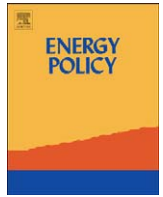


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The diverging paths of German and United States policies for renewable energy: Sources of difference

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ABSTRACT

The United States and Germany started out with very similar policies for renewable energy after the energy crisis of the 1970s. By the year 2000 they were on very different policy paths and, as a result, the German renewable energy industry has moved well ahead of that in the United States, both in terms of installed capacity in the country and in terms of creating a highly successful export market. In this paper, we reject some of the conventional explanations for this difference. Instead, these differences arise from the intersection of contingent historical events with the distinctive institutional and social structures that affect policy making in each country. Our analysis of the historical path-dependent dynamics of each country suggests that those who wish to further renewable energy policy in the United States need to take into account these institutional and social factors so that they will better be able to exploit the next set of favorable historical circumstances.

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1. Introduction

Why have Germany and the United States developed such different policies for supporting renewable energy? Germany has become the world leader in installing renewable energy technologies and one of the dominant countries in making them for export. Many observers, including renewable energy advocates in the United States, attribute that success to the German government's strong policies in support of renewables, and often advocate that the United States should take lessons from Germany (e.g. Aitken, 2005; Bradford, 2006; Swisher and Porter, 2006). While the renewable energy industry is certainly growing in the United States (EIA, 2007, Table 2), it has not kept pace with that in Germany (for comparison, see IEA n.d.). A better understanding of the sources of these differences can help analysts understand both countries' trajectories and the potential and limits of transnational learning for energy policy.

Germany and the United States started out on remarkably similar paths in terms of developing renewable energy. At a crucial historical juncture, policy entrepreneurs in Germany pushed their country toward a different path and that divergence interacted with different institutional structures, contingent circumstances, and political and policy framing of renewable energy. Those differences in turn reinforced and magnified the

divergence in the paths, leading to the current situation. While some of those differences are eroding, some are still very much in evidence and suggest that leaders in the United States will need to consider both institutional changes and a re-framing of energy policy, and particularly the role of renewable energy in it, in order to adopt an aggressive policy to pursue renewable energy.

This paper will begin by critiquing simple explanations for the differences between German and the United States renewable energy policy. While some of those explanations contain important factors, they are inadequate in themselves and distract attention from other, even more important, explanatory factors. The paper will then present a brief historical narrative of the policies in both countries, emphasizing the points of convergence and divergence and the particular events and institutions that magnified what were initially small points of divergence to the widely varying policies that now exist between the two countries. This historical institutionalist analysis points to the importance of exploiting opportunities for substantial change, and what that exploitation requires, in order for the United States to have a more aggressive renewable energy policy and robust industry.

2. Weaknesses of conventional explanations

The first step in understanding these differences is to eliminate explanations that do not stand up to scrutiny. The first, and most obvious, inadequate explanation is resource endowments. By any measure, the United States has an immense comparative

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advantage in renewable energy resources.¹ While the point may seem trivial, it discounts any simple functionalist explanation that the countries are just responding to their natural comparative advantages.

A different explanation, also inadequate, is that German public opinion supports renewable energy more strongly and so German politicians respond to these pressures with stronger policies. While intuitively appealing, this point also has limited explanatory power. First, public opinion does not always drive policy making; while there is a relationship, it is a complex and contingent one (Kingdon, 2003, pp. 65–67). Second, public opinion in the United States and Germany on environmental protection in general and renewable energy in particular has not been very different. In the United States, large majorities have expressed a preference for renewable energy since 1977 and continuing to the present day (Farhar, 1994, 1996a,b, 1999). Poll data from 1995 show that the public chose renewable energy as the area in which the Department of Energy should devote the majority of its research funding and that view has continued until as recently as April 2007 (Farhar, 1996a; Broder and Connelly, 2007). German public opinion expresses similar views. German support for renewable energy, and for environmental values more generally, has been especially strong since Chernobyl. Public opinion on climate change, closely related to renewable energy, has been very similar in the United States and Europe (Brewer, 2003). However, Lauber and Mez (2004) note that, if anything, government support for renewable energy has led, not followed, public opinion. German public opinion mirrors European public opinion more generally, which strongly supports renewable energy and does so for explicitly environmental reasons (Commission of the European Communities, 1982; European Opinion, 1993; Attitudes, 2006).

Germany does not have an advantage from being the first to work on these technologies or have a comparative technological advantage in them. Both countries have large and sophisticated manufacturing systems and both countries invested heavily in research and development beginning in the 1970s, as detailed below. In terms of wind technology, Heymann points out that both the United States and Germany had very similar technological strategies from the 1970s on, diverging only much later (Heymann, 1998). Both countries have much to gain from garnering the manufacturing jobs that would come from developing renewable energy technologies.

Some observers point to the Green Party in Germany as an important advocate within the government for renewable energy. Certainly, Germany's election system, being a complex form of proportional representation, provides much greater political influence to small third parties than is the case in the United States (Adolino and Blake, 2001, pp. 58–61) and the Green Party has been important in energy policy in Germany, as discussed below. However, Germany began putting strong policies for supporting renewable energy into place before the Social Democratic/Green Party coalition came into power in the late 1990s and renewable energy has enjoyed more bipartisan support in Germany than in the United States.

3. Response to crisis: parallel paths

The energy crisis of the 1970s, starting with tight energy markets in 1971–1972 and then the oil embargo in 1973, catalyzed

substantial changes in energy policy in both countries. The United States created new institutions, pushed for greater domestic supplies of fuel, and dramatically increased research and development spending on all forms of energy, including renewable energy (for a detailed history see Laird, 2001). Created in 1977, the new Department of Energy (and its forerunner from 1975, the Energy Research and Development Administration) contained a separate division for renewable energy, then called solar energy, which had its own Assistant Secretary. This new agency meant that renewable energy had an institutional champion for the first time in the United States federal government, creating both an institutional base for promoting the technology and a target of lobbying for those who sought greater support for renewables. And support they got, as the budget for renewable energy R&D (not including energy efficiency) shot up from \$15.4 million in fiscal year (FY) 1975 to \$542 million in FY80.² It went down abruptly thereafter (Laird and Stefes, 2007).

Germany experienced a very similar set of energy policy developments. Renewable energy caught the attention of German policy makers in the wake of the 1973 oil crisis. In its attempts to lower dependency on oil imports, Germany's government significantly increased R&D spending for domestic energy sources, including renewable energy, though the bulk of the spending went toward nuclear and coal energy sources. Between 1974 and 1982, annual public expenditures for renewable energy research and development grew from 20 million DM (about 10 million USD) to over 300 million. According to Jacobsson and Lauber (2006, pp. 261–263), this increase in R&D spending served several functions for successive developments in the renewable energy sector. First, the spending was sufficient to attract the attention of universities, private research institutes, and smaller start-up companies, which created research networks and thereby a reservoir of technical knowledge. Furthermore, renewable energy advocates were able to demonstrate through numerous publicly financed wind power and solar projects that renewable energy had indeed the potential to become a significant source of energy. Third, renewable energy development was not restricted to technical innovations.

