Wind-Power Development in Germany and the U.S.: Structural Factors, Multiple-Stream Convergence, and Turning Points

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Introduction

Renewable energy is seen as a solution to problems of anthropogenic climate change, air pollution, resource scarcity, and dependence on energy imports (Vasi 2009; IPCC 2012). Of the various forms of renewable energy, wind-generated electricity has a unique set of advantages, which make its potential environmental benefits especially large. Wind power produces relatively low levels of environmental damage over its life cycle (like solar),[1] relies on relatively mature technology, and already comprises a nontrivial share of energy production (like hydro and biomass). It is also based on a potentially enormous natural resource and has been growing rapidly in many industrialized and developing countries (Greene, et al. 2010). Global installed capacity of wind power rose an average of 25% a year from 2001 to 2012, to a total of 282,000 Megawatts (MW), and wind power now generates about 3% of global electricity consumption (data from World Wind Energy Association and BP 2012).[2]

Although common experiences with the oil crises of the 1970s and more recent concerns about global warming have motivated most industrialized countries to adopt wind-power development policies, they vary greatly in the extent to which they have successfully developed this renewable-energy source. The key indicator used in this chapter for description and causal explanation is the share of a country's total electricity generation or consumption that is produced from wind, since this describes the extent of wind-power development while controlling for the size of the country's economy and energy sector.[3] By focusing on an outcome measure, this chapter concerns environmental performance; by choosing a specialized outcome measure that is directly linked to improvements in environmental quality, it avoids the problems with aggregated indices noted in the Meadowcroft chapter in this volume. In terms of electricity generated from wind as a share of total national electricity consumption, the leading countries in the world in 2011 were Denmark (28%), Spain (16%), Portugal (18%), Ireland (16%), and Germany (8%). Laggards according to this metric include Italy, the U.S., Canada (all at 3%), Australia (2%), and Japan (0.5%) (IEA 2012, 5).

The central question that this chapter addresses is whether these differences among countries are simply due to structural constraints, i.e., factors that political actors cannot alter significantly in the short or medium term, or whether to a large degree they are due to political processes that wind-power advocates could initiate, influence, or exploit. This question lends itself to a comparative approach, in order to use countries' contrasting experiences as a basis for explanation and theory development. A cross-*national* comparison is appropriate because wind-power policies are largely made by national governments, although laggard European countries (not included here) may be affected by the EU's renewable-energy policies, such as its 2001 directive setting national targets. At the same time, the role of subnational governments in federal systems must be taken into account where it is of major importance for a country's wind-power development.

In this chapter, I will focus on two country cases in order to examine a large number of process variables, which are difficult to include in large-N studies because of the unavailability of reliable, comparable information on those variables across many cases. Thus, I aim to correct for the bias of large-N studies toward structural factors (cf. Karapin 2012). A small-N approach also facilitates longitudinal analysis, and the comparative analyses in this chapter will include cross-temporal comparisons within each country, in addition to comparisons between them. To further aid in theory development, I will assess multiple theories, rather than merely providing support for one approach. This method helps guard against assuming that one's favorite theory is correct and makes it possible to discover where different theories are each applicable (Sabatier 2007, 330; Zahariadis 2007, 86-87).

Germany and the U.S. comprise a useful comparison for addressing this chapter's central question and for building theory, for several reasons. They currently represent a leading and a laggard country, respectively, in terms of wind-power development as a share of total electricity generation, and hence provide a clear contrast to be explained, even though this does not mean that their relative positions are necessarily fixed, as I will explain below. More generally, the two countries represent what Jahn terms the first and third worlds of the environmental state, respectively, and in fact they occupy extreme positions in that typology (see his chapter in this volume, esp. Figure 4.2 and Table 4.3). At the same time, in absolute terms, both the U.S. and Germany are very significant wind-power producers in the global context. Because of the large size of its energy sector, the U.S.'s small share of wind power still translates into a large absolute volume. In terms of absolute wind-power capacity, the U.S. is in second place globally, while Germany is in third. China leads in total capacity, although its wind sector provided only 1.6% of its national electricity demand in 2011 (IEA 2012, 5). Together, the U.S. and Germany account for about 37% of global capacity, so explaining these two country cases is of inherent importance for understanding the politics of wind power worldwide.

There is another, perhaps more important reason for comparing these two countries. Plausible structural explanations have been advanced to explain the differences between their wind sectors, so comparing them provides a good test of the structural theories. Given the structural differences between the two countries, was it inevitable that Germany would increase its wind share so much more than the U.S.? Or did political and other processes, which could have unfolded differently, play a significant role? If so, under what conditions did actors have significant scope for influencing these outcomes?

The following section describes two contrasting theoretical perspectives that will be assessed in this chapter, one based on socioeconomic structures and political institutions, the other on the interaction between problem and political streams. Next, I briefly describe the differing wind-power outcomes and policies in Germany and the U.S. The rest of the chapter then explains the differences between the two countries in a series of analyses that examine first structures and then processes. These analyses go beyond a static comparison by distinguishing three phases: U.S. leadership (1978-93); Germany's surge into a growing leadership role (1993-2004); and the beginning of catch-up by the U.S. (2004-present). The conclusions discuss how certain combinations of structures and processes drove the turning points between these phases, and consider the implications for theories of environmental outcomes and for multiple-streams theory.

Theoretical Perspectives

Implicit in many causal analyses of environmental policies and outcomes is the question of how much difference actors such as government officials, environmental organizations, political parties, or coalitions of actors have made and could make in the future. To bring this question into sharp relief, it is useful to contrast a structural theory of environmental performance with the multiple-streams theory of policy-making.[4]

A structural approach: socioeconomic structures and political institutions

Major works on environmental outcomes and on climate or energy policies argue for the importance of structural features, i.e., those that are basically unchanging over the medium term (e.g., Kitschelt 1986; Jänicke, Mönch, and Binder 1996; Jahn 1998; Neumayer 2003; Paterson 1996; Scruggs 2003). Some studies of renewable energy also take this approach (e.g., Huang, et al. 2007; Keller 2010; Toke, Breukers, and Wolsink 2008). These literatures examine a wide range of structural factors, such as wind resources, fossil-fuel endowments, export dependence, the openness of policy-making institutions, electoral systems, the strength of implementation institutions, planning systems, and the strength of landscape protection organizations. These factors are too numerous to treat adequately in this chapter, so to provide the best test of the structural theory, here I will describe four factors that seem best able to explain the U.S.-Germany differences (Keller 2010). While these factors refer to conditions that may change somewhat over time, the rate of any change is very slow, so they can be seen as structures with basically stable effects on these two countries from the 1970s to the present.

First, countries' energy policies are influenced by their fossil-fuel endowments and industries. Those with less domestic production of fossil fuels, and therefore greater dependence on energy imports, are more likely to develop policies that promote renewable energy at the expense of fossil fuels. Their fossil-fuel-sector lobbies are relatively weak, and thus less able to block renewable-energy policies. Moreover, such countries have a national interest in developing domestic energy sources in order to improve their balance of payments and reduce dependence on oil and natural-gas imports, since these have been subject to price volatility and supply insecurity (Paterson 1996, 80; Keller 2010, 4741). Second, countries dependent on manufacturing and on exports have an interest in promoting industries that would create new manufacturing jobs, in part to meet international demand. Since wind power is a much more labor-intensive form of energy production than coal or natural gas, it is in such countries' interests to promote it over fossil fuels (Gipe 1991, 763).

Third, the nature of the electoral system affects a political system's openness to innovations in environmental and energy policy. In countries with proportional representation, ecological or left-libertarian political parties were more likely to become established by the early 1990s than in countries where electoral rules strongly favor major parties at the expense of minor parties, such as the U.S. (Willey 1998). Green parties have been strong advocates of renewable-energy policies and may influence policy through participation in government, by exerting competitive pressure on other parties, and by playing crucial roles in advocacy coalitions (Neumayer 2003, 205, 218-19; Karapin 2012, 60-61).

