Many countries have adopted comprehensive policy frameworks to support renewable energy, leading to a rapid scale-up of these technologies. One hundred and nine countries have enacted some form of policy regarding renewable power, and 118 countries have set targets for renewable energy. In contrast, the United States has not adopted any consistent and stable set of policies at the national level to foster the use of renewable energy. There is no federal carbon tax, no nationwide cap-and-trade system for carbon, and no long-term incentive mechanism for renewable energy generation. Federal support for renewable energy has consisted mainly of R&D and production tax credits. In this essay, I explore why some nations and certain U.S. states have developed robust policies for the deployment of renewable energy while the United States as a whole has not.

The U.S. production tax credit for renewable energy, first introduced in 1992, has repeatedly expired and then been extended. It has led to a boom-and-bust cycle that inhibits long-term investments. According to Jeff Immelt, chairman and CEO of Gen-
eral Electric, “The current energy markets don’t favor cleaner technology or low carbon…. No business will invest when there is no certainty…. If we’re serious about transforming our energy markets, we must send the right signals and create demand for the technologies that solve these problems.” While many technologies could contribute to an alternative energy future in the United States, including energy efficiency, nuclear energy, and carbon capture and storage, I concentrate here on renewable energy.

Absent a consistent national approach, thirty-nine U.S. states (including the District of Columbia and Puerto Rico) have enacted policies to foster renewable energy. The mechanism most widely used by states, the Renewable Portfolio Standard (RPS), is a set of performance requirements calling for utilities to supply a minimum amount of their electricity from renewable resources (measured in absolute or relative terms). Figure 1 shows which states have mandatory standards for renewable energy, as opposed to those with voluntary goals.

Reflecting the diversity of the nation, no two states have an identical RPS. The state-level policies differ in the percentage of renewable energy that must be achieved, in the definition of renewable, and in their enforcement mechanisms. Some states have created a commodity called Renewable Energy Certificates (RECs) as a means to implement the portfolio standard. RECs, which usually represent 1 megawatt hour (MWh) of energy produced from renewable resources, can be sold and purchased. A utility that does not produce renewable energy to comply with the applicable RPS can purchase RECs from generators of renewable electricity. Because of the differences in RPSs from state to state, there is no nationwide REC market, and RECs can be traded across states in only a few cases.

Local initiative is no doubt valuable, but it also brings disadvantages. First, the diversity of state-level approaches adds complexity for businesses that have to study individual policies and develop separate business models for each state. Such complexity increases not only transaction costs for businesses but also final electricity prices for everyone. Second, because some states have no policies to foster renewable energy, a “free rider” problem has emerged. Those states may benefit from lower sulfur dioxide and particulate emissions as a result of their neighbors’ policies, without shouldering any of the effort or cost. Third, the lack of a national framework increases regulatory uncertainty for investors: in many states, renewable energy incentives are created through executive orders that a newly elected governor could retract. Lastly, jurisdictional inconsistencies between states inhibit the fungibility of RECs, thereby diminishing the economic efficiency of the RPS. A larger market for RECs – ideally a single national market – would allow renewable energy to be produced in locations where renewable resources are most abundant and where it is most cost-effective.

Thus, there is a tension between, on the one hand, the value of local initiative and, on the other, the benefits of greater coherence that a national policy framework might provide. To probe how this tension might be resolved, I will examine both international and U.S. state-level case studies where comprehensive policies to encourage renewable energy have been adopted. My aim is not to evaluate the specific policy mechanisms that countries and states have chosen, but rather to shed light on the underlying societal factors that contributed to each government’s decision to enact the policies in the first place. I explore four factors that could influence a government’s decision to adopt favorable policies for renewable energy: (1) eco-
nomic motives; (2) a high endowment of renewable resources and/or a low endowment of nonrenewable sources; (3) the political system; and (4) cultural factors and attitudes. (I discuss only the first two factors in the case studies involving U.S. states.) To simplify matters, I focus on the electricity sector.