Stakeholders in renewable energy began to organize in various associations such as the *Bundesverband Solarindustrie* (Federal Association for the Solar Industries) and *Eurosolar* to increase their political influence. Advocates of renewable energy were especially successful in finding allies among members of the German Bundestag (the lower house of the federal parliament) some of which were founding members of the new renewable energy associations, such as the Social Democrat Hermann Scheer, who co-founded *Eurosolar*, and actively supported the further development of renewable energy. In 1980, the first Enquete Commission of the Bundestag on energy recommended more efficiency and the expansion of renewable energy (Jacobsson and Lauber, 2006, p. 261).

Both Germany and the United States experienced similar failures in this period. Heymann (1998) argues that the governments of both countries promoted the development of wind power by using what he calls a top-down strategy, providing subsidies for sophisticated and high-efficiency turbines based on scientific and engineering principles that were scaled up in size very quickly. In the process, both governments underestimated the technical challenges and subsidized large turbines that worked very poorly or not at all, a process that exhibited

¹ For example, compare the solar insolation maps for the United States, available at http://www.nrel.gov/gis/images/us_pv_annual_may2004.jpg and that of Europe, including Germany, available at <http://re.jrc.ec.europa.eu/pvgis/apps3/pvest.php#>.

² Figures are in current dollars. In 2000 constant dollars the figure is well over \$1 billion, and the budgets actually peaked in FY79. Source for FY75 is US Department of Energy (1978) and for FY80 is US Department of Energy (1981).

what he calls “hubris.” Heymann contrasts these failures with the Danish “bottom-up” strategy of more gradual scale-up and greater emphasis on artisan experience and technical learning. The result was that the United States and German wind industries fell behind the Danish industry and by the end of the 1980s there was only one manufacturer of large wind turbines left in the United States.

The account in Bergek and Jacobsson (2003) challenges part of Heymann’s analysis. They point out that while Germany did have a large wind project that failed, the government also funded R&D on small- and mid-sized wind turbines, and those turbines were coming into the market by the late 1980s. Similarly, in the United States the government supported the deployment of small-scale residential solar technologies through tax credits (Rich and Roessner, 1990). Also, R&D programs targeted both large and small applications. That said, the largest sums of money for R&D and for demonstration projects went to large-scale applications (see e.g. US House, 1978, esp. p. 28). Contemporary analysts criticized the government programs for their emphasis on top-down, large-scale programs (Hammond and Metz, 1977).

During the 1980s, renewable energy also experienced other setbacks in both countries. In Germany, although the federal government significantly increased spending on the development of domestic energy sources, the bulk was not spent on renewable energy but on its competitors, nuclear energy and coal, which received subsidies of up to a hundred times more than renewables. Moreover, such spending as there was on renewable energy focused on the development of off-grid technologies destined for the export to developing countries (Jacobsson and Lauber, 2006, esp. pp. 261–262, present this history in detail). It also became clear that the German government was not united in its support of renewable energy. Political cleavages within the government that should later dominate the debates about it appeared early on. While the *Bundesministerium für Forschung und Bildung* (BMFB, Federal Ministry of Education and Research) supported spending on renewable energy development, the *Bundesministerium für Wirtschaft* (BMWf, Federal Ministry for the Economy) argued that the renewable energy technology was not mature enough to justify large subsidies. The BMWf has traditionally been a strong supporter of nuclear energy and Germany’s coal industry. The decision of the conservative government under the leadership of Chancellor Helmut Kohl, which had taken office in 1982, to cut R&D spending for renewable energy by almost half was another worrying sign that it might remain a negligible part of Germany’s energy mix (Lauber and Mez, 2004, p. 599).

The United States renewable energy policy suffered even more severe setbacks in the early 1980s. By the time President Reagan took office in 1981, renewable energy had become a highly politicized and partisan issue (Laird, 2003) and he aggressively shifted resources away from renewables. That shift showed up in several forms. First, President Reagan cut the R&D budget for renewable energy drastically (Laird and Stefes, 2007). Second, he reduced the size and influence of the staff in the renewable energy division in the Department of Energy. The loss of overall positions for permanent civil servants, along with pressure from political appointees that headed the agency, pushed out many of the most experienced managers from that part of DOE, undercutting the agency’s effectiveness (Kraft and Axelrod, 1984). Finally, tax credits that Congress had passed in the late 1970s expired in 1985. The credits had primarily aided homes and businesses that had installed solar heat and hot water systems. They expired just as oil prices were dropping and the result was a rapid collapse of the solar energy industry in the United States: a 70% decrease in the shipment of such solar collectors and more than half of the firms in the industry going out of business (Rich and Roessner, 1990, p. 197).

4. Turning point: the re-emergence of energy policy

By the late 1980s and early 1990s both countries experienced problems that led them to re-consider their energy policies and once again put renewable energy back on their agendas in a more serious manner. Nevertheless, at this point their paths (despite their surface similarities) began to diverge. Germany and the United States responded differently to the changing circumstances of energy policy and those differing responses, which in the German case became self-reinforcing, led to very different situations by the twenty-first century.

In Germany, two factors undermined renewable energy’s primary domestic rivals, coal and nuclear energy. First, the 1986 Chernobyl disaster discredited nuclear energy among the German population. Although the explosion of the fourth reactor of the nuclear power plant in Ukraine’s Chernobyl had taken place thousands of miles away, Germany experienced elevated radiation levels, which caused anxiety among many citizens, who sometimes reacted with dramatic lifestyle changes.³ The successive attempts of Germany’s nuclear industry to placate widespread fears have so far failed to improve its image. Recurring smaller incidents in Germany’s nuclear power plants contradict the assurances that German-built nuclear power plants are fail-proof (Reiche, 2004, pp. 46–55; *Der Tagesspiegel*, 2007).