Fourth, the nature of the interest-group system is also held to bear on environmental policies, including renewable energy. Pluralist interest-group systems are marked by the fragmentation of business interests, an adversarial relationship between business and government, and hence relatively unstable or uncertain environmental policies. Neocorporatist systems are characterized by a relatively centralized and concentrated representation of interests, cooperative relations between business and government, and more stable policies that are more smoothly implemented by economic actors (Crepaz 1995; Jahn 1998, 119-20, 125; Scruggs 2003, 133-61).

A process approach: stream convergence, policy windows, and advocacy coalitions

By contrast, most of the cross-national literature on wind power, as well as some key works on Germany and on the U.S., argues for the importance of short-term, relatively steerable processes. These include the positions and strategies of economic, non-governmental, and state actors, mobilization by environmental movements, advocacy-coalition formation, issue framing, policy feedback, market formation, election results, and policy design features (e.g., Bird, et al. 2005; Gan, et al. 2007; Jacobsson and Lauber 2006; Kraft and Axelrod 1984; Laird and Stefes 2009; Portman, et al. 2009; Sovacool 2008; Stenzel and Frenzel 2008; Swisher and Porter 2006; Szarka 2007; Vasi 2009; Walz 2007). The multiple-streams theory of agenda setting and policy making can subsume many of these variables into a coherent framework (Kingdon 2003; Zahariadis 2007). In this theory, an issue is most likely to reach the decision-making agenda when intense problem perception, viable policy solutions, and strong political commitment converge. Each of these is affected both favorably and adversely by streams of events and other processes, which are partly but not completely independent of each other. When problem and politics streams converge to produce both the perception of a severe problem and strong political commitment to address it, a policy window is created. The window may be exploited by policy entrepreneurs who promote particular solutions, which already have been generated and tested in their own complex, slow-moving stream (Kingdon 2003, 15-18, 203). Similar to theories of critical junctures (Collier and Collier 1991) and of punctuated equilibrium (Baumgartner and Jones 1993), the theory of multiple streams attempts to locate and explain moments of unusual openness, when policies that are usually stable may rapidly change.

Here I will focus on the problem and politics streams. Doing so will simplify the comparative analysis and provide a somewhat tougher test of this process theory, since policy streams are those most amenable to influence by political actors. Problem streams concern which problems are seen as most important and hence get onto policy makers' decision-making agendas. A problem stream is altered significantly through extraordinary focusing events (such as environmental disasters), dramatic new information about environmental conditions, and/or strong feedback from existing policies. The politics stream concerns who holds power, their ideological or value-based commitments, and the political constraints they anticipate. This stream is affected by election results, changes in government leadership positions, shifts in public opinion, and mobilization by organized groups that affect their balance of power (Kingdon 2003, 197-98).

The politics stream requires further elaboration, partly to capture more fully the influences on decision making as opposed to agenda setting. Hence, I will use certain concepts from the advocacy-coalition framework, which is largely consistent with and complementary to multiple-streams theory.[5] Among other things,[6] advocacy-coalition theory analyzes the changing balance of power between a coalition of advocates for a policy direction and a coalition of their opponents (Sabatier 1988; Sabatier and Weible 2007). Both kinds of coalition can draw on specialists in a variety of government and private organizations, including government agencies, parties, parliaments, interest groups, non-profit organizations, social-movement organizations, research institutions, and media outlets (Jänicke 2005, 138; Jost and Jacob 2004; Watanabe 2011). The composition, political resources, and constraints of advocacy and opposing coalitions can be influenced by elements of the problems and politics streams, such as environmental crises, other socioeconomic developments, shifts in public opinion, changes in the governing coalition, or policies in other subsystems (Sabatier and Weible 2007, 202).

The combination of these two theories offers to explain the development of renewable-energy policy. When problem and policy streams converge, they open a policy window. At such times, if the advocacy coalition is more powerful and mobilizes more energetically than the opposition coalition, stronger policy will result.

Testing and interrelating structural and process theories

Although structural and process theories often appear as rivals in explanations of environmental outcomes, in fact they can be complementary theories. Few studies of renewable energy examine both structures and processes,[7] and fewer still analyze the relative weights of these causes or how they relate to each other.[8] Perhaps without intending to, studies that examine only structural factors imply that these comprise a sufficient explanation, while studies that are limited to an analysis of processes imply that the latter are not much affected by structures.

In the rest of this chapter, I try to contribute to our understanding of the relative causal weights of structures and processes and how they fit together in producing environmental outcomes. First, the structural theory described above will be tested for congruence between the putative causes and the outcomes; e.g., whether Germany has a high degree of reliance on manufacturing that predisposes it to renewable energy more than the U.S. Then, in the case studies, the multiple-streams theory will be tested through process tracing to try to produce causal chains of mechanisms that stretch from processes that generate the problem and politics streams (such as the 1970s oil crisis and election results), to the creation of policy windows at times of stream convergence, and on to policies and outcomes.

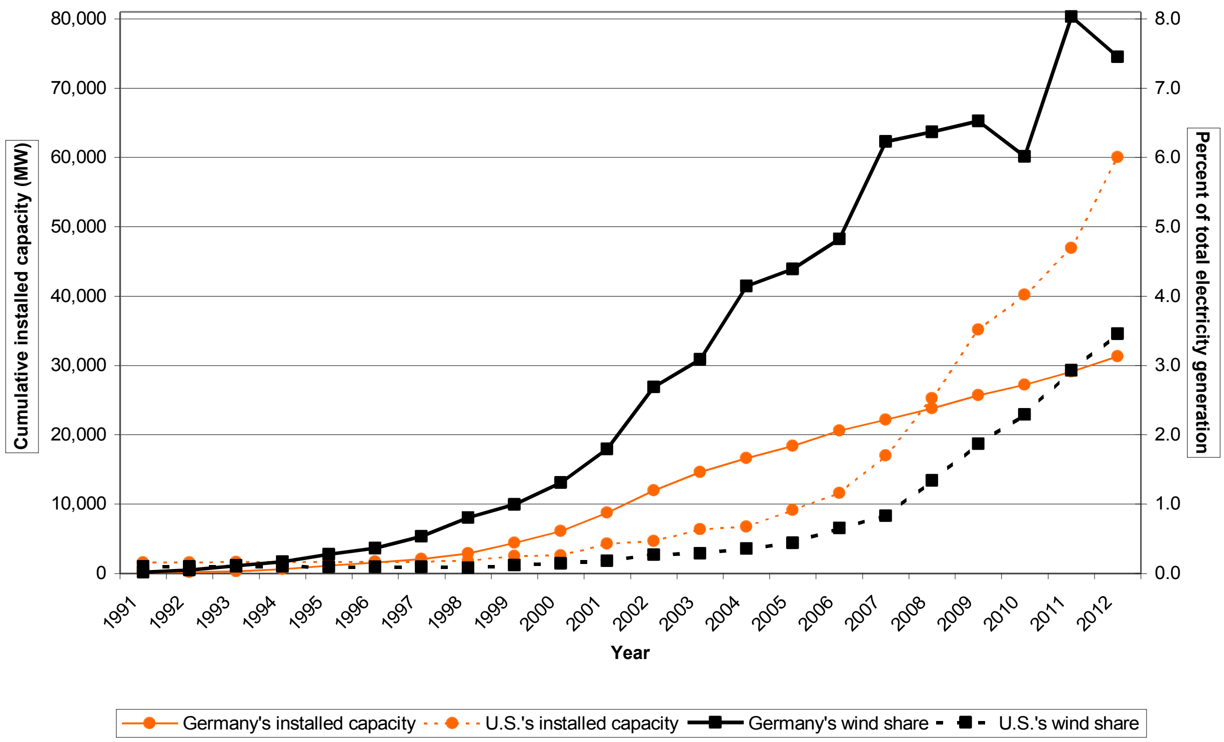
In addition, there are several ways to test these theories against each other, which will be employed in the empirical sections of the chapter and discussed in the conclusions. Are the stable outcomes predicted by the structural theory actually produced, in the form of a relatively invariable gap between wind-power development in Germany and the U.S.? Or, alternatively, do the relative positions of the two countries vary over time in ways that can be explained by process variables? Are the mechanisms identified by the process theory, such as the development of a coalition of wind-power advocates, simply determined by structural factors, such as electoral institutions that promote ecological parties? Or, alternatively, do they depend on extraneous and contingent factors such as election results or the timing of events? Finally, are structural features, such as the shape of the interest-group system, themselves influenced by the processes studied? By using each theory to critique the other, I aim to improve our understanding of the scope and limits of each and of how they complement each other.