Germany, Denmark, and China have made tremendous efforts at the national level to catalyze and support the development and deployment of renewable energy in their countries. Similar to the United States, all three nations relied heavily on coal at one point (indeed, China still does). While Germany and China are large industrial economies, Denmark is much smaller. In the late 1990s, a center-left coalition of the Social Democrats (SPD) and the Green Party enacted various policies to reduce carbon emissions and increase the share of renewable energy in Germany. These policies endure, in a modified form, still today. Passed into law in 2000, the Renewable Energy Sources Act (EEG) is the centerpiece of renewable energy policy in Germany. It provides for a feed-in tariff, a mechanism that guarantees generators of renewable energy the payment of fixed prices per kilowatt-hour (kWh). The tariff was scheduled to be reduced over time to account for decreasing costs, but once an installation is commissioned the price of that respective year is guaranteed for fifteen or twenty years. The
feed-in tariff is part of an overall policy framework that promotes renewable energy and energy efficiency in Germany, and that is embedded in EU-wide policies such as a cap-and-trade system for carbon. After the 2011 nuclear accident in Fukushima, nowhere outside of Japan was the political fallout felt more keenly than in Germany. The center-right coalition of the Christian Union (CDU/CSU) and Free Democrats (FDP) agreed on a set of new policy measures to achieve the Energiewende (or energy transition), which includes targets to produce at least 35 percent of Germany’s electricity with renewable resources by 2020 and 80 percent by 2050. As of mid-2011, Germany generated 20 percent of its electricity from renewable resources.

Economic Motives. A major driver for alternative energy in Germany today is the perception that renewable energies are an engine for economic growth and job creation, but this was not initially the case. As of 2011, 382,000 people in Germany worked in the renewable energy sector. The scale-up of renewable energy and energy efficiency has created attractive business opportunities for smaller companies such as Enercon, a producer of wind turbines, as well as diversified industrial players such as Siemens. Siemens claims that as of 2011, it generated more than 40 percent of its entire sales revenue with its “Environmental Portfolio,” which consists mainly of renewable energy and energy-efficient technologies. Renewable energy technologies are now among Germany’s fastest growing export segments. According to Hans-Josef Fell, a member of the German Bundestag for the Green Party, “80 percent of the wind turbines produced in Germany are exported; there you can see the reward that you can get if you take a pioneering role.” In addition, the policies have created opportunities domestically for companies that install renewable energy technologies, ranging from large industrial players that install offshore wind turbines to small-scale installers of solar panels on rooftops. The policies have also benefited farmers using residual biomass to produce electricity as well as farmers who provide land for solar panels and wind turbines. Jürgen Trittin, former German Environmental Minister, has argued that the success of renewable energy is in part because “[e]specially in rural areas . . . people understood that renewable energies can constitute an additional source of revenue.” Germany’s renewable energy industry has therefore reached a critical size, which in turn makes it opportune for politicians along the entire political spectrum to support it.

Resource Endowment. Germany is not blessed with optimal conditions for renewable energy. Given existing technologies and energy demand in 2010, Germany could technically cover 128 percent of its electricity consumption with renewables. Overall, the renewable energy potential for electricity is around 9.7 MWh/capita/year. Germany has virtually no oil reserves and only small proven natural gas reserves, but it does have considerable reserves of coal, with 4.7 percent of global proven reserves. In 2011, Germany had net imports of 76.2 billion cubic meters of natural gas, making it a major gas importer. Germany’s high dependence on foreign gas resources has certainly motivated policy-makers to support renewable energy for electricity. But given that coal reserves are readily available, dependence on foreign gas cannot fully explain Germany’s enthusiasm for renewables.