The attack on renewable energy’s most important competitor, Germany’s enormous coal industry, came from two sides. Germany is the biggest producer of brown coal and relies on coal for over 50% of electricity production. Yet coal mining, especially black coal mining, in Germany is expensive and has only been sustainable with the help of massive government subsidies. These subsidies have come under scrutiny by the European Union, which ruled these subsidies illegal. The other factor that has undermined the political support for coal, which is one of the dirtiest sources of energy, has had its origin in the fast-growing movement against global warming. Long before climate change became a concern in the United States, German policy makers moved this issue to the top of their environmental agendas in the late 1980s. A Bundestag Enquete Commission on Climate Change recommended a sharp reduction in CO₂ emissions in the late 1980s, advocating a fundamental reform of Germany’s energy policy (Lauber and Mez, 2006, p. 106). The aversion to nuclear power and the desire to reduce CO₂ emissions opened an opportunity for renewable energy, especially in the area of electricity generation.

The energy status quo in the United States came under different stresses, but those problems also opened up opportunities for renewable energy. Chernobyl had little effect on the United States nuclear industry; it had been moribund since the Three Mile Island accident in the 1979 (Duffy, 1997, Chapter 7). In contrast, the Exxon Valdez oil spill in Prince William Sound, Alaska in 1989 came at the same time that oil production in Alaska began to decline, reminding the United States policy makers and the public of the vulnerability of the energy system (Alternative Energy, 1992, p. 581). However, the biggest push for a new energy policy came in the wake of the Persian Gulf War of 1991, following Saddam Hussein’s invasion of Kuwait. Though President Bush (41) had been developing a more comprehensive energy policy prior to the war, it was the war itself that put the issue on the agenda and led to the 1992 Energy Policy Act (Smith, 2002, pp. 34–36). This Act contained many features, the most important of which for renewable energy was production

³ For instance, the government warned citizens to abstain from eating wild mushrooms and game, which had accumulated dangerous levels of radiation. Parents also rejected feeding their children fresh milk and instead began to hoard condensed milk that was produced before the accident.

tax credits, especially for wind. These credits worked differently than the tax deductions from the 1970s that subsidized the purchase of renewable energy equipment. The production tax credits gave the tax break for actually producing electricity from a renewable source, with wind a certain amount per kilowatt-hour (Lazzari, 2004, p. 7). Analysts have given the production tax credit much of the credit for wind's growth in the United States, noting that such growth has sharply declined when the tax credit has lapsed (US DOE, 2007). The Act also authorized a substantial R&D program but did not, of course, provide the actual appropriations for it (Lazzari, 2004, p. 7). These policies set the broad pattern for the rest of the 1990s, production tax credits that needed almost yearly renewal, occasionally lapsing, and a constant battle in Congress over the renewable energy R&D budget, which resulted in an unstable budget that never grew significantly.⁴

5. Diverging paths: the feed-in tariff

In this same period of time, Germany began changing its energy policies in response to the problems noted above. In particular, one of the reform proposals included the introduction of a feed-in-tariff (FIT) for renewable energy, a policy mechanism wholly different from those found in the United States. During this time, not only did the substance of German policy start to change, but Germany also, through a gradual process, developed ever-stronger and more long-term policies to support renewable energy. Thus, its path diverged from the United States and that divergence grew wider over time, as the new institutions and industries in Germany reinforced the new approach to the issue. However, Germany's path was neither simple nor inevitable but instead evolved partly through the creation of new institutions and social relations with the industry.

Other scholars (Bechberger and Reiche, 2004; Jacobsson and Lauber, 2006; Lauber and Mez, 2006; Reiche, 2004) have presented detailed histories of the political and policy developments that led to Germany's feed-in tariff. We draw and build upon their accounts to explicate the path-dependent dynamics of these policy developments and to explore the institutional and social relations that allowed and reinforced Germany's divergent path. Those factors, combined with the historical contingencies that affect all policies, explain why the German policy path diverged so strongly from that of the United States.

The FIT reflected a growing consensus among German parliamentarians that renewable energy needed and deserved state support to become competitive in the energy market. The parliament submitted several policy proposals, including a FIT for renewable energy, to the federal government. That the parliament took the initiative already signaled its commitment to this issue, as the majority of bills (about 60%) are tabled by the government and only about a third by the parliament (Schmidt, 2003, p. 90). In order to appease the parliament and especially the parliamentarians of the ruling coalition, the government under Chancellor Kohl and especially the BMWi attempted to persuade the conservative members of the parliament to oppose any such policies in the future. Therefore, while the bills had support from several parties in parliament, renewable energy in Germany still suffered at this time from conservative opposition, at least at

the administrative level, similar to its problems in the United States. To appease renewable energy supporters inside and outside of the governing parties, the government proposed two subsidy programs for photovoltaic and wind energy, which the parliament duly passed. Launched in 1989, a 100 MW wind program (later expanded to 250 MW) guaranteed investors a payment of 0.03€/kWh. From 1991 until 1995, the 1000-roof program sponsored the installation of solar panels on private houses and public facilities, as federal and state governments covered 70% of the installation costs (Lauber and Mez, 2006, p. 264). Note how these policies still paralleled the developments in the United States, with a production subsidy for wind and a modest capital subsidy program for solar, the latter policy the United States had started in the 1970s but had not yet revived.

Governmental opposition to a further expansion of public support for renewable energy failed to slow down the renewable energy lobby and its supporters in the German parliament. In 1990, an unlikely coalition of conservative backbenchers who supported subsidies for small hydropower plants and members of the opposition Green and Social Democratic (SPD) parties who favored the expansion of wind energy drafted a bill for a FIT. This bill gained rapid support among members of all parties, the BMFB and the newly created *Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit* (BMU, Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety). Attempts by the BMWi to stop the bill failed, as the ministry's most important allies, the large utilities, underestimated the impact of the bill and were otherwise preoccupied with the take-over of the East German electricity sector after the fall of the Berlin Wall just a few months earlier. In October 1990, the Bundestag eventually passed the *Stromeinspeisegesetz* (StrEG, Feed-In Law) with widespread support from all parliamentary factions (Lauber and Mez, 2006, p. 106).

The StrEG required utilities to connect renewable energy generators to the grid and to buy electricity from these sources at fixed rates varying between 65% and 90% (depending on the renewable energy source) of the average tariff that utilities charged their final customers. The StrEG excluded facilities bigger than 5 MW or were owned by large utilities and so mainly benefited the 3500 owners of small hydropower plants in the South of Germany and modest-sized wind turbine operators in the North of Germany. Investors in wind turbines already benefited from the 100 MW wind program. Together with this market creation program, the StrEG led to an explosion of newly installed wind turbines. Between 1990 and 2000, wind power increased by a factor of almost 100—from 68 MW to over 6000 MW. At least for wind energy and hydropower, the StrEG achieved its intended purpose of leveling the playing field for renewable energy. Other renewable sources, however, did not benefit to the same degree. Solar energy remained the poor cousin of the renewable energy family, as the feed-in tariff rates barely covered 10% of photovoltaic energy production costs, deterring solar panel producers from making further investments in Germany (Bechberger and Reiche, 2004, p. 50).