Wind-Power Outcomes and Policies

Both Germany and the U.S. recently have experienced rapid growth in wind power, but the takeoff occurred later in the U.S., and hence its wind share of electricity generation was still less than half of Germany's in 2012 (see the two black lines on Figure 5.1).[9] In Germany, wind power began to grow rapidly in 1991, sustained an average growth rate of 39% per year over the 1994-2004 period, and reached 16,600 MW in 2004. Although growth slowed markedly since then, it still averaged 8% per year during the 2004-12 period (the solid gray line on the figure). In 2012, wind power generation had reached 46,000 Gigawatthours (GWh), or 7.4% of total electricity generation in Germany (the solid black line).

By contrast, in the U.S., growth in wind power has been uneven. Installed capacity grew rapidly, at 34% a year, over the 1983-89 period, but only reached 1400 MW in 1989. Then, capacity grew very slowly for the next decade, rising only 3% per year from 1989 to 1998, to only 1800 MW. The real takeoff of wind power in the U.S. began in 1999, which was eight years later than in Germany. Installed capacity then grew at an average rate of 28% a year in the 1998-2012 period and reached 60,000 MW in 2012 (see the dashed gray line on the figure). However, because of its relatively late takeoff, wind power still made up only 1.8% of the U.S.'s electricity generation in 2009, although this had risen to 3.5% in 2012 (the dashed black line).

Figure 5.1: Cumulative Installed Wind Power Capacity and Wind Shares of Electricity Generation in Germany and the U.S., 1991-2012



It is clear that the state, including the national state, has been crucial for the growth of wind power. The development of wind power requires government support for research and development, subsidies in order to at least partially level the playing field with energy sources that have large environmental externalities and their own government subsidies, and regulatory assistance to break into (semi)-monopolistic markets (Walz 2007). Not surprisingly, the leading countries have stronger wind-power development policies than the laggards (Szarka 2007, 68-86).

Two main differences in their wind-power policies go a long way toward explaining why

Germany's wind share is still more than double that of the U.S. First, financial incentives have been larger in Germany, although exact comparisons are difficult (Walz 2007, 78). In Germany, wind-energy producers were guaranteed 90% of the retail price of electricity from 1991 to 2000, and since then about 8-9 Euro cents (currently about 11-12 U.S. cents) per Kilowatthour (KWh) (Lauber and Mez 2006, 113). In the U.S., the federal production tax credit has provided a subsidy of about 2 U.S. cents/KWh since 1992, which is only about 20% of the average retail electricity price. The incentives from state-level renewable portfolio standards (RPSs) currently add between 0.5 and 5.5 cents/KWh, depending on the state, and green-power choice programs add another 1.5 cents/KWh, which applies to about 30% of wind-generated electricity (Stern and Wobus 2008, 16, 20; Bird, Kreycik, and Friedman 2008, 10). Hence, total subsidies for wind power in the U.S. are highly variable across states, and now range from 4 to 9 U.S. cents/KWh, compared to about 11 U.S. cents/KWh offered everywhere in Germany.

Second, policies and the policy context have been much more stable in Germany than in the U.S., which has created a more secure climate for investors. In Germany, the 1990 Electricity Feed-In Law guaranteed prices to producers beginning in 1991, and the only major political challenge to those rates was defeated in 1997. Then, in 2000, the Renewable Energy Sources Act guaranteed feed-in tariffs for 20 years and distributed the costs of the subsidies equally across all utilities and their customers, which reduced political opposition. Moreover, the overall policy context for renewable-energy development has been more favorable and stable in Germany, as it has included prominent, ambitious greenhouse-gas reduction targets since 1990 and renewable-energy targets since 2000 -- 12.5% of electricity by 2010, later raised to 30% by 2020 (Bechberger and Reiche 2004, 50; Mez 2009, 386-87; Lauber and Mez 2006, 110; Walz 2007, 69; Vasi 2009, 328). By contrast, in the U.S., tax credits for wind power often have been allowed to expire or have been renewed only at the last minute. National targets for renewable energy and greenhouse-gas emissions also have been lacking, along with any sustained federal government interest in binding international commitments concerning the latter, all of which signal a lack of political commitment in those areas. Taken together, these factors have created much uncertainty for investors, insurers, and employees in the wind-power sector (Wiser 2007, 5; Sovacool 2008, 156-57).

Explaining these differences in policies and outcomes is the topic of the next two sections.

Structural Explanations of the Germany-U.S. Differences

Germany and the U.S. differ in a number of structural features that have been advanced as explanations of their differences in environmental outcomes (Jahn 1998; Scruggs 2003), energy and climate policies (Paterson 1996), and specifically wind-power development (Keller 2010). These might explain why Germany has developed wind power much more intensively than the U.S.

However, some of these possible explanations have little support. For example, wind resource has been advanced as an explanation in several cross-national and cross-state studies (Menz and Vachon 2006; Toke, Breukers, and Wolsink 2008, 1133; Bird, et al. 2005; Vasi 2009). But the U.S. does not lag Germany in wind power because the U.S. lacks adequate wind resource. The most recent estimate of the wind potential in the U.S. is 36,900,000

GWh/year, which is about nine times current electricity consumption and over 250 times the current generation from wind (NREL 2010). Although comparable cross-national measures of wind resource are not available, the available studies show that Germany has much less wind resource than the U.S. (cf. Toke, Breukers, and Wolsink 2008, 1132-33).

Another possible explanation is that the U.S. lags in wind power because it has developed other renewable energy sources to a greater degree than Germany. This would reduce the pressure to develop wind power more aggressively that might come from any domestic environmental or energy-security interests or international climate-policy commitments. However, Germany also leads the U.S. in most other areas of "new renewable energy" (excluding large hydroelectric plants), including biomass, solar, and wind; the U.S. leads Germany only in geothermal energy. Germany leads in the total generation share of all new renewables, by 18.5% vs. 5.4%, a nearly three to one ratio that is even larger than its lead in wind power (2012 data from BMU 2013, 12; USEIA 2013, Tables 1.1, 1.1.A).

Several other structural explanations do have empirical support, although shortly I will argue that their contribution to an overall explanation is limited. First, Germany has smaller fossil-fuel endowments and greater dependence on energy imports, manufacturing, and manufacturing exports, than the U.S. Germany's energy imports totaled about 74% of total energy consumption in 2000, compared with 25% for the U.S. (AGEB and USEIA data). Also, among major industrial countries, Germany has ranked at or near the top in the share of manufacturing jobs in the economy since 1970, while the U.S. has ranked near the bottom. In 1995, 23% of Germany's jobs were in manufacturing, compared with 13% in the U.S. (Pilat 2006, 6). Germany also depends much more on exports than the U.S. does; exports made up

30% of Germany's GDP in 2002, compared with only 7% in the U.S.[10] As a result, Germany arguably has a stronger national interest than the U.S. in developing renewable energy, since this reduces reliance on energy imports, improves its balance of payments, and increases domestic employment. Indeed, renewable-energy policy in Germany has been justified partly by reference to the 280,000 jobs the government estimates it to have created (BMU 2009, 31).

Second, proportional representation allowed the Green party to become a national force in Germany, averaging 7.5% of the vote in parliamentary elections since 1983, while the U.S.'s plurality winner-takes-all electoral system has protected the Democrats and Republicans against potential third parties. Hence, ecological parties have been insignificant in the U.S., which reduces pressure for innovation in energy policy. Conversely, the Greens, as the case studies will show, have been important advocates of renewable energy in Germany. Third, the competitive, pluralist interest-group system in the U.S. is accompanied by an adversarial relationship between government and business, while Germany has a neocorporatist system and more cooperative business-government relations in environmental as well as economic policy areas (Scruggs 2003, 227-28, 233). Hence, business opposition to environmental policy is usually more muted in Germany than in the U.S., where environmental deregulation was pushed by business interests and attempted by the Reagan administration in the 1980s (Kraft and Axelrod 1984).