Political System. In Germany, federal and state governments are usually formed as a coalition between different parties. The seats in the Bundestag (the directly elected legislative body) are assigned in proportion to the party vote after accounting for constituency representatives. This sys-
tem has allowed the Green Party to play an important role in shaping German energy and environmental policy. Founded in 1980, the Green Party entered the Bundestag for the first time in 1983, winning 11 percent of the vote by 2009. The party’s competition for votes has induced established parties, in particular the center-left SPD, to adopt environmentally friendly positions. Thus, Germany’s multi-party system, with a legislature elected by means of proportional representation, has allowed “green” positions to gravitate toward the center of the political spectrum. According to Hermann Scheer, a former member of the Bundestag for the SPD and one of the architects of the EEG, “[A] decisive factor for the success of the EEG was that the SPD, a big party, could be turned around.”

Cultural Factors. Renewable energy enjoys widespread support among the German population. In a 2011 survey, 90 percent of Germans advocated a more rapid scale-up of renewable energy, with 73 percent in favor of renewables even if it meant increased electricity costs. Renewable energy is viewed as the least bad among energy options in a country where nuclear power enjoys only tepid support. Wind energy is widely accepted, but solar photovoltaic (PV) energy is more controversial because some Germans believe that they should not subsidize a technology that is not well suited to Germany, which has poor solar insolation. Drawing a connection between support for renewable energy and German culture is difficult and runs the risk of stereotyping, but research does indicate that Germans tend to feel threatened by uncertain outcomes and thus have created beliefs and institutions to avoid unknowns. In the context of environmental or security threats, Germans may be willing to act in a precautionary manner without knowing the exact consequences that environmental threats would have on their lives. Furthermore, compared to the United States, Germany is a less individualistic society. This lower degree of individualism might create a higher tolerance for policy measures that lead to higher levels of government intervention, such as taxes on energy and subsidies for renewable energies. These factors suggest that German culture may indeed have had a strengthening influence on the development of renewable energy policies in that country.

Denmark began to promote a transition to renewable energy in the mid-1970s as part of a strategy to shift away from its heavy reliance on coal. Early support mechanisms included a national certification program for wind turbines, investment subsidies, and mandatory grid connections for decentralized energy generation. Renewable energy was scaled up rapidly in the 1990s, driven by financial incentives including a feed-in tariff established in 1992 and policies that enabled communities to benefit directly from wind energy development. In the late 1990s, the growth of renewable energy in Denmark slowed significantly. In 1999, the Danish government expected that the EU would ban feed-in tariffs and therefore switched from the feed-in model to a system for trading green certificates. This transition largely failed because complicated transition rules took years to implement and led to significant uncertainty for investors. In 2001, a newly elected conservative government abolished many support mechanisms for renewable energy, leading to stagnation in wind development until 2007. Since then, two important cross-party “energy agreements” between the government and opposition parties have created consistent support for renewable energy. In 2008, an agreement was reached that fixed the goal of 20 percent share of renew-
ables in total gross energy consumption by 2011, guaranteed prices for renewable energy, and established a compensation scheme and participation model for local populations. In March 2012, a new target was established by the Danish Parliament: to achieve 100 percent of total energy consumption (that is, electricity, heating, and transport) with renewable energy by 2050. No other energy agreement in Denmark has received broader parliamentary support (171 out of 179 seats). The goal is for wind to supply 50 percent of Denmark’s electricity by 2020. (Wind currently provides 25 percent of total electricity.) The agreement covers a comprehensive range of measures to achieve these goals, including a commitment to build 1 gigawatt (GW) of offshore wind capacity and financial support for the development of new energy technologies (for example, wave energy).

Economic Motives. Support for renewable energy in Denmark has been closely tied to industrial policy. With the announcement of the 2012 energy agreement, Martin Lidegaard, Minister for Climate, Energy, and Building, said, “Denmark will once again be the global leader in the transition to green energy. This will prepare us for a future with increasing prices for oil and coal. Moreover it will create some of the jobs that we need so desperately, now and in the coming years.” According to the central government, the Danish clean-tech sector already accounts for 100,000 jobs, a significant number for a population of only 5.6 million. Renewable energy technology has become a major export for Denmark, with energy equipment (mostly wind technology) accounting for 11 percent of total exports. The continuous support for wind power has resulted in internationally renowned success stories, most notably Vestas, the world market leader in wind turbines. Vestas entered the wind turbine industry in 1979 and now has a global market share of 12.7 percent. The Danish state has a 79.96 percent ownership stake in Dong Energy, the nation’s largest energy company.