In addition to the StrEG, other public programs and regulations supported the expansion of renewable energy. Federal and state energy research programs provided close to 2 billion Euros over a period of 7 years (1990–1997). Federal banking institutions allocated low-interest loans worth millions of Euro for renewable energy installations. The expiration of the 1000-roof program in 1995 threatened a collapse of the solar energy market. Yet state and local governments reacted in a timely fashion, urging utilities to conclude cost-covering contracts with renewable energy suppliers and starting their own market introduction programs. The solar market therefore slowly but steadily increased, promoting technical and political learning. On the

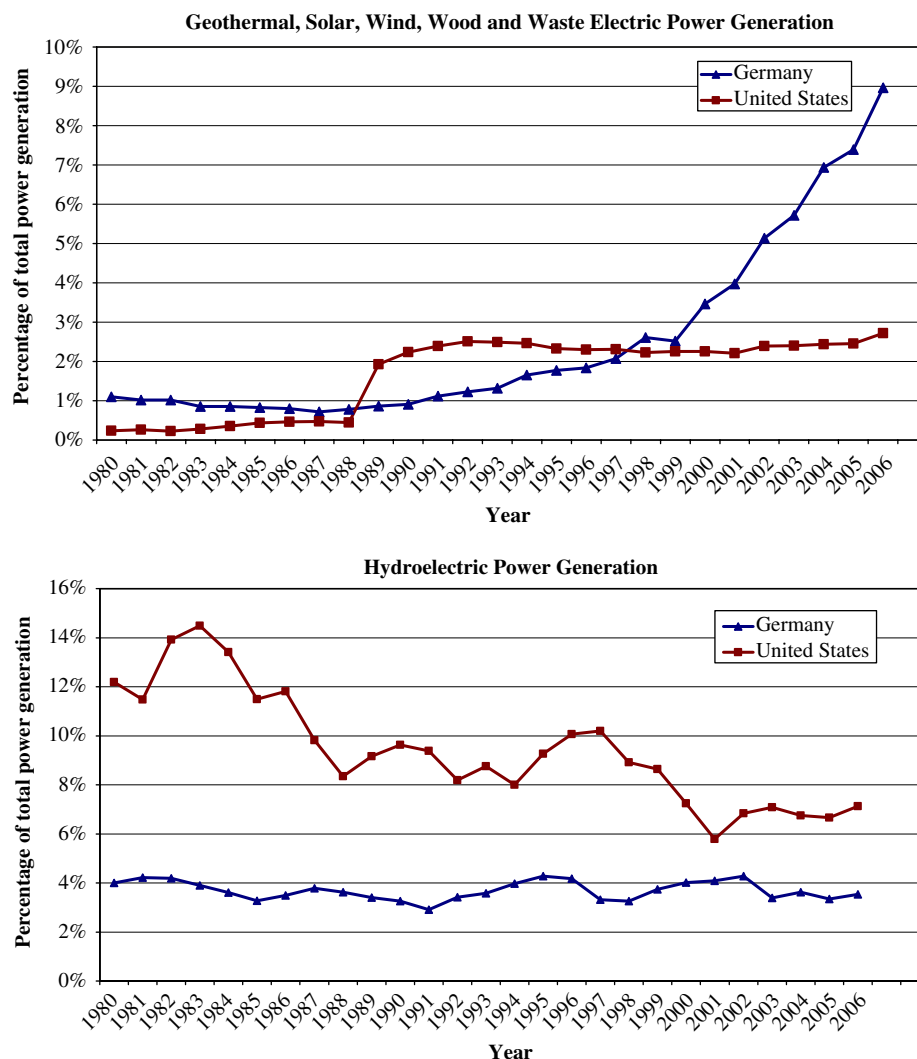
⁴ While there were and are many other policies relevant to renewable energy in this period, particularly with regard to biofuels, the PTC was the most important federal policy behind the growth of the wind industry, the most important renewable energy technology of the 1990s, and the R&D program was the most important for the future of renewable energy. The individual states in the United States had a variety of other policies, some very important, which are not discussed here.

regulatory side, a 1996 change of the *BauGB* (Federal Building Law) prioritized the construction of wind turbines, removing the requirement of prior changes to the communal land utilization plans. Finally, publicly sponsored information campaigns aimed at further increasing the already high support for renewable energy among the German society (Jacobsson and Lauber, 2006, p. 266).

The growth in the German renewable energy industry was not inevitable and almost got derailed in the middle of the decade. In 1996, the *Verband der Elektrizitätswirtschaft* (VDEW, Association of German Electrical Utilities) filed a complaint with Directorate General for Competition (DG Competition) of the European Commission concerning the StrEG, invoking violation of state-aid rules. Supported by DG Competition, the BMWi proposed a reduction of the feed-in-tariffs in response. In 1998, *PreussenElektra*, a large utility in Germany's north, challenged the StrEG in a German lower court, invoking the same legal approach as VDEW 2 years before. Since the issue touched on European law, the local court transferred the case to the European Court of Justice (ECJ), ruling out the possibility that the issue would be quickly resolved. In the short run this massive opposition to the StrEG succeeded in shaking the confidence of renewable energy investors, which explains why renewable energy experienced a short period of stagnation in the second half of the 1990s (see Figs. 1 and 2).

Beyond the StrEG's effect on boosting small hydropower and wind energy, the law also structured political conflicts over energy for most of the 1990s. The StrEG was supported by a large and diverse coalition of progressive Greens and Social Democrats, traditional farmers who owned small hydropower plants and their political representatives from the conservative parties, researchers in public and private institutions, the renewable energy associations, small- and medium-sized businesses, and bureaucrats in the BMU and BMFB. The success of the StrEG reinforced this coalition and increased its political importance, as the economic value of renewable energy as an export engine and job machine rapidly grew. Moreover, the formation of renewable energy policy networks facilitated political learning and the institutionalization of its advocacy. On the other hand, this success called the opposition to the scene. The BMWi complained that the extra costs inflicted by the StrEG undermined the German export industry. Moreover, since the StrEG did not entail any mechanisms for sharing the burden among the utilities, the utilities in the North and South paid the lion share of extra costs incurred by renewable energy generation, provoking their opposition (Lauber and Mez, 2006, pp. 106–108).