Some problems with the structural accounts

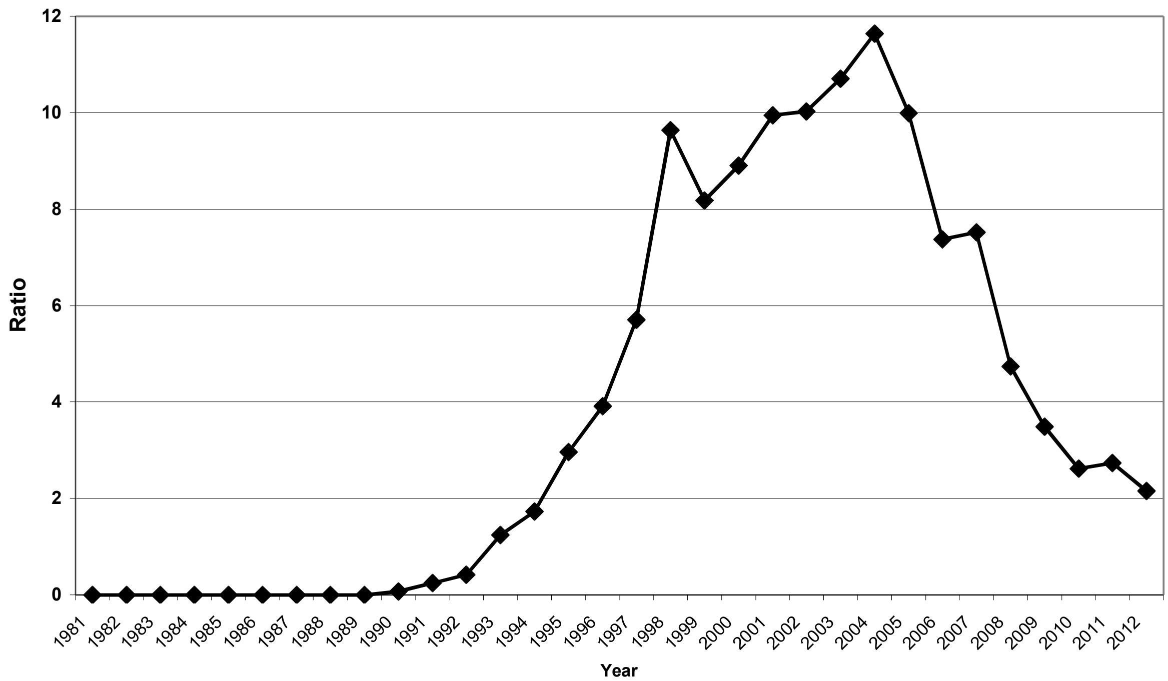
Together, these structural factors contribute to an explanation of why Germany took a leadership role in wind-power development. However, the structural explanations are also problematic in several ways. First, the U.S.'s structures do not present only disadvantages. It has greater wind resources than Germany, and its institutions favor innovation in energy policy in at least two ways. The U.S.'s pluralist interest-group system and weak political parties make it more open to new interests and ideas than Germany, with its moderately strong neocorporatist arrangements and programmatic parties (Kitschelt 1986, 66, 81). Also, while both countries have federalist institutions, state governments in the U.S. have more autonomy in renewable-energy and climate policy than do Germany's *Länder* (Rabe 2004, 16-18; Keller 2010), though this is partly due to the relative passivity of the U.S. national government in those areas (Derthick 2010). This provides another avenue for innovation in the U.S. system, since states are relatively free to experiment with renewable-energy policies (Rabe 2006). If they have success, it may be imitated in other states, and the national government may come under pressure to adopt reforms, partly in order to make policy more uniform.

It is possible that these advantages for the U.S. operate at the same time that the disadvantages do. Since the U.S. lags Germany in wind power and other new renewables, one could defend the structural theory by arguing that the U.S.'s structural disadvantages outweigh the advantages when it comes to renewable-energy policy and outcomes. But in theoretical terms, it is not clear why some structural features would be more important than others. A theoretically more fruitful line of analysis starts with the fact that the two sets of structural factors cancel out or balance each other to an extent. This creates scope for other causal factors, such as political processes, to contribute to the outcomes.

Another, larger problem for the structural explanation of Germany's leadership over the U.S. is that the outcomes fit the explanation only for the period since the early 1990s. In fact, the same structural explanation would be completely wrong for the 1970s and '80s, when the U.S. actually *led* Germany in wind power, and the explanation has been losing force since 2004, when the U.S. began to catch up. The U.S. initiated the commercial use of modern wind power almost ten years before Germany did, in California (Dismukes, et al. 2007). Hence, as late as 1992, the U.S. had over 60% of the world's wind-power capacity and nine times Germany's, and the U.S. still led Germany in terms of its share of wind power in total electricity generation.[11] Also, since 2004, the U.S. has been catching up to Germany in terms of its wind-power share, due to rapid recent growth in capacity in the U.S. (28%/year) and a slowdown in Germany's growth (to 8%/year).

In short, the relative positions of Germany and the U.S. in terms of wind-power development are variable, not fixed. Although the U.S. now lags Germany's share of wind power, this was not always the case, and it might not be the case even five years from now. Indeed, if their respective post-2004 growth rates were to continue, the U.S. would begin to exceed Germany's share of wind power in electricity generation in 2016.[12] The variability in their relationship can be seen in Figure 5.2,[13] which shows the ratio between Germany's and the U.S.'s share of wind power in total electricity generation; a ratio above 1:1 means that Germany is leading. The ratio rose from less than 1:1 in the 1981-92 period to a peak of almost 12:1 in 2004. Since then it has declined, to just over 2:1 in 2012.

Figure 5.2: Ratio of Germany's to the U.S.'s Wind Share of Electricity Generation, 1981-2012



Therefore, rather than simply saying that Germany's leads the U.S. in wind power, it is more complete and accurate to say that the relative positions of the two countries have gone through three phases: U.S. leadership (1978-93), U.S. stagnation and growing leadership by Germany (1993-2004), and the beginning of catch-up by the U.S. (2004-present). Hence, there are three turning points in the relative positions of Germany and the U.S. to explain, which the next section does in terms of the convergence of problem and political processes.

Process Explanations of the Germany-U.S. Differences

The U.S. takes the lead (1978-93)

In the 1970s, problem and politics streams converged to produce a window for innovations in energy policy in the U.S., both at the federal level and in some states. The 1973 oil crisis presented large, unexpected problems, which included a quadrupling of oil prices, a five-month embargo of the U.S. by OPEC, and gasoline rationing (Smith 2002, 24-25). Unusually strong political commitment resulted largely from the election of Jimmy Carter, who won the 1976 presidential election by only a 50-48% margin. Carter had a strong interest in energy policy and advocated the creation of an energy department during the presidential campaign (Laird 2001, 90). He and his administration (1977-81) sharply increased R & D spending for wind power, which peaked in 1980. He also created the cabinet-level Department of Energy and within it an office for renewable energy, led by an assistant secretary (Cox, Blumstein, and Gilbert 1991, 353; Walz 2007, 67; Nemet and Kammen 2007, 750; Laird and Stepes 2009, 2620). Carter also proposed major energy legislation, and one part that survived interest-group and congressional resistance was the Public Utility Regulatory Policy Act (PURPA) of 1978. This law gave independent power producers grid access and required utilities to purchase their power at the "avoided costs" of the utility's own generation. Implementation was left to state governments, some of which set high purchase prices for renewable-sourced electricity by choosing to interpret the avoided costs under generous assumptions concerning future fossil-fuel prices (Swisher and Porter 2006, 186). Wind projects also were eligible for two federal investment tax credits adopted in 1978 and for accelerated depreciation starting in 1981 (Cox, Blumstein, and Gilbert 1991, 354). These aggressive national Carter-era policies set the stage for a boom in wind power in California during the 1980s, when the vast majority of the world's wind-power capacity was built in that state.