A remarkable feature of the Danish example is the direct economic participation of individuals in the development of wind power. Cooperatives were a critical form of ownership, particularly from the 1970s to the early 2000s. They were enabled by legislation that restricted the ownership of turbines to people who resided in close proximity to the wind turbine sites. In 2001, 175,000 households and farmers owned 80 percent of all wind turbines in Denmark, but as of 2008, co-op ownership had fallen to 20 percent due to increasing turbine sizes that necessitate much higher levels of investment and new legislation that no longer requires shareholders to reside in the vicinity of the turbine. Because local ownership has been an important factor in garnering support for wind energy, the Danish government created new policy measures in the 2008 energy agreement to revive local participation. The measures include the possibility to purchase turbine shares, a guarantee fund for local cooperatives, and a compensation scheme for local residents.

Resource Endowment. Another factor that can explain the motivation for Danish policy-makers to foster renewable energy is the excellent potential for renewable energy in the country. Denmark has a renewable energy potential for electricity of up to 28.6 MWh/capita/year, with the great majority coming from wind resources. In principle, wind power could cover current levels of electricity consumption many times over. At the same time, Denmark has only a moderate endowment of oil and natural gas. In 1973, when the first oil crisis occurred, Denmark was 90 percent dependent on foreign oil, and its economy was badly damaged as a result. Through aggressive measures since then to improve
energy efficiency and boost domestic offshore production, Denmark is now a net exporter of oil and gas.\footnote{44}

Political System. With the exception of the unfavorable regulatory environment in the early 2000s, there has been consistent support for renewable energy in Denmark. The political system is characterized by a multiparty structure, whereby many parties are represented in the parliament at any one time. Parties need only 2 percent of the vote to obtain a seat in the Danish parliament, the Folketing. Several of the current parties are known for their commitment to environmental protection. Because of the large number of parties in the Folketing, Danish governments are often formed as coalition administrations. For more than a century, no single party has ever held a majority.\footnote{45} Danish politics therefore requires formulation of consensus across parties. These attributes of the political system have contributed to relatively stable support for renewables.

Cultural Factors. Attitudes in Denmark have long been supportive of renewable energy development. As early as the 1890s, the Danish scientist Poul la Cour played a pioneering role in the development of wind turbines; today, wind energy in Denmark is part of the social landscape.\footnote{46} Energy generation is decentralized and close to the end user, even in the capital city of Copenhagen. Wind turbines, which have been around the country for centuries, are visible everywhere and are perceived as a natural part of the landscape. Another factor that might explain the success of renewable energy in Denmark is an embedded long-term orientation in Danish society that is more pronounced than in the United States or Germany.\footnote{47}

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\textbf{China} is full of energy contradictions. It is the largest coal producer, the largest emitter of carbon dioxide, and also one of the largest clean energy investors in the world. In 2010, China invested $51 billion (USD) in clean energy.\footnote{48} Most of China’s environmental policies are implemented to achieve targets set by the central government in its five-year plans. In the 12th Five Year Plan, for the period 2011 to 2015, the government set ambitious targets for renewables, for “nonfossil” fuels, for carbon intensity, and for energy intensity.\footnote{49} To reduce the resource intensity of China’s economy, the central government enacts some national-level policies and then assigns partial responsibility to provinces and municipalities to achieve the targets.\footnote{50} China’s support for renewable energy was greatly enhanced in 2005 with passage of “The Renewable Energy Law of the People’s Republic of China.”\footnote{51} The law created four mechanisms to promote renewable energy: (1) a national renewable energy target; (2) a mandatory connection and purchase policy; (3) a feed-in tariff system; and (4) a cost-sharing mechanism, including a fund for renewable energy development.\footnote{52}

Apart from large hydropower, solar PV and wind energy play the biggest role in China. The growth of the wind energy industry was amazingly swift: in 2010, China became the largest wind power market in terms of annual capacity increase and total cumulative installed capacity.\footnote{53} In the case of solar PV, only a small fraction of the Chinese PV module production has been installed domestically, with most products going to Germany, the United States, and Spain. But China has created the Golden Sun demonstration project and, in 2011, announced a feed-in tariff to encourage domestic installation of solar PV.\footnote{54} Despite its dependence on coal, China is taking significant steps to foster alternative forms of energy.