These political and legal challenges to renewable energy incited massive campaigning by its supporters. In addition to



Figs. 1 and 2. The United States data from 1980 to 1988 include generation only from utilities and from 1989 on includes data from independent power producers, which explains the large jump in that year. Source: Energy Information Administration (2007).

the traditional StrEG alliance, the counter-opposition included new allies such as several labor unions, church groups, farmer organizations, and the *Verband Deutscher Maschinen- und Anlagenbauer* (VDMA, German Engineering Association), whose members had increasingly benefited from the renewable energy boom. In the end, their efforts were only partially successful in thwarting attempts by the BMWi to dilute the StrEG. In fact, the Feed-In Law was formally incorporated in the Act on the Reform of the Energy Sector, which implemented an EU directive aimed at introducing a fundamental liberalization of the European energy markets. As part of the incorporation, the StrEG was amended, lowering the burden for utilities in regions with high use of RE. This amendment essentially capped the requirement of utilities to purchase renewable energy at 10% (Lauber and Mez, 2004, pp. 602–603). It is unclear whether renewable energy in Germany would have eventually fallen victim to the various attacks at the federal and EU level. Yet instead of foundering, renewable energy revived in the wake of the 1998 election.

In the fall of 1998, after 16 years in office, the conservative government of Christian Democrats (CDU/CSU) and Free Democrats (FDP) lost the parliamentary elections to a coalition of the Social Democratic Party and its junior partner the Green Party. Both parties vowed to expand renewable energy as a share in electricity production, setting ambitious targets in their coalition treaty: 12.5% by 2010; 50% by 2050, and an intermediate goal of 20% by 2020. In 1999, the new government enacted a market incentive program for the use of renewable energy in heat and electricity generation and passed the 100,000-roof program, an expansion of the 1000-roof program of the previous government, offering low-interest loans to photovoltaic investors. But as important as these programs were, the government's flagship legislation was a thorough reform of the StrEG, the *Erneuerbare Energie Gesetz* (EEG, Renewable Energy Law) of 2000 (Bechberger and Reiche, 2004, p. 51).

The EEG made several improvements on the StrEG. "Whereas under the 1990 Feed-In Law compensation rates had been defined as percentages of average end-customer tariffs with no security as to their level or duration, the new rates were now fixed for 20 years." (Lauber and Mez, 2006, p. 110). These gave investors long-term planning reliability in times of rapidly fluctuating electricity prices.⁵ The EEG also introduced different fixed tariffs, depending on the renewable energy source as well as the size and location of the renewable energy plant. The new rates tremendously increased the premium for most renewable energy sources, especially solar energy, so that investors could expect a decent return on their investments. To reflect technological improvements and to make the law compatible with EU law, the EEG foresaw an automatic and successive decrease of the feed-in tariff for plants built in later years. Moreover, every 4 years the EEG would be revised to reflect newest technological developments. In addition, by including large-scale operations as eligible beneficiaries, the large utilities were now entitled to benefit from the feed-in tariffs. This was an important concession to the utilities, as only large investors could finance future offshore wind farms. Finally, the EEG made sure that additional costs would be evenly spread among all grid operators, avoiding future legal challenges like the one initiated by *PreussenElektra* (Reiche, 2004, pp. 147–160).

Like the StrEG, and contrary to the typical legislative process in Germany, the EEG had its origins in a very energetic Bundestag. Despite the coming to power of a center-left government and an unmistakable commitment given to renewable energy in the coalition treaty, the government was internally divided along the same lines as the conservative predecessor government. Once again, the BMWi—now under the leadership of a Social Democrat with close ties to the large utilities and the coal industry—vehemently opposed any feed-in tariffs and favored instead a voluntary agreement with the utilities and later a quota system. The BMWi received strong support from the utilities, the VDEW, and the *Bundesverband der Deutschen Industrie* (BDI, Federation of German Industries), which argued that renewable energy would make energy more expensive, imposing an additional burden on the German export industries. Since in the German political system only the ministerial bureaucracies have the relevant legal, technical and other expertise for drafting laws, they usually originate from the executive branch. This allowed the BMWi to stall the introduction of a comprehensive feed-in tariff law. Yet in the end, members of the parliament took matters in their own hands, drafted the law, and made sure that it would pass. The conservative opposition at this point was divided over the right course of action and it could not muster any major resistance to the law. After further dilute-and-delay tactics, the BMWi eventually gave in and adopted the law (Bechberger, 2000).

At this point, any major challenge to the EEG could only come from the European Union. Yet even at this level, everything worked in favor of the renewable energy supporters. In 2001, the European Court of Justice decided that feed-in laws do not constitute state-aid. A year later, the Directorate General for Competition withdrew its initial objections to the StrEG and the EEG. Today, more than two-thirds of EU member states have adopted the German feed-in tariff model, which has turned out to be a very effective means to promote renewable energy (Bechberger and Reiche, 2005). While the StrEG was successful promoting wind energy, the EEG dramatically increased the importance of other renewable energy sources. For instance, while solar energy produced only 1 GWh electricity in 1990, and 64 GWh in 2000; by 2007 it was already 3500 GWh (BMU, 2008). In addition, renewable energy has become a major job machine with more than 1,70,000 people (and even more by some estimates) currently working in the renewable energy sector. Employment in this booming sector is expected to almost double by the year 2020, rivaling the German chemical industry and surpassing Germany's pharmaceutical industry as one of Germany's major job engines (BMU, 2006).

6. Preserving the status quo: the United States policy in the 1990s

The first Gulf War in 1990–1991 brought energy back onto the public and official policy agenda (Rossi, 1995; Joskow, 2001). It looked for a time that this new oil crisis might push the United States onto a different path, one with greater emphasis on renewable energy. But a combination of historical contingencies, institutional structures, and state–society relations, all quite different from those in Germany, frustrated those who sought to promote renewables. The result was that the United States stayed on its old energy policy path for more than another decade.

On August 2, 1990, the Iraqi army invaded Kuwait, creating a major crisis in the Persian Gulf, the most important source of oil in the world. Despite diplomacy, the situation escalated and by late November the United Nations Security Council passed a resolution permitting the use of force to expel the Iraqis from Kuwait. Within

⁵ The liberalization of the European energy market initially led to a rapid decline of electricity prices in Germany, as the largest utilities tried to push smaller competitors out of the market. As soon as they succeeded—instead of eight large utilities, Germany now has only four that enjoy almost-monopoly positions in their specific regions—electricity rates returned to their earlier levels and have now reached historic highs [Source?].