California's structural advantages were also necessary conditions of the boom there. The state had abundant land, some with excellent wind resources (in mountain passes), as well as many rich individuals potentially interested in investing in wind projects. The latter was important since utilities were not eligible for most federal tax credits, a feature that also encouraged the growth of independent power producers (Gipe 1995, 30; (Cox, Blumstein, and Gilbert 1991, 354).

But the wind boom in California also would not have occurred without strong state-level political support for wind and solar power. This occurred through a key development in the politics stream: the election of Jerry Brown as governor of California (1975-83). In his 1974 election campaign, Brown ran on the slogan "serve the people, protect the earth, explore the universe" and advanced a strong environmental agenda. Although Brown was elected only narrowly (by 50-47%), his victory helped create a policy window for renewable energy in the state. Advised by renewable-energy advocates such as Amory Lovins, Brown appointed "soft-energy" proponents to the California Energy Commission and California Public Utilities Commission, and also created an Office of Alternative Technology, both of which pressed for a strong renewable-energy policy (van Est 1999, 34-35). Staffers in the latter agency helped ensure that a 1978 solar tax-credit law would also apply to wind power. The same year, the state legislature passed the Mello Act, which set relatively ambitious targets for renewable-sourced electricity -- 1% by 1987, 10% by 2000 (Righter 1996, 204-6).

Encouraged by this political support, the California Public Utilities Commission, all of whose members were Brown appointees after January 1979, went on the offensive and levied multi-million-dollar fines against two large utilities for failing to pursue alternative energy, conservation, and cogeneration (Harris and Navarro 1999, 12-13). The fines spurred the utilities to negotiate with independent power producers and the commission, which led to contracts with high purchase prices for wind power (Gipe 1995, 30). The commission also had begun mapping wind resources in 1977, providing crucial data that were not available in other states (Righter 1996, 204-6).

The convergence of federal and state politics streams led to a very generous combination of financial incentives for wind power at this time: a 15% federal investment tax credit for certain energy properties enacted in 1978, a generic federal investment tax credit of 10%, accelerated depreciation from the federal government, and a California tax credit for wind power of 25% (Cox, Blumstein, and Gilbert 1991, 347, 354). On top of all these tax incentives, the California Public Utilities Commission required that wind-power operators be guaranteed a price of about 7 cents/KWh in contracts lasting at least 10 years. As a result, 50,000 individual investors provided $2 billion in capital, and companies rushed to build wind farms in California, mainly in three mountainous areas. Companies installed 1141 MW of wind-power capacity by 1985, and California generated 87% of the world's wind power that year (Righter 1996, 203-4; Harris and Navarro 1999, 14; Cox, Blumstein, and Gilbert 1991, 356).

The U.S. falters and Germany surges ahead (1993-2004)

In the early 1990s, Germany began to exceed the U.S.'s wind share of electricity generated, because wind power stagnated in the U.S. after 1985 while it took off in Germany after 1990. The U.S. boom in wind energy turned to a bust because its problem and politics streams simultaneously reversed direction and created a different kind of policy window, one that conservatives used to undermine renewable energy. One factor was the large decline in fossil-fuel prices during the 1980s. After peaking in 1980, crude oil prices fell for the next six years, declining by 70% in real terms, and coal and natural-gas prices also fell sharply during the 1980s (USEIA data). The low prices sharply reduced political interest in alternative energy and made the aggressive renewable-energy strategy of states like California difficult to sustain (Sovacool 2008, 150-54).

The problem stream shifted also because the top-down approach to wind-power development that was taken in the 1970s led to technological failures in the 1980s; wind power became seen as a problem more than a solution. U.S.-made wind turbines broke down in field conditions in California in the early 1980s, because aerospace firms failed to anticipate problems such as insects and ice, and the extremely high subsidies led to shoddy construction (Cox, Blumstein, and Gilbert 1991, 349). By 1985, only 38% of U.S.-built turbines were working reliably, compared with 98% of those built by Danish firms. Hence, another effect of the technical problems was that Danish turbine producers came to dominate the U.S. market (Heymann 1998, 646).

Around the same time, the politics stream presented a reversal of fortunes for environmental policy, including renewable-energy policy. Nationally, the election of Ronald

Reagan as president in 1980 inaugurated a shift toward environmental deregulation and which drastically curtailed national support for renewable energy (Kraft and Axelrod 1984, 319; Kraft 2004, 115). Congress largely went along with Reagan's proposed cuts to wind and other renewable-energy programs. R & D spending for wind power fell by 50% from 1981 to 1984 and kept declining through the early 1990s. Spending for renewable energy and energy conservation fell by about 90% during the 1980s (Nemet and Kammen 2007, 750; Kraft 2004, 174). Federal tax credits and accelerated depreciation for wind power were allowed to expire in 1985, dealing a severe blow to the industry (Gipe 1991, 758).

California also saw a political reversal, after the Republican George Deukmejian was elected governor in 1982. He attacked the state's renewable-energy tax credits, and although the legislature initially resisted him (van Est 1999, 55), the combination of changes in the problem and politics streams was irresistible. California stopped signing preferential contracts for wind power in 1985, gave operators with existing contracts only five years to get their projects online, and let its tax credit for wind projects expire (Swisher and Porter 2006, 187; Harris and Navarro 1999, 16). Some wind and solar companies went bankrupt, many skilled and experienced people left the industries, and wind and solar became saddled with a stigma of ineffectiveness and financial failure (Sovacool 2008, 154-55; 2009, 4502).

The problem and politics streams continued to be unfavorable for national renewable-energy policy into the 2000s. Real oil prices remained near or below their late 1980s levels until 2004, and Republicans controlled either the White House or the House of Representatives for all but two years until 2009. However, a brief spike in oil prices in 1990, the 1990-91 Persian Gulf war, and President George H.W. Bush's interest in environmental issues helped lead Congress to pass the National Energy Policy Act in 1992. A broad coalition including the natural-gas and renewable-energy industries as well as energy-efficiency advocates helped get a national production tax credit for wind power into that legislation (Eikeland 1993, 65-68).

Nonetheless, these forces were too small and short-lived, and the 1992 Act was too weak, to have much effect on wind-power development in the 1990s. The production tax credit's low level of subsidy combined with low fossil-fuel prices meant that wind power did not become competitive with natural gas until about 2000. Moreover, providing the incentive as a tax credit made it difficult for wind-power operators to claim it, since their long-term tax liabilities were not large and predictable enough. This promoted the sale of wind-generation facilities to large corporations and hindered the development of a new set of economic actors with a strong interest in technological development and political advocacy for wind power (Swisher and Porter 2006, 188). Furthermore, Congress gave low priority to the renewal of the production tax credit, allowing it to expire for periods of several months in 1999, 2002, and 2004. The expirations in some years, and uncertainties about the credit's extension in others, created insecurity for investors and led to a boom-bust cycle in the construction of new wind projects, which reduced the long-term growth of the industry (Wiser 2007).

By contrast, commercialization of wind power in Germany did not really begin until after 1990. But Germany quickly passed the U.S. in its wind-power share of electricity (in 1993) and in absolute wind-power generation (in 1997). The extremely rapid growth in Germany was largely due to the 1990 passage of the Feed-In Law, its defense in 1997, and its strengthening in 2000. And that legislative history, in turn, was due to a convergence of politics and problem streams in the late 1980s that created an extraordinarily large window for energy and climate policy.

The politics stream included the emergence of a broad, strong advocacy coalition. The coalition eventually included the Greens, environmental organizations, research institutes, unions, religious organizations, hydroelectric producers, key elements of the Christian-Democratic and Social-Democratic parties, the Environment Ministry, and the Federal Environmental Agency. The environmental movement and its legacies contributed crucially to the advocacy coalition, in several ways. The West German environmental movement was stronger than in most industrialized countries, with a major focus on opposition to nuclear power during the 1970s and '80s (Koopmans 1995). The movement spawned organizations such as the Eco-Institute and solar associations, which in the late 1980s began to develop feed-in tariff proposals for renewable energy (Jacobsson and Lauber 2006, 263). Environmentalists also helped to found Green parties, initially at local and regional levels, in alliance with leftist activists. The environmental movement also influenced public opinion on nuclear power and climate change in the long term (Vasi 2009, 328). Moreover, once the Greens gained Bundestag seats beginning in 1983, the new party strongly influenced the established parties toward environmental positions. The Christian-Democratic federal government began to regulate SO_X emissions in efforts to prevent forest dieback, and the Social Democrats backed away from their support for nuclear energy (Papadakis 1989; Schreurs 1997, 153; Weidner 2002, 154).

