continued, even broadened in some cases. In particular, activity on the international level in support of renewables has increased, with measures to found an International Renewable Energy Agency (IRENA), which was officially brought into being in January of 2009.

The latest revision of the RESA (*EEG* 2009) was passed by the Bundestag on 6 June 2008 and accepted unanimously by the Bundesrat on 4 July 2008 (BMU, 2008, 12). RESA 2009 takes into consideration the current market conditions for RES and its greatest impact is in higher rates for wind and biomass. The increase in remuneration rates for wind energy is quite noticeable: 9.2 Eurocent initial remuneration for onshore wind turbines and 13 Eurocent for offshore turbines. The rate increase can be largely attributed to the fact that the wind energy branch is continually growing and has formed a powerful lobby organization in the *Bundesverband Windenergie e.V.* (BWE, German Wind Association). This newest amendment is part of the federal government's "Roadmap Energiepolitik 2020," a plan which lays out ambitious targets for achieving goals in all three sectors of the *Energiedreieck*, a "magic triangle" of three goals: supply security, economic efficiency/competitiveness, and environmental sustainability (Kohl & Müller, 2007, 30; BMU, 2006b, 21). Also passed in January of 2009 is a law on generation of heat from renewables, requiring all newly-built housing developments to include renewably-generated heat.

It is clear from these developments that RES-E in Germany has gone from being an obscure topic disfavored by the federal government to a central focus of federal policy. While Judith Lipp wrote in 2007 that "it was not commitment to renewables but the success of policy that carried the country forward to its lead position today," both within the federal government and among the populace RES-E in Germany today benefits from widespread acceptance and legitimacy (Lipp, 2007, 5489).

2.5 Influences upon Germany's Approach to RES-E

Government policy is not produced in a vacuum. It is therefore important to examine the surrounding factors in a society that affect policy formation with respect to renewable energy. Germany's adoption of policy promoting renewable energy technologies has been influenced by both domestic and international factors, under which EU policies play an important role.

Domestic Influences

The wave of environmentalism which rapidly emerged in the 1970s profoundly affected the mindset of the public in Germany. Naturally not everyone is a tree-hugging environmentalist, but there does indeed exist a pro-environmentalist thread in German society which has pressured the government into taking a more progressive stand toward environmental issues. Numerous environmentalist non-governmental organizations such as Greenpeace also have a visible presence.

Party differences play an important role in the development of renewable energy policy within the federal government and parliament. While the SPD and Green Party both support RES-E for their environmental aspects, the CDU/CSU and FDP are more concerned with the economy and job market than environmental responsibility. The party statement from the 2002 parliamentary elections revealed the views of the four parties in office after the passing of the 2000 RESA. Logically, the Green Party has concerned itself the most with renewable energy. Their 2002 party statement even contains the line "Within a few decades we can and will achieve the transition from a fossil to a solar age" (Reiche, 2004, 93). The Green Party demands a quick and effective increase in the percentage of renewable energy in Germany's energy mix. The SPD, while supporting the expansion of RES-E in Germany, officially promoted a more reserved goal of doubling the proportion of RES-E in the electricity mix by 2010 from the 2001 level. The CDU, the major party in the current governing coalition, also promotes the goal of doubling RES-E production but in their 2002 program set no specific timeline for reaching this goal (Reiche, 2004, 94).

The only party to completely disagree with the RESA was the FDP, which publicly described it as a "'national allowance for certain technologies and guarantee of overly high prices, which have above all led to extensive undesirable developments in the area of wind energy utilization'" (Reiche, 2004, 94). While the FDP does support the expansion of renewables, their desire to see this happen in the least expensive method tends to compromise development of RES-E. Their preference is for a quota system, which experiences in Great Britain and other countries have proven to act more as a brake on RES expansion rather than a support. In their 2009 European elections programs all parties state the necessity of renewables as part of the future energy mix, but their different views and approaches may make it difficult for further expansion of renewables.

Party views differ greatly on the issue of a nuclear phase-out. Part of the federal government's comprehensive strategy for a sustainable future energy supply is a planned closing of all nuclear power plants when they reach their lifetime. In the Roadmap 2020 the BMU states several compelling reasons for the nuclear phase-out; critical for RES-E is the security of investments in renewables that is expected to arise from the phase-out. With nuclear power no longer an option, the BMU expects the phase-out will contribute to a speedy modernization of energy supply with an emphasis on decentralized production of energy through renewables (BMU, 2009a, 15).

Furthermore, although RES-E policy is in place in Germany at the federal level, at state and local levels approaches differ greatly. Particularly in the brown coal region in North Rhine-Westphalia, coal interests dispute the RESA. In southern Germany, particularly in Bavaria, regional governments have done their best to prevent the build-up of wind turbines in the mountainous, picturesque landscape, citing concerns over the disruption of the natural scenery. On the other hand, the state of Schleswig-Holstein established a target of achieving 25% wind energy by 2010 in the year 1995 which was already met by 2003 and is now approaching 40% (EWEA/Greenpeace, 2004, 14; Molly, J., 2008, 12). Some cities and municipalities have taken it upon themselves to create comprehensive support programs for development of RES-E, such as Marburg in Hessen and Freiburg in Baden-Württemberg (AEE, 2009).

International Influences

International and European Union-level politics have also influenced Germany's approach to environmental and energy policy. Renewables play an important role in climate change politics. Therefore, in accordance with the Kyoto Protocol and the European burden-sharing concept, the German government made an ambitious pledge to reduce greenhouse gas emissions by 21% from 1990 levels between the years of 2008 and 2012 (Runci, 2005). By 2000, a reduction of 18-20% of carbon dioxide emissions had already been achieved (Lauber, Mez, 2006, 109). This reduction stemmed in part from the shutting down of old coal power plants in former Eastern Germany but also attests to the success of German energy and climate policies.