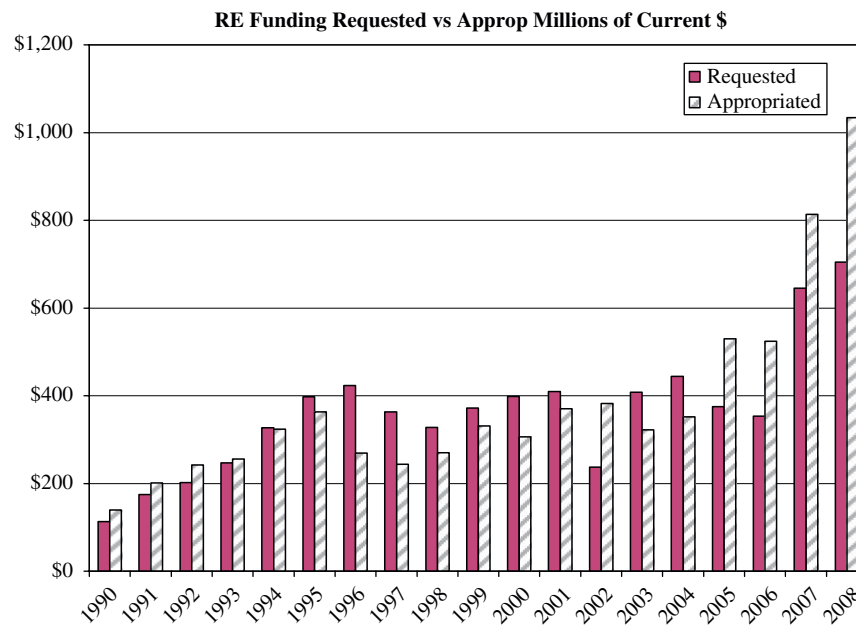


Fig. 3. Requested versus appropriated renewable energy R&D budgets in current dollars.

a week, American forces deployed to Saudi Arabia, by mid-January the United States and other coalition forces began air raids on Iraq, and on 24 February the coalition forces began their ground attack. The Iraqi army was expelled from Kuwait and combat was over by the first week of March.⁶

Not surprisingly, oil markets responded to this crisis. Spot market prices were as low as \$15 per barrel in June 1990. By September they had more than doubled and peaked at \$36 per barrel in October. However, even though the war did not end until early March 1991, oil prices began declining in November 1990, reaching an equilibrium between \$18 and \$22 per barrel for the rest of 1991 and all of 1992, slightly more than they had been in late 1980s (US DOE, 2008).

The rapid, if temporary, doubling of oil prices put the energy issue back on the public agenda. The Bush administration had been working on a comprehensive energy policy more than a year before the start of the war, but the war and price increases made the issue more public. The President addressed it in his 1991 State of the Union speech, in which he called for both more energy efficiency and greater development of renewable energy (Rossi, 1995, pp. 195–198). Shortly after the speech President Bush sent his new energy bill to Congress, where Members in the House and Senate had already prepared their own comparable bills. After a typically convoluted legislative process, the President signed the Energy Policy Act of 1992 on October 24, 1992 (see Rossi, 1995 for a detailed history of the legislative process that led to the Act). Many of the bills provisions applied to fossil fuels and nuclear power and indeed President Bush signed the bill in front of an oil rig (Signing, 1993).

For renewable energy, the bill provided numerous tax breaks, including the 1.5 cents per kwh production tax credit for wind energy (Lazzari 2004, p. 7) and authorized, but of course did not fund, increases in renewable energy R&D (CBO, 1992, pp. 10–12). The wind production tax credit turned out to be the most important policy incentive for the development of the wind industry during the 1990s (US DOE, 2007). An expanding R&D program created the potential for the technological innovation

that renewable energy would need to come down in cost and better penetrate the market. As a symbol of his commitment to expanding R&D funds, President Bush upgraded the Solar Energy Research Institute to the National Renewable Energy Laboratory (Richmond, 1991). With these items in place, one might think that renewable energy policy was in a position, as in Germany, to be off on a new path, one that would have the positive reinforcements of policy success and growing industrial clout in lobbying for extending supportive policies.

However, those efforts to dramatically change renewable energy policy failed and the United States stayed on its pre-1990s energy policy path for more than a decade. Two important ideological features of energy policy interacted with the fragmentation in both the policy-making process and state–society relations to frustrate those efforts to make large changes. It did not help, of course, that oil prices were stable and low throughout the decade, and Joskow (2001) attributes the stasis in policy to that market stability. But policy makers are also supposed to be able to plan for the future, as well as deal with the present, and in any case German policy makers took a different path even though they faced the same world price of oil, so it is worth analyzing the other factors that led to the stasis.

The central feature of the United States policy making, fragmentation, shows up clearly in the battles over the renewable energy R&D budgets. Since the 1970s, renewable energy had taken on a strong ideological cast in the United States, one that made it anathema to most political conservatives (Laird, 2003). While that image began to change in the 1990s, it was still important politically. As a result, the renewable energy R&D budget went up and down during the 1990s and into the 2000s, with Congress sometimes cutting the President's requested budget for renewables and sometimes increasing it, as shown in Fig. 3⁷.

One should not pay too much attention to the year-to-year differences in this graph, since changes in reporting conventions affect some of those differences. The more important dynamic for

⁶ Frontline Chronology of the Gulf War, accessed at <http://www.pbs.org/wgbh/pages/frontline/gulf/cron/> on July 31, 2008.

⁷ Sources: Department of Energy, Office of the Chief Financial Officer, *Congressional Budget Request*, volume varies by year. For FY1990–1999, SuDoc E1.34: (last 3 digits of year); for FY2000–on, available at <http://www.cfo.doe.gov/budget>, Accessed 29 July 2008.

our purposes is the inability of the president to control this budget. When Democrats controlled Congress in the early 1990s they matched or increased the President's requested budget, with a slight exception in FY94. When the Republicans gained the majority in Congress they consistently cut President Clinton's budget requests for renewable energy and they did the same for the second President Bush, with the exception of FY02, until FY05, when they began again pushing the budget up higher than the president wanted it. Democrats increased that trend when they regained their majorities in Congress in 2007.

This political tug-of-war over the renewable energy R&D budget is one factor that prevented the United States from exhibiting positive political feedback that renewable energy policy enjoyed in Germany. University and industry research groups could not depend on steady funding for renewable energy projects, which limited the growth of a strong and coherent group to support those policies. In a non-parliamentary system such as the United States, sharp conflicts between the executive and legislative branches mean that outside groups cannot predict where the policy is going to go. German funding for renewable energy R&D has also had its ups and downs in the same period, but it has tended to track election results and be more stable for several years running. A direct numerical comparison is difficult to make because the German system funds research programmes more than the United States does, the administrative responsibility for German renewable energy R&D changed over this period, and Germany has a policy of relying more on industry R&D than government funding (see IEA, 2003, pp. 126–129, IEA, 2007, pp. 158–162). That said, renewable energy R&D in Germany consistently absorbed a much larger part of total energy R&D and governing coalitions could set a direction for R&D funding without the added volatility of conflicts between the executive and legislative branches.