Economic Motives. In an April 2012 speech, China’s Premier Wen Jiabao said, “Greening of the economy is not a burden on growth; rather, it is an engine that drives
growth and an effective means to achieve sustainable development.” As of 2011, four of the ten largest manufacturers of wind turbines were Chinese companies. Similarly, five of the top ten manufacturers of solar PV cells were headquartered in China. China’s wind power industry (power generation and turbine manufacturing) generated an average of 40,000 direct jobs annually between 2006 and 2010 and is expected to generate 34,000 jobs annually between 2011 and 2020. China’s renewable energy industry has reached a scale large enough to contribute directly to global price reductions, further incentivizing domestic deployment of renewable energy.

Resource Endowment. China has a moderate endowment of renewable energy resources, mostly in wind energy and large hydropower. Its renewable electricity potential is up to 6.1 MWh/capita/year, significantly lower than the Danish potential. Including biomass, solar thermal, and geothermal energy, China could possibly meet its entire domestic energy demand with renewables. In terms of nonrenewable resources, China’s main endowment is coal, with 13.3 percent of global reserves; yet China’s reserve-to-production ratio is only thirty-three years, indicating that China either needs to find alternatives to coal or bear the energy-security risks of becoming a massive coal importer. China has poor remaining endowments of oil and gas, quickly becoming a major importer of both. China is now the second largest oil importer in the world after the United States.

Political System. China’s single-party system, its “socialist market” economy, and its long traditions of planning and industrial policy have facilitated the rapid build-up of its solar PV and wind energy industries. The one-party system requires extensive internal consensus-building among elite Communist Party leaders but suffers from few external challenges. Party leaders are rotated around China to govern provinces and cities, so there is less regional political strength than in most countries. The key challenge in Chinese energy policy has not been in the passing of laws and regulations but rather in their implementation. Indeed, the central government has often issued progressive targets, regulations, and rules, only to find it difficult to persuade and incentivize local governments to implement them. China’s population size, local competitive pressures, and limited enforcement capacities conspire to make policy implementation a huge challenge. Still, the government has successfully used incentives to spur the development and deployment of renewables in China.

Cultural Factors. As with other countries, it is difficult to generalize about Chinese culture, but one factor that might help explain China’s large investment in renewable energies is a pervasive long-term orientation in Chinese culture. The Chinese people have a strong awareness of their country’s long history, and they also appear to have unusual patience about the future—manifest in their willingness to invest in long-term outcomes. The Chinese have an extremely high savings rate, for example, which is equal to approximately 50 percent of GDP. This cultural predilection coupled with the Communist Party’s tradition of planning could partially explain the Chinese government’s ability to develop a long-term renewable energy plan and to make relatively large and steady investments in renewable energy.

Since the late 1990s, Colorado, Texas, and Ohio have each adopted strategies to manufacture and/or deploy renewable energy. Politically, these states range from independent to conservative, yet they have embraced renewable energy. In 2004, Colorado became the first U.S. state to adopt an RPS by ballot initiative.
The RPS was subsequently extended in 2007 and 2010. The current RPS requires investor-owned utilities to provide 30 percent of their retail electricity from renewable resources, while cooperatives and municipal utilities must provide 10 percent of their electricity from renewable resources by 2020. In February 2012, Colorado generated 15.4 percent of its electricity from renewable resources.