Additionally, the European Union has set a goal for sourcing 12% of its electricity needs from RES-E by 2010 and 20% from RES-E by 2020. Some consider these goals to be ambitious, while others like Fell of the German Green Party see these goals as not enough. Simultaneously, some countries (i.e. Great Britain, France, Sweden) are planning new nuclear power plants,

which seems to go against the desired renewable energy goals. Germany continues to hold to its nuclear phase-out by 2022, but this stubborn adherence receives much criticism. Many German citizens view this determination as folly – what good does it do for their country to halt nuclear power production when nearby countries continue to expand their own nuclear branches?

A further challenge is the fact that energy demand continues to grow, despite goals of increased energy efficiency. In the "Roadmap Energiepolitik 2020" the German government states a goal of reducing electricity consumption by 11% (BMU 2009a, 20). Yet electricity and energy consumption in Germany and the EU, as elsewhere in the world, continues to grow. In 2006 RES-E use in the EU grew by 8.5 million metric tons of oil (Mtoe), while total energy consumption grew by 5.5 Mtoe, constituting a 7.5% growth in RES-E and a 0.3% increase in total energy use (U.S. Dept. of Energy, 2008). Once again, such statistics cause citizens to question the effectiveness of their government's policies. The German government aims to play the role of a pioneer in energy politics and plays the role very well, but the hope of inducing other countries to follow their example has been less fruitful. While countries such as Spain, and recently Great Britain, have implemented feed-in tariff programs modeled off that of Germany, few are ready to make such ambitious pledges as those made by the German government.

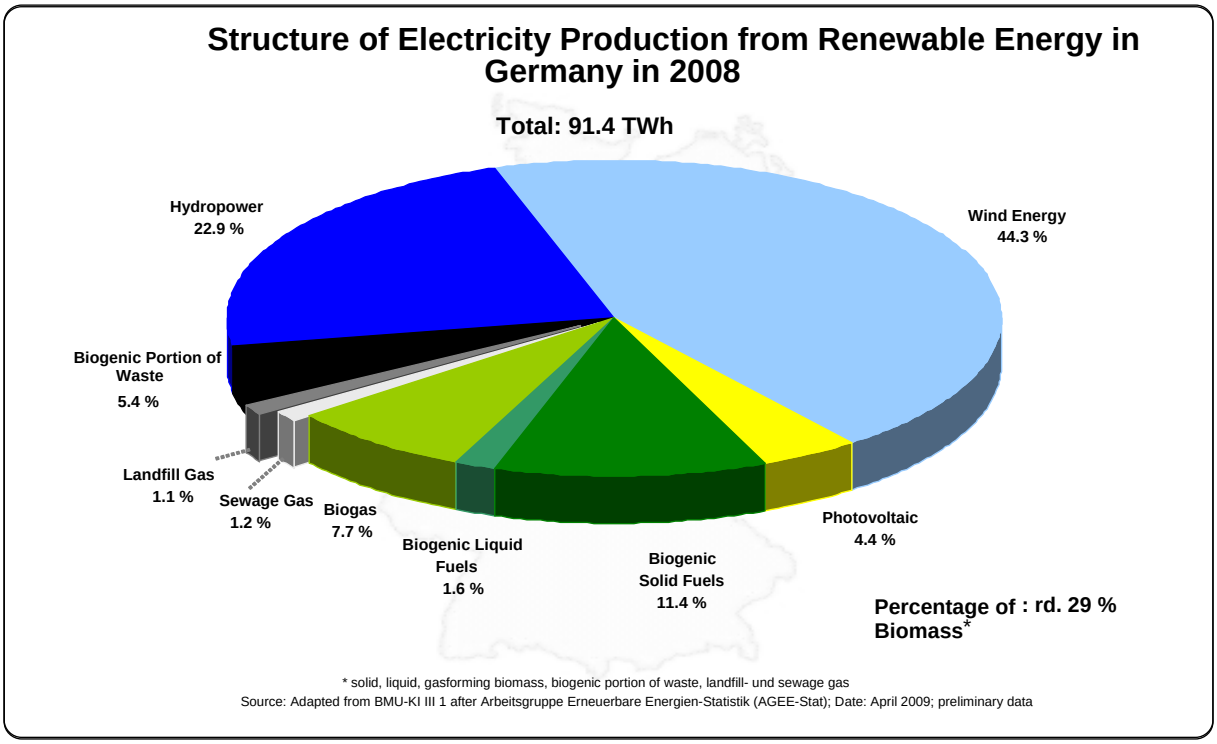
3. Wind Energy: a German Success with Challenges of Its Own

The European Wind Energy Association and Greenpeace stated in their joint work "Wind Force 12" that "there are no technical, economic or resource barriers to supplying 12% of the world's electricity needs with wind power alone by 2020" (EWEA/Greenpeace, 2003, 2). The main limiting factor is lack of political will and dedication. Path dependencies on oil, gas, and coal are still too strong as well as the lobbies for these resources. This is true across the globe, including in Germany. Wind energy has made a name for itself in Germany, however, and this section details this development.

Wind energy was the first renewable technology to take off in Germany after the passing of the *Stromeinspeisungsgesetz* in 1990 and currently makes up the largest portion of renewably-generated electricity in Germany (see Figure 1). In the year 2008 9.7% of Germany's total final energy consumption and 14.8% of net electricity consumption was provided by RES-E. (BMU, 2009b). In the electricity generating field, wind energy is at the top and plans for offshore wind park construction and increased capacity onshore through repowering may keep it at the top for

years to come. However, the development of the technology and its implementation in Germany has not been a smooth road to success, but rather one filled with challenges and pitfalls. Despite the ubiquity of wind energy in Germany, challenges continue to this day. This section will first provide a brief overview of the history of wind energy technology and its use in Germany, emphasizing developments from the 1970s onward. The challenges of onshore and offshore wind in Germany will be discussed separately, followed by suggestions for improvements to the conditions for wind energy in Germany.