These political developments linked to the environmental movement were peaking at the same time that a series of focusing events created major changes in the perception of environmental problems in the 1985-86 period, in West Germany and elsewhere. First, ozone depletion rose as an international issue in 1985, when the Vienna Convention on Ozone Depleting Substances was adopted and British scientists published the first findings demonstrating the existence of the ozone hole over Antarctica. Then, in January 1986, a report by the respected German Physical Society warned of climate change and rising sea levels, which sparked much anxious media coverage and public attention in West Germany (Beuermann 2000, 100; Kords 1996, 204; Der Spiegel 1986). Finally, in April, the Chernobyl nuclear disaster sharply focused attention on environmental problems in West Germany, which was one of the West European countries receiving the greatest amount of radioactive fallout (Peplow 2006, 983).

These events drove changes in the politics stream, creating a window of opportunity for elites who promoted climate protection and renewable energy. In the wake of Chernobyl, public support for environmental protection reached a peak in West Germany in the late 1980s (Bang 2003, 217). The federal government created the Environment Ministry in June 1986 and a parliamentary inquiry commission on ozone and climate issues that October (Watanabe and Mez 2004, 112). The commission, which created and expressed a consensus across all the parliamentary parties, called for Germany to reduce CO_2 and methane emissions by 30% compared with 1987 and to adopt an electricity feed-in-law to assist renewable energy (Lauber and Mez 2006, 105-6).

Bound up with these political changes was the formation of a broad advocacy coalition for renewable-energy policy. In 1989, Green and Christian-Democratic deputies entered into a highly unusual alliance to support a feed-in law for renewable-energy sources, including wind, solar, small biomass, and small hydroelectric projects. The law was resisted by the large electricity utilities, the Federal Economics Ministry, and party leaders, but gained support from deputies in all parliamentary parties. Its unanimous passage was aided by two additional contingent events. In 1987, the electricity utilities announced that they had reached their limits in making payments for small hydroelectric producers, which drove those producers into the advocacy coalition. In fact, the head of their association, who was also the operator of a hydroelectric plant, was the Christian-Democratic deputy who led the parliamentary push for the feed-in law (Reiche 2004, 146). Also, as the unification of Germany unfolded rapidly in 1989-90, the utilities became distracted by their takeover and restructuring of the former East German electricity sector, so they did not anticipate the Feed-In Law's likely effects on new renewables and did not strongly oppose it (Bechberger 2000, 4-5; Lauber and Mez 2006, 106; Jacobsson and Lauber 2006, 264).

Although the principle of a feed-in tariff -- government sets a price at which utilities must purchase renewable-sourced electricity -- had also been used in the U.S.'s PURPA, as well as in Denmark's renewable energy policies, there is no evidence that this policy instrument diffused from either of those countries to Germany. Rather, a voluntary feed-in tariff for renewable-sourced electricity had existed in Germany since 1979 in the form of an agreement among trade associations, before the 1990 Feed-In Law converted it to a regulatory measure on terms much more generous to wind-power producers; what happened in Denmark was similar (Reiche 2004, 146). This suggests, in contrast to the Knill, Shikano, and Tosun chapter in this volume, that the apparent "spread" of policy instruments across countries may often be due to approximately simultaneous invention in broadly similar contexts, rather than to transfer from one country to another.

The 1990 law strengthened the advocacy coalition for renewable energy by creating a market for wind turbines and solar photovoltaic cells and hence reducing their costs, and by spurring interest-group formation and mobilization. Hence, when large utilities and the federal government tried to reduce the feed-in subsidies in 1997, the advocacy coalition responded by holding a demonstration in Bonn that drew four thousand people. The coalition included wind turbine suppliers and operators, solar energy producers, metalworkers, farmers, environmental and religious organizations, and the large Equipment and Machinery Producers Association. Their mobilization helped defeat the proposed cuts in a Bundestag committee (Jacobsson and Lauber 2006, 265; Michaelowa 2005, 195; Watanabe 2009, 151-52, 160, 166, 179, 184).

The advocacy coalition reached a new level of influence after the 1998 parliamentary elections, in which the Greens received 6.7% of the vote and joined in a national coalition government with the Social Democrats for the first time (Jänicke 2005, 138; Weidner 2002, 182). Under that government, a series of major climate policies were enacted, including a 100,000 roofs program for solar photovoltaics and the 2000 Renewable Energy Sources Act (Bechberger and Reiche 2004, 50). The advocacy coalition grew to include one of the large utilities (Preussen Elektra) and officials in the environment ministry. It overcame strong opposition from the Federation of German Industry and most large utilities to help pass the 2000 Renewable Energy Sources Act and the 2004 amendments to it (Jacobsson and Lauber 2006, 267-69; Wüstenhagen and Bilharz 2006, 1688).

The U.S. begins to catch up (2004-present)

The next turning point occurred in the early 2000s, when the growth of new wind installations became rapid in the U.S. and began to slow in Germany (see the gray lines on Figure 5.1 above). The slowdown in Germany was due in part to gradually falling feed-in tariffs for new onshore wind turbines after 2001 (Lauber and Mez 2006, 111) and the declining availability of suitable new onshore sites. The growth in the U.S., which began in 1999 and accelerated in 2005, was caused by a convergence of factors in the problem and politics streams which opened policy windows in a large number of states.

First, fossil-fuel price increases made the problem of finding an alternative to fossil fuels more acute, and wind power appeared to be a increasingly viable solution. In particular, U.S. natural-gas prices at the wellhead rose sharply beginning in 2000, rising from about $2 per thousand cubic feet in the 1986-99 period to a peak of $6-8 in the 2005-08 period, before falling to about $4 in the next three years and to less than $3 in 2012 (USEIA data). Hence the operating costs of fossil-fuel electricity plants rose from about 2.0 cents/KWh in 1998 to 3.6 cents in 2008 (data from USEIA 2010, Table 8.2). At the same time, the cost of wind-power generation fell, by about 1.1 cents/KWh from 1998 to 2006 (Wiser and Bolinger 2008, 23-25). Given its subsidies, wind power became commercially competitive with natural-gas fired electricity generation in the U.S. around 2000, when the price of natural gas passed $3.50/thousand cubic feet (Bird, et al. 2003, 5). Since 2003, wind power has on average sold for about 4 cents/KWh, which is cheaper than gas-fired generation but still more expensive than coal-fired generation (Wiser and Bolinger 2008, 18-19).[14]

However, economic drivers by themselves were not enough to produce a surge in wind power, because competitiveness also depends on state and federal subsidies. The approximately 4 cents/KWh charged by wind-power producers is supplemented by a 2 cent subsidy from the federal production credit, and by state and consumer subsidies that currently range from about 2 to 7 cents/KWh, depending on the state (Stern and Wobus 2008, 16, 20; Bird, Kreycik, and Friedman 2008, 10). In this period, adequate subsidies and a relatively high natural-gas price are both necessary for wind power to be competitive.

Since national subsidies have not grown in inflation-adjusted terms since 1992, the rapid rise in supportive state-level policies that occurred from the late 1990s was crucial for wind-power development. The most effective state policies have been renewable portfolio standards and programs promoting green-power choice, which began in the late 1990s (Menz and Vachon 2006). The former mandate that utilities produce, purchase, or subsidize specific, accelerating amounts of renewable-sourced electricity, while the latter encourage customers to voluntarily subsidize renewables. By 2008, RPSs had been adopted in 28 states, over half of all electricity customers had an option to buy "green power," and 2% of them did so (Sovacool 2008, 158; Bird, Kreycik, and Friedman 2008, 1). Although already in 1978 the PURPA law had included a feed-in tariff, RPSs have remained the most important instrument for U.S. states in the last three decades. Despite the success of feed-in-tariffs in Germany, Denmark, and Spain, that policy instrument has largely failed to diffuse to the United States, where it is limited to a few recent, small local and state experiments (Rickerson, Bennhold, and Bradbury 2008; Gipe 2009).