**Economic Motives.** In a national radio address, former Colorado Governor Bill Ritter remarked, “At a time when concern about our economy is growing and American families are struggling with high energy costs, [we] have proposed policies that will take advantage of renewable energy resources. . . . In Colorado, we call this the New Energy Economy. By creating a 21st century energy policy, we are creating jobs, revitalizing the economy, protecting the environment and helping secure our nation’s energy future.” This strong-willed push for renewable energy has indeed attracted U.S. and foreign renewable energy companies to Colorado. Vestas, the Danish wind company, operates four manufacturing plants in Colorado. It employs around 1,700 people and has invested $1 billion in the state. Other companies that supply Vestas, including Hexel and Bach Composites, have followed. Therefore, support for renewable energy is viewed as interconnected with economic development.

**Resource Endowment.** Colorado has significant renewable and fossil fuel energy resources. The state is particularly rich in natural gas, holding 8.5 percent of total U.S. reserves. The state also contains vast coal reserves and produces more than it needs for its own electricity generation. In addition, Colorado is rich in renewable resources, providing excellent opportunities for energy generation from both fossil fuels and renewables.

Texas first adopted an RPS in 1999, when George W. Bush was governor. The standard required an additional 2,000 MW of renewable energy capacity to be installed by 2009. The current standard requires 5,880 MW of renewable energy capacity by 2015 and 10,000 MW by 2025, although the 2025 standard had already been reached as of 2009. The RPS is binding for all investor-owned utilities and voluntary for all municipal and cooperative utilities. As of February 2012, Texas had the highest wind energy capacity installed in the United States. Texas is a particularly interesting case because policies in support of renewable energy were not enacted to counter climate change. In fact, Texas policymakers avoided framing support for wind energy as an environmental effort. Texas Governor Rick Perry, who describes himself as a climate change skeptic and rejects federal carbon regulations, had other motivations to support renewable energy development.

**Economic Motives.** Governor Perry has made diversification of the energy industry in Texas one of his top priorities. In a 2010 talk, he asked: “Is it wind? solar? biomass? clean coal? next generation nuclear? My answer is four simple words: all of the above. That’s exactly the strategy we’re pursuing in Texas, and it’s working which shouldn’t surprise anyone because Texas knows energy.” President Obama later adopted Governor Perry’s popular “all of the above” rhetoric. The Texas economy relies heavily on the energy sector, and renewable energy is simply seen as one new building block within the energy industry. In the course of the rapid scale-up of wind capacity, various wind energy companies, including GE, have established manufacturing facilities in the state. Wind energy has also garnered support in rural Western Texas, where most of the wind parks have been built. In rural areas, wind energy provides struggling farmers...
with an additional source of income, creates jobs, and raises local tax revenues. Landowners, provisioning their land for the wind turbines, usually receive a signing payment as well as royalties based on the amount of electricity produced.\textsuperscript{74} Thus, renewable energy—wind, in particular—has evolved into a considerable source of jobs and revenues in Texas.

\textit{Resource Endowment.} Texas has the largest wind energy potential in the United States. Despite its position as a national leader in terms of oil and gas reserves, Texas has historically imported coal from Wyoming to supply its coal-fueled power plants.\textsuperscript{75}

Ohio enacted an RPS in 2008, requiring investor-owned utilities to provide 25 percent of their electricity from alternative energy resources by 2025. In this case, “alternative energy” includes not only renewable energy technologies but also clean coal and advanced nuclear power. Of this 25 percent, at least 12.5 percent must come from renewable resources and at least 0.5 percent from solar energy.\textsuperscript{76} Ohio is far from reaching this target: as of February 2012, only 1.7 percent of total electricity in the state came from renewable resources.\textsuperscript{77}