Figure 1. Structure of electricity production from renewable energies in Germany in the year 2008. (BMU, AGEE-Stat, 2009)



3.1 Overview of Wind Energy Development in Germany

Pre-1970s

Electricity was being generated from the wind in Germany as early as the early 1920s. The technology had been first developed by the Danish inventor Poul la Cour, in 1892 (Wizelius, 16). In Germany the first wind turbines were produced by the *Vereinigten Windturbinenwerke Dresden* and *Maschinenfabrik VoB*, (from 1924 on named Firma Köster) from Husum (Tacke, 2004, 50). From the beginning of the 20th century large-scale power monopolies were already being established, however, and in the period after the first World War, the electrification of Germany reached rural areas and began pushing wind energy out.

During the 1930s and 1940s, however, using the wind as a source of energy became a popular topic. As Dipl.-Ing. Franz Tacke noted in his book on the challenges of wind energy, "in 'times of crisis' as well as through strivings for independence from energy imports in Germany during the 1930s and 1940s the search for solutions to the production of electrical energy from wind potential was strongly intensified, without however leading to tangible results"[7] (Tacke, 2004, 8). After the Second World War, the electrification of Germany through large, centralized coal and oil electricity generating corporations occurred on a massive scale, a similar trend in other developed countries. Using the wind for electricity production was no longer seriously considered. Even though developments of technology still continued, these were considered more hobbyist or recreational interests. It wasn't until the 1970s, with the world oil crises, that generation of electricity from wind again became a topic in Germany.

1970s to Today

As mentioned above, the FRG was sceptical of RES-E, in particular of wind energy, and thus was tight with the money it handed out for technology research and development. As Matthias Heymann noted, German energy policy centered around nuclear technology and "an influential establishment made up of politics, utilities, and industry that was committed to nuclear energy"[8] hindered the attempts of wind energy supporters and anti-nuclear groups to establish an energy market based upon renewables (Heymann, 1995, 362). Government money for energy research continued to be handed out primarily to anthracite (hard coal), lignite (brown coal), and atomic energy. The first initiative for wind energy in Germany in the 1970s came from a private investor from Switzerland, Walter Schoenball. Together with Hans Dietrich Goslich he founded the *Verein für Windenergie-Forschung und Anwendung*, later *Deutsche Gesellschaft für Windenergie* (DGW). This small, private organization was not especially successful, although its efforts did result in the BMFT commissioning Ulrich Hütter to write a study on wind energy use. In this document, Hütter recommended the adoption of one of his own models. Eventually, the BMFT decided in the winter of 1976 to financially support the development of large wind power generators.

The ensuing project, called GROWIAN (an acronym for *Großwindkraftanlage*) was a serious disaster that seemed to prove the German government's doubts about wind energy. Many consider it an outright blow directed against the wind energy industry–as RWE director Günther

[7] Translation by the author.
[8] Translation by the author.

Klätte said, "We need Growian in order to prove that it doesn't work"[9] (Weinhold, 2006). Heymann called the Growian project not an isolated case, "but rather the expression and symbol of the aid policies until well into the 1980s"[10] (Heymann, 1995, 382). The design was for a wind turbine 100 meters tall and with a blade diameter of 100 meters with a 3 MW capacity. It was erected in the Kaiser-Wilhelm-Koog and put into operation in June of 1983, but within a month, three of the four brake discs had broken. A series of problems ensued and the turbine was put out of operation in 1987. In the end, the project cost what would today be around 54 million Euro and only operated 420 hours (Weltonline, 2007). Shortly thereafter the first commercial wind park was established in the same location, comprised of 32 small turbines.

After the failed GROWIAN project government funding for wind technology research drastically declined. In 1981 government research funds allotted for wind energy amounted to 24 million DM – in 1984 the figure had sunken to 1.5 million DM (Heymann, 1995, 426). Other gigantic turbine projects were funded by the BMFT but faced similar fates as GROWIAN. It was mainly through private investors that research on smaller wind turbines was able to continue. From the beginning there were also numerous restrictions for wind energy use, challenges which continue to hinder wind energy today. Regulatory bodies and the utilities companies both posed challenges for implementation of wind energy. Regarding the first, no nationwide laws regarding building permits for wind turbines existed and legal bodies in different regions chose more often than not to decline permission. Schleswig-Holstein was the first state to establish "Guidelines for the Design, Assembly, and Operation of Wind Turbines" in 1984 (Heymann, 1995, 422). In the case of utilities companies, as stressed above, they disliked the prospects of new competition from renewables and, although they generally allowed network access in the 1980s, were not prepared to take responsibility for the costs of connection, reinforcement of the electricity network, and new transformers (Heymann, 1995, 423). As early as 1986 in political discussions it was clear that market access was the main problem for utilization of wind energy (Heymann, 1995, 424).

Eventually the BMFT realized the value in supporting small, reliable wind turbines rather than unreliable behemoths like GROWIAN. With the advent of the 100/250 MW Mass Testing Program in 1989 that wind energy in Germany became marketable; the Electricity Feed-in Law reinforced the trend. Installed capacity in Germany went from 19 MW in 1989 to 1100 MW in 1995 (Breukers, Wolsink, 2007, 2741). Early implementation of wind energy in Germany

[9] Translation by the author.
[10] Translation by the author.

occurred on largely on a small-scale local level, especially in the state of North Rhine-Westphalia (NRW). With significant local involvement in project ownership and/or development, local acceptance of wind turbines was also high.