While the most recent increases in the US R&D budget are encouraging, it is too early to know if they are the beginning of a trend. In addition, much of those increases comes from dramatic increases in the hydrogen and fuel cell R&D budgets, which are not part of the traditional notion of renewable energy but are put into that budget category. The broader point is that these volatile, and rather low, R&D budgets have made it impossible to mount a comprehensive and consistent innovation program in the United States. As Nemet and Kammen (2007) point out, the renewable energy budgets are part of the decline of energy R&D more generally, both from government and industrial sources, all suggesting that the United States has not moved onto a new energy policy path.

Volatility also shows up in the production tax credit for wind energy. Legislation has put that credit in place for only one or a few years, so it has required constant renewal. That renewal has not always been forthcoming and when it has lapsed the rate of wind installations has plummeted (US DOE, 2007, pp. 20–21). This volatility increased the uncertainty for investors, which cannot help but slow down renewable energy development. Those tax credit renewals depend on both Presidential and Congressional support, which is aided by the ability of renewable energy advocates to make their case to policy makers. During the 1990s, that case got harder to make, as government activism became increasingly constrained by a strong predisposition to make policies more market-friendly (Fox-Penner, 1996). In addition, the advocacy groups exhibit the fragmentation so characteristic of American policy making generally (Jones, 1979), which weakens their ability to make their case.

The result of all these factors is that the United States policy for renewable energy did not make a significant break with the past in the roughly 15 years after the first Gulf War, in sharp contrast to Germany. The volatile subsidies impeded both research on new

renewable energy technologies and the deployment of existing technologies. Since renewable energy did not become as large a part of the United States energy system as it did in Germany, the United States policy makers could take it less seriously. Since renewable energy equipment manufacturers did not grow in the United States to the extent that they did in Germany, the United States renewable energy sector lacked the political clout that the industry had in Germany. The fragmented nature of issue advocacy in the United States made renewable energy advocacy groups less effective than they are in Germany. The orientation toward market-friendly policies in the United States increased the political barriers that subsidies for renewable energy needed to overcome. The past year's increases in oil prices and change in administration certainly present another window of opportunity for renewable energy advocates in the United States, but it is too early to tell what will happen.

7. Recent German policy: consolidating the new path

Despite (or more likely because of) Germany's success story, resistance to the promotion of renewable energy through feed-in tariffs did not vanish. In 2003, the BMWi once again spearheaded the opposition to the EEG, with support from the BDI, the large utilities, and the coal and nuclear lobby groups. The CDU/CSU under the leadership of Angela Merkel and the FDP also opposed the EEG, as did the *Industriegewerkschaft Bergbau, Chemie, Energie* (IG BCE, Mining, Chemical and Energy Industrial Union) whose membership consists largely of coal and mining workers. Yet the pro-renewable energy camp had become even stronger, receiving support from most other labor unions and large parts of Germany's engineering companies. Most importantly, after the reelection of the Red-Green government in 2002, authority over renewable energy development was transferred from the BMWi to the BMU, which had rapidly expanded its renewable energy department under the leadership of an energetic minister who was also a member of the Green party. With an unrivaled expertise, the BMU dominated the amendment debate and insured that the revised EEG would continue to be a major promoter of renewable energy in Germany. By including large hydropower plants as beneficiaries of the revised feed-in tariffs, the EEG even received support from one of the four large utilities, *Energie Baden-Württemberg*.⁸ The revised law also confirmed the rates for solar energy, which the government had already drastically increased in 2003 to avoid a collapse of the photovoltaic market when the 1,00,000-roof program expired that year. At the same time, wind energy from low-wind areas were excluded and rates for onshore wind reduced. The BMU thereby reacted to growing resistance from citizens' groups that opposed large wind turbines in their neighborhoods (Reiche, 2004, pp. 153–158). By 2004, when the revised EEG passed in the lower and upper houses of Germany's parliament, opposition to renewable energy per se was virtually nil.

Today, despite criticism of the feed-in tariffs from the utilities, the renewable energy sector in Germany is an economic powerhouse and major job engine, enjoying widespread political support. It is therefore unlikely that the current policies for the promotion of renewable energy will be weakened in the near future. When in 2005 the Red-Green government lost snap elections to the parliament, the Green Party was driven from government, giving way to a grand coalition of CDU/CSU and SPD under the leadership of Christian Democratic Chancellor Angela Merkel. Yet despite Merkel's earlier opposition to renewable

⁸ The other three are Swedish Vattenfall, E.ON, and RWE.

energy, which continued during the 2005 electoral campaign, the new government has maintained a steady course in supporting renewable energy through the EEG. Renewable energy in Germany thereby owes its solid position in the energy market to the strength of its supporters as well as the weakness of its critics (Bundeskanzleramt, 2007).

Concerning the opponents, the liberalization of the European energy markets has had the unintended consequence of leading to further market concentration in the energy sector. Today, four large utilities control close to 90% of the German electricity market. Although the European Union requires the unbundling of generation, transmission, and marketing of electricity, the reality is that the “Big Four” still control all three areas. Their quasi-monopoly position allows them to discourage unwanted competition, charging for example unreasonably high fees for access to their grids. These unfair practices have especially hurt renewable energy. Yet the large utilities are on the defense, facing demands for further liberalization from DG Competition and a hostile German public, which relates high energy prices not to the development of renewable energy, as claimed by the opponents, but to the monopoly position of the Big Four. Public relations campaigns of the large utilities are therefore largely ineffective, because citizens do not trust the sources (Tagesschau, 2005). The ensuing political pressure has also encouraged the government to take stricter measures against unfair business practices. In 2005, the Federal Network Agency was created, which supervises and rules on the grid access fees. At last, the political power of the large utilities, which has its origin in a favorable legislation passed under the Nazi regime, appears to be broken, removing the strongest bastion of resistance against decentralized energy production in Germany (Der Spiegel, 1995, pp. 77–104).

The political decline of the large utilities and their associations (notably, the VDEW) has further helped the cause of the renewable energy camp. This camp has grown steadily since the 1980s, including the many renewable energy associations such as the *Bundesverband Erneuerbare Energien* (BEE, Federal Association for Renewable Energy) and the Green Party, but also a broad range of other groups that benefit only indirectly from renewable energy such as church groups. The tremendous economic success has helped the renewable energy associations to become politically skilled and powerful lobbies. Yet to speak with a professional, strong and united voice has not been an inevitable outcome of economic success. In fact, the Green Party and later the BMU have strongly encouraged the renewable energy advocates to build a united front, expressing their intention to talk only to the representatives of the peak organizations.⁹ They also supported renewable energy by spending large amounts of money on public campaigns. Finally, through the BMU and the Green Party the renewable energy associations have gained direct access to the highest government levels. Whereas German energy policy was previously decided in remote policy networks consisting of the BMWi, the utilities, the industry associations, and a few experts, today Germany's energy policy making is much more accessible and transparent, allowing the renewable energy advocacy coalition to voice their interests in an unmistakable way.