\textit{Economic Motives.} Ohio has repositioned itself as a manufacturer of renewable energy technologies in an effort to transform the Rust Belt into a Green Belt. Ohio-based companies are successfully leveraging their traditional competencies and infrastructure to develop and produce world-class solar PV technologies, for example. Building on existing expertise in glass and plastic film manufacturing to support the automotive industry, Ohio today hosts important solar companies. The city of Toledo is now a hotspot for solar technology R&D and commercialization in part because the University of Toledo decided to support research in the field of alternative energy.\textsuperscript{78} First Solar, one of the largest vertically integrated solar companies in the world, has its U.S. manufacturing facilities and its major R&D activities in Ohio. In the wind energy sector, Ohio-based companies have become leading component suppliers for turbine manufacturers. Businesses have retooled their facilities and trained their workforces to produce components like bearings, gears, or composites for the wind energy industry.\textsuperscript{79} Interestingly, actual deployment of wind and solar technologies in Ohio has lagged other states. Only very recently, after the enactment of Ohio’s RPS, has Ohio begun to catch up, growing its wind capacity by an amazing 950 percent in 2011 (admittedly from a very low base). With a current capacity of around 100 MW, Ohio has 300 MW capacity of wind energy under construction and 3,683 MW in queue.\textsuperscript{80} These developments are creating opportunities for companies to plan, build, and maintain wind parks.

\textit{Resource Endowment.} Ohio has a low endowment of oil and gas but relatively large coal reserves. Despite its coal endowment, Ohio imports about two-thirds of its coal demand from other states. In terms of renewables, Ohio possesses vast resources of onshore and offshore resources. Wind speeds offshore over Lake Erie achieve the highest energy-potential classification.\textsuperscript{81} Ohio also has onshore wind resources that alone could generate 13.2 MWh/capita/year of electricity.\textsuperscript{82}

All these examples reveal that economic motives played an important role everywhere. The resource endowment had a strong influence on policy decisions in some cases (for example, Texas) but cannot explain the extent of motivation in other cases (Germany, for instance). The degree of dependence on foreign sources of energy, coupled with domestic resource endowments, better explains the motivation to aggressively pursue renewable en-
nergy. The structure of the political systems in Germany, Denmark, and China facilitated the enactment of renewable energy policies, but in different ways. The parliamentary systems in Germany and Denmark allow for the direct participation of “green” parties, although in neither case have these parties ever gained majorities. Instead, they have developed compromises with other parties that led to policies favorable to renewables. China and Denmark both have strong state-owned energy companies. This ownership structure forces these firms to comply with the will of the government, but the firms may have special political influence during policy formation that could limit the shift to renewables. In Denmark’s case, Dong Energy has become enthusiastic about renewable energy even though the majority of its current production is based on fossil fuels. In China, the enterprises owned by the central government are predominantly based on fossil fuels, with most of the renewable energy firms either privately owned or owned by the local government. Culture and attitudes appear to play an important role in Germany and Denmark especially, but also in China.

In the U.S. states considered here, it appears that Colorado’s and Texas’s historical experience with energy industries may have contributed to an understanding of the opportunities and a readiness to diversify the industry. Also, these two Western states have a cultural tradition of self-reliance and independence, so renewable energy may be attractive in these respects. Figure 2 summarizes the importance of the factors in supporting the adoption of renewable energy policies in each country or state. By analyzing surveys of Americans conducted between 2002 and 2010, Stephen Ansolabehere and David Konisky have examined why Americans support renewable energy. They find that 75 percent of Americans want to increase the amount of solar and wind in the American energy portfolio mainly because these technologies are perceived to reduce environmental harm at the local level and because they are perceived to be relatively affordable. They write, “Attitudes about global warming have weak or no correlation with attitudes about which fuels we use to generate electricity in the United States.” Their findings illuminate the cases of Colorado, Texas, and Ohio, where factors other than climate change motivated action.

The case studies provide insight into the underlying societal drivers that motivate policy-makers to adopt comprehensive policies in support of renewable energy. Approaches by other countries or individual states cannot serve as a blueprint for the United States: the policies emerged in the specific economic, social, and political contexts of each case. Comparing the United States to examples of what has worked elsewhere can, however, serve two purposes. First, one can identify which motivating factors are lacking at the national level in the United States. Second, learning from the experience of other governments, including at the state-level in the United States, could inform the design of a U.S. national policy framework. With these two purposes in mind, I conclude by examining each of the four factors in the U.S. context.