As mentioned above, the initial erection of wind turbines occurred without any strategic planning. Pressure from the wind sector led to the revision of the building code in 1996 to allow for the privileging of wind turbines and require designation of appropriate sites in regional land-use plans. Paragraph §35 BauGB specifically states that "in outskirt areas a project is only permissible if public interests are not in conflict with it, sufficient development is secured, and if it … serves the research, development or use of wind or hydropower."[11] (§35.5 BauGB) Tacke argues that the successes of wind energy development in Germany would not have been possible without the revision of the building code, since a great deal of uncertainty in regulating bodies regarding the legal situation for construction in outskirt areas existed prior to the revision (Tacke, 2004, 214). Now regional planning bodies have three zone designations for setting aside wind turbine sites: *Vorranggebiet*, *Eignungsgebiet*, and a combination of *Vorranggebiet mit der Wirkung eines Eignungsgebiet*. The *Vorranggebiet* designates land for a specific, regionally-relevant use – in a plot of land designated as a *Vorranggebiet* for wind energy development, wind turbines have priority and nothing else can be built there if it conflicts with the wind turbines. The *Eignungsgebiet* pertains to §35 BauGB and limits construction of wind turbines to the designated land plot only. Combining the two gives wind turbines priority in a specific area and also prevents them from being built anywhere else in the region (Köck, Bovet, 2008, 532).

However, the revised building code has also posed problems for wind energy. The process of designating possible sites for wind turbines is a process of elimination, a negative approach instead of positive. A series of analyses are undertaken to eliminate sites inappropriate for wind energy according to specific criteria. Settlement areas, areas used or planned for infrastructure, nature protection areas such as bird sanctuaries, local recreation, and areas important for tourism are all typically eliminated from consideration. Since the final decision on appropriate areas for wind energy lies with the regional planning bodies, communities may not be fully satisfied with the final zoning plan. In fact, as Breukers and Wolsink noted, the planning requirement for wind energy has brought about a certain degree of resistance from local municipalities, nature protection organizations and citizens' groups (Breukers, Wolsink, 2007, 2744). Since wind projects are privileged and communities cannot refuse their erection, developers in some cases

[11] Translation by the author.

have alienated local authorities and the local population with an “overconfident and demanding manner” (Jobert, etal., 2007, 2754).

Several slowdown periods have occurred in what has otherwise been a rapid proliferation of wind power in Germany, revealing the necessity of continued governmental support (See Figures 2 and 3). Political debates about RES-E between utilities and the government on the one hand and between the economics and environment ministries on the other in 1996-1997 led to investor insecurities and a slowing of wind turbine implementation. State-level support was able to keep development continuing in some areas, such as in NRW where a comprehensive Rational Use of Energy and the Use of Renewable Energy Sources (REN) support program has existed from 1987 onward (Breukers, Wolsink, 2007, 2741). Slumps in wind power development occurred again in 2000 and 2004 as investors and project developers awaited the decisions of the federal government regarding the EEG and its 2004 revision. The current global financial troubles are expected to also negatively affect the growth of wind energy and all renewables in countries across the globe. Thus, although wind energy implementation has come a long way in Germany and is widely accepted by the public, there are definitely still challenges that stand in the way of future development. The next section will broach some of these challenges.

Figure 2. Development of Electricity Production from Wind Energy in Germany from 1990 to 2008. (BMU, AGEE-Stat, 2009)

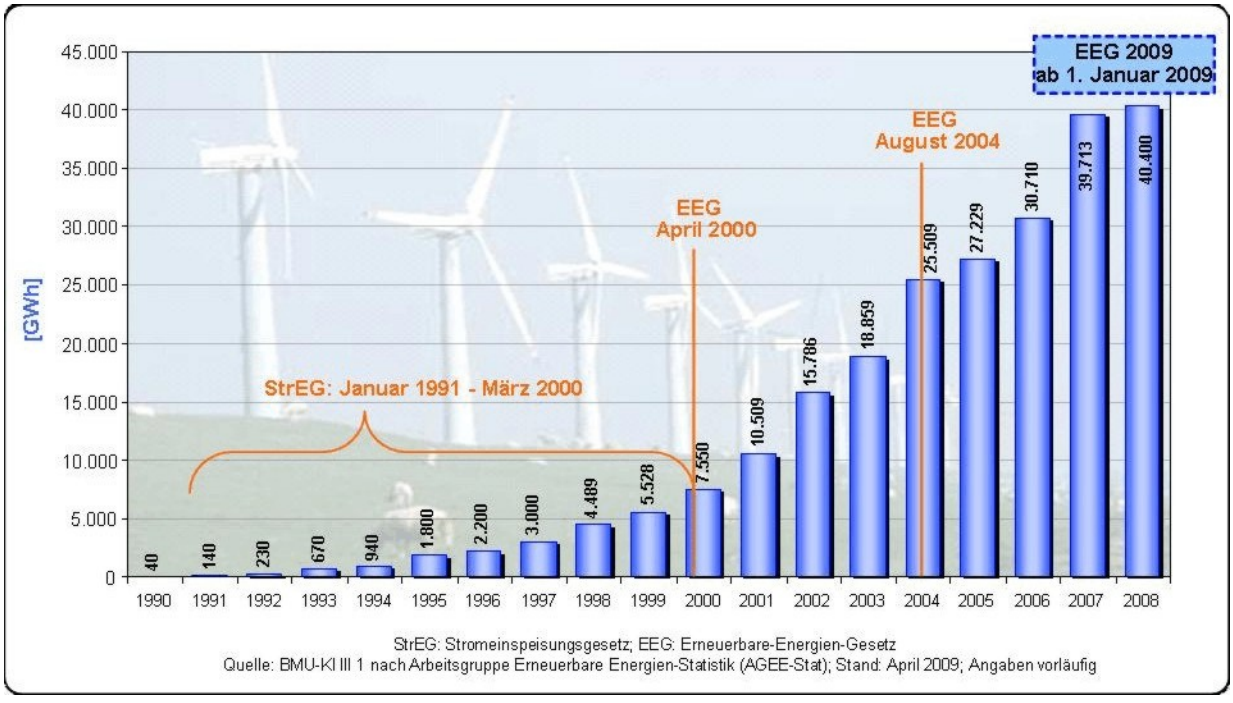
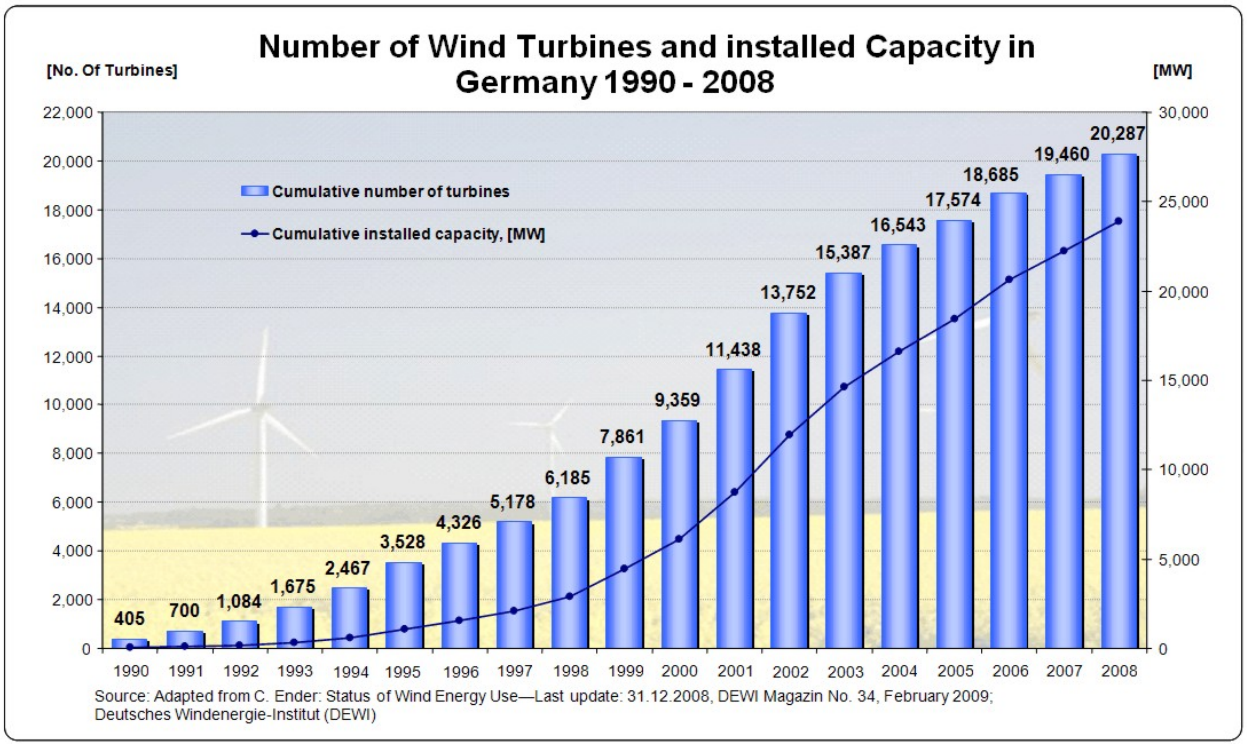