Why did some states move strongly in favor of wind and other renewable energy? The answer does not lie in the party control of government. The legislatures of states that adopted

RPSs were roughly divided between Democratic and Republican control, and 16 of the first 22 states with RPSs had Republican governors, even though Democrats are now stronger advocates for renewable energy on the national level (Rabe 2006, 6). However, there is an important structural factor that facilitates state action in the U.S. Historically, state governments have regulated energy and areas related to it, such as economic development, land-use planning, and disaster planning. Hence, in the 1990s many states already possessed strong administrative capacities to regulate energy production, and their citizens accepted and even expected state action in this area. This constellation reduced the power of energy lobbies at the state level (Byrne, et al. 2007, 4567). While this may have been a necessary condition, it was not sufficient, as shown by the lack of action by all but a few states before the late 1990s.

At that time, a conjunction of changes in the problem and politics streams created windows of opportunity for policy entrepreneurs in many states (Rabe 2004). First, the delayed effects of the 1992 Energy Policy Act created problems and opportunities for state-level energy policy. Spurred by the planning reviews required by the federal act, states began to open their electricity markets beginning in 1996, by promoting new kinds of power producers and retail choice for customers. The reforms also led to a lull in the construction of new power plants, and hence there was a need for new capacity by the late 1990s. Second, natural-gas prices increased sharply and became volatile beginning in June 2000, which prompted state-level concerns about energy security and diversification (Martinot, Wiser, and Hamrin 2005, 5, 19).

At the same time, two political changes occurred that also favored renewable-energy advocates. First, the UN Framework Convention on Climate Change process and the adoption of the Kyoto Protocol in December 1997 spurred some states to develop climate policies in the absence of federal government leadership, since the U.S. Senate symbolically voted 95-0 to reject the protocol in that year and President George W. Bush rejected the protocol in 2001 (Rabe 2004). Moreover, policy entrepreneurs saw an opportunity to link climate policy with other important state goals, i.e., economic development, the creation of in-state manufacturing jobs, increased energy security, and compliance with the Clean Air Act (Byrne, et al. 2007, 4567; Rabe 2006, 6-7; Peterson and Rose 2006). Second, renewable energy also became very popular with the public. Ninety percent supported alternative and renewable energy development in a 2001 survey, and in 2006, 77% said it should be the top priority for energy policy in the U.S. (Byrne, et al. 2007, 4566).

How states responded to these pressures and opportunities depended on their particular circumstances and processes. Texas is a key example, since, if it were an independent country, it would now be the world's eighth largest greenhouse-gas emitter (WRI and UNFCCC data). It would also rank sixth in absolute wind-power capacity, with 12214 MW in 2012, which was 20% of the U.S. total (data from AWEA 2013 and IEA 2012, 6). Its share of wind-generated electricity was 7.4% that year, the same as Germany's (data from USEIA 2013, Tables 1.6B, 1.17B). The growth of wind power in Texas has been largely the result of an aggressive RPS adopted in 1999, while George W. Bush was governor. The RPS initially required for-profit electricity retailers to install 2000 MW in new renewable capacity within ten years; it was amended in 2005 to require a total of 5880 MW by 2015. A strength in the law is the fact that non-compliance triggers automatic penalties (Rabe 2004, 50-1; 2006, 10-

12; Schmalensee 2009, 26).

This remarkable Texas policy was adopted because of a convergence of problem and political processes in that state. Texas officials undertook a restructuring of the electricity market, aiming to deregulate markets and diversify electricity supplies, partly because the state is in an isolated position in the U.S. electricity grid and because this energy-inefficient, oil- and gas-producing state actually had become a net importer of energy in 1992. The RPS was a small component of this reform, written on only one of the bill's 61 pages, and neither the bill nor its supporters mentioned the contentious issue of climate change. Moreover, this provision probably would not have been included were it not for a previous, unusual use of "deliberative polling" that brought customers, utility representatives, and regulators into discussions in the 1996-98 period. The polling showed that customers wanted renewable-sourced electricity and were willing to pay a dollar a month for it. Surprised by these results, officials started a pilot project that cost consumer 25 cents a month, and this project helped build political support for the 1999 RPS (Bird, et al. 2003, 8-9; Rabe 2004, 56-59).

Summary and Conclusions

This comparative analysis has three main theoretical implications. First, structural theories of environmental outcomes have serious limitations in explaining renewable-energy development. They cannot account for change over time within a country case, such as the boom (1980-85), bust (1985-98), and boom (1998-present) in the U.S., and hence cannot explain the changing relative positions of Germany and the U.S. In addition, the growth of government support for wind power in both countries, which helps make them both increasingly "environmental states," cannot be explained by reference to structural factors. A combination of socioeconomic, political, and international processes is likely responsible (see Duit's concluding chapter in this volume).

Second, combinations of structural and multiple-streams theories are most effective in explaining environmental performance. Although structural factors matter, their effects are not stable over time. Rather, which structures matter and when they do so depend on processes that drive the opening of policy windows and hence the turning points between periods. Those processes consist of convergent developments in problems and in politics, which are contingent on focusing events and accidents of timing, and hence cannot be readily derived from any set of structural features. If structures and processes are used together as competing explanations or rival hypotheses, we can see how far each is supported by the evidence and criticize each from the perspective of the other. The resulting analysis can help clarify how much scope actors have and under what conditions.

The interplay of structural factors and stream convergence can be seen in three periods in this comparison. During the period of U.S. leadership (1978-93), the institutional autonomy of state-level actors in U.S.-style federalism were necessary conditions, as were the structural advantages that California enjoyed, such as strong wind resources in an area with low-intensity land use and an innovative set of investors. But those structural factors mattered only because of contingent events: the 1973 oil crisis, the narrow elections of Jimmy Carter and Jerry Brown in the mid-1970s, and their administrations becoming committed to the aggressive promotion of renewable energy.

Next, in Germany's period of expanding leadership (1993-2004), its proportional-representation electoral system and cooperative business-government relations were major underlying causes of renewable-energy policies. Without them, the Greens would not have become a national-level actor capable of sparking and later extending the Feed-In Law, and the Kohl government's (1982-1998) neoliberal intentions might have been extended to environmental deregulation, as occurred with the Reagan administration in the U.S. (cf. Weidner 2002). But those institutional features came into play and helped produce the Feed-In Law only because politics and problem streams developed in certain unpredictable ways and converged in the mid- and late 1980s. These included the growth of a strong (West) German environmental movement, the establishment of the Greens, the Chernobyl accident and other extraordinary focusing events that coincided in the 1985-86 period, and the cooperation of Greens, conservatives, and the small hydro industry in an unusual alliance.

Moreover, political processes helped change the structures that shaped renewable-energy policy, in two key ways. The *combination* of the proportional electoral system and the environmental movement, not either factor by itself, led to a structural change in the West German party system with the addition of the Greens in 1983 (cf. Kitschelt 1986, 83). In addition, the environmental movement of the 1970s and '80s ultimately helped to reshape the neocorporatist system regarding environmental policy, as new economic interest groups and environmental organizations became political players (Jänicke 1997) and the protest demonstration became an acceptable method of participation (Koopmans 1995).

The decline of new wind installations in the U.S. after 1987 also was shaped by a combination of structures and processes. The decline revealed certain structural weaknesses of the U.S. for renewable-energy policy: the winner-take-all electoral system (hence no party consistently promoted renewable energy) and the adversarial relationship between business and government on environmental policy (hence a strong business backlash against environmental regulations in the late 1970s and '80s) (Kraft 2002, 36-37; Prasad 2006, 181-84). But wind power might have continued to grow rapidly in the 1980s and '90s were it not for a convergence of developments in the problem and politics streams that were unfavorable to renewable energy: the economic recession and Iranian hostage crisis that helped Reagan win the 1980 presidential election, the 1980s drop in oil prices, and the technical failures of many U.S.-made wind turbines in the field.