8. Historical contingencies, institutional structures, and path dependence

Historical institutionalists' conception of “path dependence” refers to dynamic processes involving positive feedback, which

generate multiple possible outcomes depending on the particular sequence in which events unfold (Pierson, 2004, p. 20).” This conceptualization emphasizes the particular times in which things happen and provides a framework for understanding how contingent outcomes can profoundly influence later policy developments. The notion of path dependence is not merely the claim that it is hard to change the status quo. The “positive feedback” part of this idea derives from the particular decision rules, institutional structures, political alignments, and similar variables that reinforce political actors once they have started down a particular policy path. However, in order for that positive feedback to operate, there must be some initial changes or initiatives in policy that set a country on a new path, and those changes usually come from contingent factors that set the United States and Germany apart in this case. In addition, that pressure for change has to come at a time when advocates of the existing policy are in some ways weakened and so they are unable to stop it. This leads to a pattern of policy development that also resembles Baumgartner and Jones's (1993) ideas of punctuated equilibrium (which Pierson cites as one of the studies in his overview of historical analysis in social science). Thus a set of contingent circumstances powerfully influence whether political actors seeking change can move policy in a new direction.

The historical circumstances of the United States energy policy in the early 1990s were distinctly not conducive to change, which repeated a pattern from the 1970s and 1980s. Policy for renewable energy is a component of energy policy in general and, while a temporary rise in oil prices brought the issue onto the official agenda for a short time, subsequent declines in prices coupled with effective political opposition reinforced the status quo. The public and policy makers paid declining attention to energy after the 1970s. For example, the number of Congressional hearings on energy declined steadily from the late 1970s to 2005, with only a few bumps up during major events, such as the first Gulf War and just after September 11, 2001. The same pattern holds for the number of articles in the *New York Times* on energy in any particular year, with a steady decline since the 1970s except for a few short-term increases (Policy Agendas Project, 2008).¹⁰ In the 1990s, low oil prices, low public and policy-maker interest, and a short and successful war in Kuwait reinforced the energy policy status quo, even if President Bush could get the 1992 Energy Policy Act passed. That declining interest showed up in both the public and private sectors. Both government and corporate investments in energy R&D, for almost all sources, declined during the 1990s (Nemet and Kammen, 2007). That lack of attention to energy meant that government support for renewable energy also stagnated during this period. That lack of attention, combined with the ongoing ideological conflicts over renewable energy, led to R&D support and tax subsidies that were small, short-term, and volatile.

In contrast, Germany enjoyed several contingent factors that created an opportunity for substantial policy change, even though it took a decade to get the new policies deeply institutionalized. Of greatest importance here was a sequence of historical events that reinforced each other, providing ample room for early renewable energy proponents to make enough headway in order to strengthen and unite the diverse and sometimes internally divided renewable energy alliance, setting renewable energy on a stable path. First, the Chernobyl disaster opened a window

⁹ Interview with a staff member of the Green faction in the German parliament, anonymous.

¹⁰ The data used here were originally collected by Frank R. Baumgartner and Bryan D. Jones, with the support of National Science Foundation grant number SBR 9320922, and were distributed through the Center for American Politics and Public Policy at the University of Washington and/or the Department of Political Science at Penn State University. Neither NSF nor the original collectors of the data bear any responsibility for the analysis reported here.

of opportunity for renewable energy, which policy entrepreneurs in the German parliament were eager to exploit and which did not depend upon volatile energy prices. Their efforts were successful (especially, the push for the StreG) because of the historical contingency that German unification occurred at the same time and posed serious challenges for the large utilities, which distracted them from the economic and political potentials of the StreG. The StreG demonstrated that renewable energy could grow rapidly with the proper financial support. The economic success of wind and small hydropower attracted an increasing number of investors and thereby turned renewable energy into a booming industry that created jobs for thousands of qualified workers especially in Eastern Germany where reunification had led to rapidly growing unemployment. This success story also emboldened the renewable energy associations who enjoyed special political (and sometimes even financial) support from the BMU.

Yet we would jump to conclusions if we claimed that renewable energy in Germany was already put on an irreversible path towards rapid expansion by the mid 1990s. In fact, renewable energy's success almost caused its undoing, becoming a rallying point for its opponents that attempted to stop further expansion through massive lobbying campaigns, legal action, and exploiting the division within the German government between the BMU and the BMWi. Once again, a historical contingency not only saved renewable energy but also successively contributed to an even faster expansion. The 1998 federal elections brought the Greens for the first time into the federal government. While the Greens had supported the expansion of renewable energy prior to 1998, it was only after the formation of the Red–Green government under Chancellor Schröder that they could climb into the driver seat. Taking over the BMU, which they rapidly staffed with RE experts and advocates, and building a coalition of RE advocates from all parties in the federal parliament allowed the Greens to pass the EEG. Since the EEG built on the StreG, instead of introducing a complete new policy, the legislation avoided heated political debates (Bechberger, 2000).

The rapid expansion of renewable energy in the wake of the EEG allowed its advocates to highlight its importance for economic growth in Germany. The professionalization of the renewable energy associations, which owed much to increasing budgets, political experience, and strong support from the Green Party and the BMU, turned a formerly weak and divided lobby group into a force to be reckoned with. It is therefore fair to say that with the EEG, renewable energy has been put towards a stable expansion path, which is unlikely to be reversed in the coming years and decades. This decade-long process of institutionalizing strong support for renewable energy fits with the observations of scholars in other areas. Sabatier and Jenkins-Smith (1999, pp. 118–9) make the case that substantial policy change takes at least a decade to become entrenched in policy-making institutions and so require historical analysis. The German experience with renewable energy demonstrates the possibility of strategic niche management outlined by Kemp et al. (1998). Germany's policies set up a protected niche for renewable energy technologies and reflexively learned over time, responding to selection pressures. As the technologies have become both economically and institutionally more competitive, German policy is slowing withdrawing the subsidies.

With a soaring oil price and all its attendant consequences, energy is back on the agenda in a major way in the United States. What will come of that depends on what policy entrepreneurs can accomplish, the political circumstances in which they are working, and the rules and structures that can reinforce those changes. The configuration and strength of renewable energy advocates and opponents is quickly changing, but it remains to be seen if the

advocates can put in place policy initiatives that can create the positive feedback for sustained change.

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