Figure 3. Number of Wind Turbines and installed Wind Energy Capacity in Germany, 1990 to 2008. (BMU, AGEE-Stat, 2009)



3.2 Particularities and Challenges of Onshore Wind Energy in Germany

Despite more than twenty years of experience and learning regarding the implementation of wind turbines in Germany, the process remains lengthy and complicated. Obstacles such as community opposition and lengthy permit processes prolong the planning process and slow the implementation of wind power. Difficulties in the local implementation of wind parks was anticipated as early as the 1980s (Jobert, etal, 2007, 2751). Experience has shown that involvement of the local community can increase acceptance of wind power; it is therefore critical to involve the public from the very beginning. Factors affecting the success of wind power projects can be divided into two categories: institutional conditions and site-specific conditions. Institutional conditions consist of policy measures; site-specific conditions comprise local economical and geographical factors as well as local actors and on-site planning process (Jobert, etal., 2007, 2751). Since policy measures have been detailed above, this section focuses predominantly on site-specific conditions.

Local Involvement

As mentioned above, in the early years of wind energy implementation projects were largely carried out on a local level. Project planners came from the community and many projects were community-owned, known as *Bürgerwindparks* (community wind parks). Wind cooperatives

sprung up in numerous areas, citizens investing in a turbine together and then sharing the revenue from it. By the year 1998, 95% of wind turbines in Germany had been installed by private operators (Scheer, 1998, 19). However, as installed capacity has increased, projects have become increasingly larger in size and taken on a more industrial nature, increasingly being developed by non-local medium-sized companies (Breukers, Wolsink, 2007, 2746). As of 2003, 33% of German wind power plants were owned by private individuals, 11% by communal operators, and 34% by company operators (Enzenberger et al, 2003, in Wizelius, 2007, 145). Therefore, although according to a study in 2004, 66% of German citizens support wind energy, there are increasing conflicts between project planners and citizens, who are not always involved in project development (Forsa, 2004). For a positive wind energy development, it is critical that the planning process remain transparent and open for the local community to participate.

To prevent animosity toward wind turbines and the NIMBY syndrome – "Not In My BackYard" – and alleviate conflicts, citizens' concerns must be taken seriously. These include disruption of the natural landscape, nature protection concerns – especially *Vogelschlag* (bird strike)–and effects deleterious to human health, including sound and visual effects. For most people the greatest drawback with wind turbines is the disruption of the natural landscape. The disparaging terms "*Verschandelung*" – mutilation – and "*Verspargelung*"– referring to the turbines' resemblance of asparagus– represent the negative views surrounding wind power. The value of land for recreation and natural beauty must therefore be weighed when considering possible locations for a wind park. As this is an aesthetic, emotional issue, it must be dealt with carefully. Those who see wind turbines, regardless of their location, as a destruction of natural landscape should consider the fact that the natural landscape in many places has already been disturbed by conventional power plants and power lines. Continued use of fossil fuels will also devastate the natural beauty of the land and has already done so through the effects of acid rain on forests and the aftermath of coalmining and oil drilling.