Finally, since the late 1990s, the U.S. has begun to catch up with Germany, because of a potent combination of structures and processes. Substantial state autonomy and capacities in energy policy made possible the adoption of RPSs, green-power choice programs, and other supports for renewable energy. But these would not have been adopted without a conjuncture of problem and political processes favorable to the renewable sector, especially rising and volatile natural-gas prices, declining wind-power costs, climate-change concerns raised by the Kyoto process, and the successful promotion of green consumerism by environmentalists. The supportive state policies that resulted were not simply determined by natural-gas prices, since those began to rise only in 2000, after the trend to RPSs and green-power options was underway in many states (Price 2002, 40).

In short, while the U.S. has structural disadvantages for renewable energy, both country-cases show that there is more scope for actors to make a difference when certain aspects of problem and politics streams converge, for whatever reasons. Based on the cases analyzed here, this seems most likely when extraordinary focusing events direct public and elite attention to environmental problems, fossil-fuel prices rise, environmental movements build public support, and environmentally oriented parties or candidates win elections. These processes do not only counteract structural forces; they shift the political terrain in ways that makes certain structures more or less relevant.

The third implication of these case comparisons is that multiple-streams theory needs to be improved in certain ways. The relation of the different streams to each other requires more theoretical attention (cf. Zahariadis 2007, 81-82). Problem and politics streams are often independent, in which case their convergence to produce policy windows is largely coincidental. But sometimes the two streams are both driven by the same forces, are manipulated by certain actors, or influence each other through positive feedback. The cases examined here illustrate some of these possibilities. The period of U.S. growth in the 1970s was driven by a coincidence between the oil crisis and the elections of Brown and Carter. However, the oil crisis affected not only problem perceptions but also the political commitment to energy policy that those political leaders were able to muster. In Germany, the 1990 renewable energy law resulted partly from a similar coincidence of domestic political factors (the rise of the Greens) and internationally-driven problems (the ozone issue, Chernoybyl). But in Germany, this stream convergence triggered two decades of positive feedback that produced strong, consistent policies for renewable energy. The positive feedback involved the broadening and mobilization of an advocacy coalition, the strengthening of renewable-energy policies and targets, the development of administrative institutions, and perceptions of growing technical and economic feasibility. The weakness of this kind of positive feedback so far in the U.S. has made the progress on renewable energy there more fragile.

Notes

1. Sovacool 2009, 712. However, critics have emphasized its damage to the aesthetic value of landscapes, noise pollution, and harm to bird and bat populations (Sovacool 2008, 185-86).

2. Where data sources are cited, calculations are by the author.

3. An alternative would be a measure based on installed capacity. However, the wind-power generation share measure
has the advantage of adjusting for differences in the capacity factors of the wind turbines, which can vary significantly across countries. Although generation shares are affected by annual differences in weather conditions, this is of little importance over the relatively long time frames studied here.

4. While the former aims to explain outcomes and the latter to explain agenda setting, here they will both be applied to explain policy-making and implementation. This is reasonable because wind-power outcomes depend strongly, though not exclusively, on renewable-energy policies. Also, the causal factors in multiple-streams theory often bear directly on decision making and implementation as well as agenda setting (cf. Zahariadis 2007, 80), and I will supplement them with some elements of advocacy-coalition theory to more fully address policy making.

5. Although they are sometimes seen as competitors and have different emphases, the two theories have much in common and few real points of disagreement. Both hold that the usual inertia in policy-making can be overcome when sharp changes in perceived problems and in political alignments create openings for political actors to press successfully for major policy changes.

6. Advocacy-coalition theory also emphasizes belief systems and long-term changes in ideas, which are not analyzed in this chapter.

7. Among those that do, Reiche and Bechberger (2004) and Gan, et al. (2005) assess a wide range of factors without distinguishing relative weights, and Snyder and Kaiser (2009) and Bohn and Lant (2009) largely view the processes that they consider as more influential than the structures.

8. Exceptions on the latter point include Laird and Stefes (2009) and Stefes (2010), which examine the roles of historical contingency and path dependence, and Breukers (2006), which relates structures and processes in a theory of institutional capacity building.

9. Data for Figure 5.1 are from BMU 2013, 12-13; AGEB 2008, 21; 2012, 26; 2013, 28; Dismukes, et al. 2007, 778; AWEA 2010; 2012a; 2012b, 2013; USEIA 1996, Table A1; 2013, Tables 1.1, 1.1.A. The U.S. wind shares for 1981-94 are based on my estimates of wind-power

generation, which are derived from known installed capacity and average capacity factors for the 1995-99 period.

10. *CIA World Factbook*, 2003 data via www.nationmaster.com, accessed 14 May 2010.

11. Dismukes, et al. 2007, 778; author's calculations from the data cited for Figure 5.1.

12. Based on 2004-12 annual growth rates in both countries; data from the sources used for Table 5.1. However, the sharp decline in U.S. natural-gas prices since 2008 is a potential problem for the further growth of the U.S. wind industry.

13. Data for Figure 5.2 are calculated from the same sources as for Figure 5.1 (see note 9 above).

14. However, coal power plants have faced stricter regulation by the Obama administration, making the price comparison to natural gas the more pertinent one.

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[1]. Sovacool 2009, 712. However, critics have emphasized its damage to the aesthetic value of landscapes, noise pollution, and harm to bird and bat populations (Sovacool 2008, 185-86).

[2]. Where data sources are cited, calculations are by the author.

[3]. An alternative would be a measure based on installed capacity. However, the wind-power generation share measure has the advantage of adjusting for differences in the capacity factors of the wind turbines, which can vary significantly across countries. Although generation shares are affected by annual differences in weather conditions, this is of little importance over the relatively long time frames studied here.

[4]. While the former aims to explain outcomes and the latter to explain agenda setting, here they will both be applied to explain policy-making and implementation. This is reasonable because wind-power outcomes depend strongly, though not exclusively, on renewable-energy policies. Also, the causal factors in multiple-streams theory often bear directly on decision making and implementation as well as agenda setting (cf. Zahariadis 2007, 80), and I will supplement them with some elements of advocacy-coalition theory to more fully address policy making.

[5]. Although they are sometimes seen as competitors and have different emphases, the two theories have much in common and few real points of disagreement. Both hold that the usual inertia in policy-making can be overcome when sharp changes in perceived problems and in political alignments create openings for political actors to press successfully for major policy changes.

[6]. Advocacy-coalition theory also emphasizes belief systems and long-term changes in ideas, which are not analyzed in this chapter.

[7]. Among those that do, Reiche and Bechberger (2004) and Gan, et al. (2005) assess a wide range of factors without distinguishing relative weights, and Snyder and Kaiser (2009) and Bohn and Lant (2009) largely view the processes that they consider as more influential than the structures.

[8]. Exceptions on the latter point include Laird and Stefes (2009) and Stefes (2010), which examine the roles of historical contingency and path dependence, and Breukers (2006), which relates structures and processes in a theory of institutional capacity building.

[9]. Data for Figure 5.1 are from BMU 2013, 12-13; AGEB 2008, 21; 2012, 26; 2013, 28; Dismukes, et al. 2007, 778; AWEA 2010; 2012a; 2012b, 2013; USEIA 1996, Table A1; 2013, Tables 1.1, 1.1.A. The U.S. wind shares for 1981-94 are based on my estimates of wind-power generation, which are derived from known installed capacity and average capacity factors for the 1995-99 period.

[10]. *CIA World Factbook*, 2003 data via www.nationmaster.com, accessed 14 May 2010.

[11]. Dismukes, et al. 2007, 778; author's calculations from the data

cited for Figure 5.1.

12. Based on 2004-12 annual growth rates in both countries; data from the sources used for Table 5.1. However, the sharp decline in U.S. natural-gas prices since 2008 is a potential problem for the further growth of the U.S. wind industry.

13. Data for Figure 5.2 are calculated from the same sources as for Figure 5.1 (see note 9 above).

14. However, coal power plants have faced stricter regulation by the Obama administration, making the price comparison to natural gas the more pertinent one.