Nature Protection

While nature protection groups tend to view RES-E favorably, tensions arise over the impact of wind turbines on birds and bats. Numerous studies have been undertaken regarding this relationship and the situation is more complicated than it first appears. According to the Friends of the Earth Germany (*Bund für Naturschutz* Deutschland, or BUND), around 8,000 birds die each in Germany from wind turbines, whereas five to ten million die every year from high-voltage power lines and street traffic (BWE, 2008). Breeding birds that do not migrate can adapt

to wind turbines in their territory fairly easily, whereas migrating birds are more sensitive. Conflicts with birds can be greatly minimized by utilizing data on bird migration, nesting, and feeding zones during planning and even earlier when suitable areas for wind parks are demarcated in regional land use plans. Turbine developers are continually improving designs taking into consideration bird issues – sometimes an alteration in turbine height or the addition of lights on turbines can help reduce collisions. The modern design of a round concrete turbine tower also minimizes bird casualties in comparison to earlier turbines, which had a lattice tower construction upon which birds could perch. The case with bats is a bit more complicated and more research needs to be done on the relationship between bats and wind turbines, but turbine developers are experimenting with various amelioration methods, including spinning the turbines faster during the migration period to create strong enough winds to alert the bats of the presence of the wind turbines (Heinemann, 2008).

Human Health Concerns: Sound and Visual Effects

Human health concerns – which also affect other living creatures – involve sound and visual effects. Wind turbines produce two types of sound, mechanical (from gears or generator) and aerodynamic (from rotor blades or tower). Sound disturbances can largely be avoided by placing the turbines far enough away from communities, and in fact, modern wind turbines are much quieter than older models. At a distance of 50 meters from a turbine, the average noise level for a modern turbine is 50-60 dB, approximately the level of conversation of office noises. At a distance of 300-600 meters the noise level is on average 35 dB, which is under the guide value for night quiet hours in the *Technische Anleitung-Lärm* (technical instructions on noise) (Löser, 1998, 80). “Disco effect” is the name given to the visual effect produced by the reflection of sunlight off turbine blades. Nowadays this is not a major problem, as it can be resolved by using a matte paint. The casting of shadows is perhaps a more disturbing phenomenon, but with proper distance from communities and placement of turbines this disturbance can also be largely avoided. According to general standards, a house may not be struck by shadow from an installation for more than 30 minutes daily. An additional disturbance is the possibility of *Eiswurf* – the shedding of ice crystals – on very cold days. On turbines near roadways or paths heated rotor blades can be installed to prevent the crystallization of ice on the blades (Peters, 2004, 94). With wise planning, these problems are remediable.

Technological Challenges: Network Connection, Balancing Energy

More problematic are the issues of network connection and the need for balancing energy. It is unarguable that the electricity networks everywhere worldwide need to be strengthened and built up in order to accommodate the feeding-in of many small-scale RES-E generators. The German energy agency DENA has estimated that its domestic network must be reinforced 850 km by the year 2015, a necessity that likely will not be accomplishable on this short time scale. Network connections to neighboring countries must also be strengthened to allow for the future visions of a Europe-wide electricity trade to take place. Strengthening the network is a very expensive procedure and one in which the utilities are prepared to invest six billion Euros, but even this will not cover the full costs. Furthermore, a private enterprise is needed to purchase the network, but no possible buyer has yet been found. This would enable a state-wide network to be formed, increasing efficiency, uniformity and equality in electricity transmission (BMU, 2009a, 18). At the 2009 World Energy Dialogue in Hannover in April the strengthening of the network was one of the main talking points, as was the option of high-voltage direct-current transmission (HVDC) for reducing loss when transmitting electricity over long distances, proving the significance in the wind energy sector of solving the network problem.

A final particularity regarding wind energy is the debatable issue of *Regelenergie*, balancing energy. Because the wind does not blow all the time to produce a stable amount of electricity, a reliable backup is needed. Currently this is provided by conventional power plants – coal and nuclear. Critics of wind energy and renewables in general argue that it is not possible to convert to generate 100% of electricity from renewables since there is a constant need for balancing energy. However, as the BWE reports, “the production of wind energy requires balancing energy only in marginal amounts … because today one can predict the advent of wind very well” (BWE 2005). Although energy giants like Eon and RWE have made official announcements that their costs for balancing energy have increased with the increased capacity of wind energy in Germany, the demand for balancing energy decreased from 2002 to 2004 by 12% (BWE, 2005). If all the wind turbines in Germany are viewed as one network, then the fluctuations in wind energy balance out fairly well, even more impetus for a strengthened state-wide electricity network.

Repowering

Additionally, the revised §35 BauGB complicates the possibilities for repowering in Germany. Repowering is the replacement of older, lower capacity turbines with newer, higher

capacity turbines. Wind turbines which were erected prior to the 1996 §35 BauGB revision in locations not included in community or regional land-use plans for wind turbine erection cannot be repowered because, under the revised §35 BauGB the erection of a wind turbine would not be approved in the location. Thus, once the old wind turbine is deconstructed, no new turbine can be erected in its place. A solution has yet to be found for this dilemma, also a topic of much discussion in the wind energy sector.

All of these factors make for a complicated environment for wind energy. Most of the animosity regarding wind turbines stem from misinformation and can be remedied through informational events, town hall meetings, organized visits to or family days wind parks, etc. Several studies on acceptance of wind turbines have shown that seeing a wind turbine up close increases acceptance considerably (Zoll, 2001, 238). As Breukers and Wolsink suggest, “Instead of an approach that focuses on implementing as much wind power as possible … the strategy should be to implement wind power as good as possible” (Breukers, Wolsink, 2007, 2748).

3.3 Particularities and Challenges of Offshore Wind Energy in Germany

With the exhaustion of land space onshore for wind energy and the possibility of generating up to two times the electricity demand of the entire European Union, the potential for offshore wind energy seems promising. The German federal government believes that offshore wind has an important role to play in the future of German electricity supply and has ambitious plans for installing 10,000 MW of offshore wind capacity by the year 2020. However, offshore wind energy has yet to be developed in Germany and critics are skeptical of these goals, considering that the first offshore wind park, intended for operation in October of 2008 off the coast of the island Borkum, has not yet been constructed. As a result, meeting the government’s goal will be a major feat. Technical challenges, but especially financing, are the greatest obstacles for offshore wind energy.

Technological Challenges

Offshore wind turbines have to be incredibly strong and sturdy to withstand the high wind speeds and erosion from the sea. Wind speeds at sea range between 70 and 100% higher than on land, wherein lies the great potential for generating so much electricity, but it also means far greater wear on the machinery. The salt air also causes more rapid deterioration of components. The challenge in Germany is even greater because, unlike neighboring countries Denmark, Sweden, and the Netherlands, offshore turbines in Germany have to be constructed 30 to 100

kilometers out to sea due to stipulations in the Federal Nature Conservation Act (Bundesnaturschutzgesetz, BNatSchG) (Max-Planck, 2006). The "Borkum-West" project mentioned above consists of twelve 5 MW-capacity turbines, each nearly as tall as the Cologne cathedral, to be erected 45 kilometers of the island of Borkum, where the sea is up to 30 meters deep (Knauer, 2009; Max-Planck, 2006). This requires massive bases and thick underwater cable to transport the electricity to the coast. In the case of the "Borkum-West" project, construction was initially stalled by weather conditions, but now the problem is financing.

Financing Issues

Wind turbines offshore are twice as expensive as those onshore, up to 2.5 million Euro per installed MW (Energie 2006). Not only are they more expensive to produce, resulting in higher investment costs, operation is also more expensive. In the initial stages of planning both smaller companies and the large intended to invest in projects. According to a Spiegel article in January of this year, however, "Banks are reluctant to lend money to these kinds of project development companies, most of which are heavily reliant on outside financing. The smaller wind farm investors have … overextended themselves … and the big companies like E.ON or EWE are delaying putting down the expensive cables that would connect the offshore wind farms to the grid because none of the turbines are in operation yet" (Knauer, 2009). At the Sixth National Maritime Conference in Rostock in March of this year the parliamentary state secretary of the BMU Michael Müller refuted the statement that banks are hesitating to support offshore wind projects and stressed that investing in such projects is in fact a critical means of overcoming the financial crisis (Müller, 2009). This statement reveals the goals of the federal government to create a "Green New Deal" to solve the financial crisis and create a renewable energy revolution. This factor will be discussed in the concluding section.

Nature Protection

Nature conservation conflicts center on the effects of offshore wind farms on birds, sea mammals, and fish. In regards to birds, studies show that sea and resting birds show avoidance or habituation to wind parks, in comparison to migrating birds, for whom offshore wind parks disturb their migratory path and cause collisions (bird strike). Noise emissions from the construction of wind turbine foundations can interfere with marine mammals, but these effects can be minimized through mitigation measures, such as bubble curtains, repellence by pingers, machines which mimic the sonar signals of marine mammals, and avoidance of construction during sensitive life cycle stages. In all cases environmental impact assessments are carried out

according to national level requirements for the granting of permits. Developers in Germany are required to undertake monitoring studies at their own expense (Bruns, E.; Steinhauer, I., 2005, 24). This obligates them to consider the environmental impacts of wind parks in their planning.

Seascape

As with onshore wind farms, devastation of the natural landscape – or rather, seascape – is a concern for some people. This is particularly the case for offshore wind parks planned near tourist destinations. Since the seaside is a prime vacation spot, communities fear a significant decline in revenue from tourism with the implementation of wind turbines within view from their area. Studies have been done to evaluate the effects of wind parks on tourism, most with the outcome that wind energy can be used positively to increase tourism, by offering tours of wind parks. In the case of offshore wind energy, this is slightly more difficult, but the visual impact can be greatly minimized by strategic placement of turbines, e.g. directly behind one another in rows instead of staggered.

While the federal government maintains high hopes for offshore wind energy to make a significant contribution to Germany's future energy mix, others are skeptical. The firm Enercon, the market leader in wind power in Germany, finds the concept of offshore wind in Germany a mistake. Green Party Energy Spokesperson Fell believes that offshore wind energy will not play nearly as important a role in the future German electricity mix as the federal government anticipates. In any case, offshore wind energy in Germany has not faced the same success that it's onshore counterpart has, despite its inclusion in the RESA and the increase of remuneration rates for offshore wind in the past few RESA amendments. As with onshore wind, there are many factors to consider.

3.4 Factors for Acceptance and Improved Implementation of Wind Energy

Positive/successful implementation of wind energy projects is first and foremost dependent upon keeping the planning process open and involving stakeholders at all stages. Early projects carried out by local actors were received positively because they allowed for the greatest amount of public participation; commercial planners of today's larger projects should take this as a lesson into consideration in designing their projects. Wind energy has made considerable headway in Germany, but there is still potential for greater growth, particularly in the offshore branch. While German federal policy provides adequate support for wind energy through the

RESA, the policy challenges lie more so on the regional and local level. As mentioned above, the states of Bavaria and Baden-Württemberg have created numerous roadblocks to prevent the erection of wind turbines in their regions. Creating wind energy-friendly policies requires changing attitudes toward wind energy.

By no means an easy task, positive views of wind energy can be fostered through public relations measures. Educating the public on the truths about wind energy is especially critical in increasing acceptance and debunking the myths surrounding the technology which still circulate in society. Allowing communities financial participation in projects – i.e. ownership of the park, benefits from tax money and renting of the land–serves to greatly increase acceptance of wind projects. When communities are shown the benefits derived from a wind park in their area that directly affect them, they are much more likely to support wind energy. In the past few years developers in Germany have come to realize the importance of public relations measures and are once again integrating citizens in the planning of wind projects.

4. Conclusions: Ongoing Challenges for Renewable Energy Development

As the above sections have shown, Germany has come a long way since the 1970s in promoting and developing RES and its RESA policy support for renewables is a pioneering act that has served as a model for several other countries. The German renewable energy policy is successful in the sense that the country will achieve its Kyoto Protocol greenhouse gas emissions reductions pledges, and in the sense that it has promoted the implementation of renewables and advances in RES technologies. Federal government commitments to renewables have continued since the StrEG of 1990. Public opinions on RES are still divided, with the phenomenon that the loudest voices tend to be those against renewables. The majority of the population is in favor of renewables, creating a mostly favorable environment for renewables in Germany, but this is not necessarily enough to break the country's path dependencies on coal, oil, and nuclear power that still exist. Continued federal support of renewables and increased state and local support can help legitimize renewables as a form of electricity production competitive with fossil fuels and nuclear power. The challenges that lie in the way of continued expansion of RES-E are not necessarily particular to Germany, but rather factors that all countries must take into consideration.

Objectives of a nation's energy policy do not always harmonize with those of a policy designed specifically for renewable energy. As mentioned previously, in Germany, the energy legislation is in principle guided by a so-called *Energiedreieck*. A successful renewable energy policy is able to achieve the desired environmental goals of the state and establish RES-E as a primary energy source, at this point in a mix of renewables and more efficient, fossil sources, such as coal power plants using the technology of combined heat and power –CHP. Renewable energy sources must therefore receive a level of legitimacy as a mainstream form of energy generation. This can be achieved by recognizing the fact that RES-E have not only environmental benefits, but also serve the other interests in the *Energiedreieck*: long-term security and economic competitiveness. Already the economic benefit of RES-E through the creation of new jobs has been realized in Germany. As of 2008, around 84,300 to 90,000 people were employed in the wind energy sector (AEE, 2008). German expertise in RES-E technology improves the national economy not only domestically, but also abroad through the exportation of technology to other countries. The Enercon wind energy firm, for example, is involved in markets in over thirty countries and has production facilities in India, Portugal, Brazil, Spain, and Turkey (Enercon, 2009). In promoting renewable energy, governments should therefore emphasize the social and economic benefits in addition to the environmental ones.

Transitioning from an energy mix heavily dependent upon and nuclear power and fossil fuels requires contending with the powerful lobbies supporting these energy sources and breaking long-established path dependencies. The German government is on the path to breaking its dependency upon nuclear power through its phase-out plan. Sticking to this plan is necessary to provide investment security in renewables. Despite its devastating environmental effects, coal will continue to play an important role in energy mixes across the globe for at least the next fifty years. Without well-established renewable energy markets, as oil becomes scarcer and prices rise, it is easier for countries to turn to coal. Even in Germany, where renewables have a fairly significant role in the energy mix, this is the case, for the country has substantial domestic coal reserves. During the Schroeder administration the decision to continue subsidizing anthracite coal was a topic of much debate (Reiche, 2004, 192). The German government has included a discussion on coal in its Roadmap 2020 and intends all future coal power plants to be CHP and super-efficient (BMU, 2009a, 16). One must keep in mind, however, that even super-efficient coal power plants are just a short-term solution, for eventually coal supplies will also be exhausted, and even super-efficient coal plants still contribute to climate change.

Propagation of false information about RES-E in the media, by the utilities giants, and in other public arenas is naturally a significant hindrance to RES-E development. One of the most common arguments against renewables is that they are more expensive than fossil energy sources since they require subsidizing. This argument only seems to be true because the external costs of conventional energy sources have not been internalized. If the negative effects of producing energy from conventional sources – environmental, health, etc. – are taken into account, then renewables would prove the better choice. This is the idea behind putting a price on carbon through a cap and trade program or a simple carbon tax. The European Carbon Trading System (EU ETS) is a cap and trade program seeking to reduce carbon dioxide emissions and simultaneously help spur the transition to renewables, but at this point in time it is more viable in theory than in practice. Since the external costs of fossil fuels have not yet been internalized, renewables still require support such as a feed-in tariff to establish a place in the electricity market.

Transparency is critical for federal level policies and actions. An unequivocal commitment to renewables and clarity in policy are necessary. While political views are usually short-term, lasting the two, four, six, etc. years of a politician's term in office, for successful development of RES-E and the transition to an environmentally-friendly, sustainable energy system, long-term views are crucial. This means that the goals for RES-E established by one administration must be maintained and promoted by future administrations, regardless of differences in party views. In Germany this has thus far been the case, although there were fears in 2005 with the advent of the Merkel administration that the RESA would no longer be continued. With social and economic concerns and many powerful lobbies in these areas also putting pressure on politicians, it can be difficult to maintain a strong commitment to environmental issues.

The financial crisis in which the world finds itself today may very well be the impetus needed for the shift in societies toward RES-E. Talk has begun of a "Green New Deal," promoting RES-E and other sustainable industries to create jobs and pull economies out of recession. The idea is promising, but cannot occur without a major value change in industrial societies. As written in a BMU brochure from 2006 on renewable energies as an innovation for the future, the way to a sustainable energy sector can only be achieved by a value change from "'always further, always faster, always more' to 'better to live better than have more'" which "leads away from a constantly growing consumption of goods to a qualitative growth of the satisfaction of one's

needs and sharpens sensibility for the environment"[12] (BMU, 2006b, 17-18). Whether or not the current financial crisis is a big enough crisis to cause this value change is still uncertain, for on the other hand, it has also resulted in decreased funding for renewable energy projects.

What is certain is that the German government has created a powerful, pioneering policy for promoting renewable energy technologies. Germany's thriving wind energy sector bears witness to the effectiveness of a feed-in tariff for establishing RES-E in the electricity market. Taking into consideration the example of Germany's policy development and the multitude of factors discussed here, it is hoped that other countries will give as much attention to renewable energy as has Germany. Despite the many issues one has to face, fostering renewables at this point in time is highly opportune and a wise decision.

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