Economic Motives. One striking similarity across all the case studies is the importance of economic interests in motivating country and state governments to support renewable energy policies. Why, then, has the United States at the federal level not realized sufficient economic interest to enact legislation, even though thirty-nine U.S. states have implemented an RPS and/or goals? The most striking contrast between the United States at the national level and all the cases is that beyond wish-
ful thinking about creating “green jobs,” little effort has been made to determine the direct economic benefits of renewable energy for ordinary Americans. Also, one cannot help but notice that the renewable energy industry is very small compared to the fossil fuel industry in the United States, so the political strength of the renewable energy industry is tiny by comparison. It is worth noting that this was also the case at the beginning of the transition from coal to wind in Denmark, and it is still the case in China. The recent surge of unconventional natural gas production in the United States has also overshadowed (or competed with) growth in renewable energy.

Opponents portray government regulations that support renewable energy as harmful to the economy. A common argument in the United States is that you can either mitigate climate change or grow the economy. Such debate is by no means unprecedented, even in Germany and Denmark. And a certain degree of skepticism about the promise of the “green economy” is appropriate. Not every policy that supports renewable energy will directly stimulate economic growth, especially if the government cannot stay the course; and even if it does, the jobs, economic spillover, and revenue benefits remain uncertain.

Often the number of jobs in the renewable energy industry is cited to prove its positive impact on the economy. While these employment figures might serve as a crude indicator, they are insufficient to describe the impact that support for renewable energy has on economic development, especially because these industries
are subsidized by tax- or ratepayers and there is always an opportunity cost for investment. In Europe, the net economic impact is calculated as a function of the price difference between renewables and fossil fuel generation (which changes over time due to learning and economies of scale), the extent to which technologies are produced domestically and exported, and spillover effects to other economic sectors. For Europe, this net economic impact has been estimated to be slightly positive. Thus, even without accounting for society’s health and environmental benefits, economic welfare appears to be better off with public support for renewable energy than without.

There is also evidence in Germany, Denmark, and China that domestic incentive mechanisms for renewable energy deployment increase national companies’ likelihood to export products and compete globally. The emergent industrial cluster in each country appears to promote interfirm learning and positive spillovers for the economy. This outcome is consistent with earlier findings that local rivalry and demand conditions can foster innovation and productivity in an industry. But support for certain industries (that is, industrial policy) is not the norm in the United States. From the case studies, one can observe a positive feedback cycle between economic motives and renewable energy policies. Renewable energy deployment incentives are initially necessary to correct for market failures and create the demand needed for the renewable energy industry to prosper. Once such industries have grown, this market support can be ratcheted down and business interests will emerge to reinforce the support for renewable energy. Hence, the first lesson for the United States is that a predictable and stable incentive mechanism for domestic electricity generation would be helpful. The repeated expiration and renewal of production tax credits has fallen short of providing the market consistency needed to foster a strong U.S. renewable energy industry.

A second lesson from the case studies is that the economic participation of local populations appears to be critical to garner widespread and sustained popular support. The examples from Denmark, Germany, and Texas have shown that the decentralized nature of renewable energies has the potential to stimulate local economies, especially in rural areas. The extent to which local communities can participate in renewable energy development depends on the ability of local communities to participate in the construction, operation, and ownership of renewable energy projects. Projects that involve local ownership are currently very rare, constituting, for example, only 2 percent of the wind capacity installed in the United States. Development of U.S.-specific models for local ownership or participation in the market might generate broader support for renewable energy in the United States. Mechanisms that have been applied successfully in Denmark, such as issuing shares in wind parks, could serve as a starting point for policies that are suitable in the U.S. context. State ownership of energy firms is almost unimaginable in the United States, but there is a robust tradition of rural electricity cooperatives that could be used to build local support.

Resource Endowment. America’s resource endowment helps explain the lack of a national move toward renewable energy for electricity generation. The United States has the largest coal reserves worldwide, with 27 percent of global reserves. With the unconventional natural gas resources that have become economically feasible to recover, the United States is estimated to have 482 trillion cubic feet of “new” gas resources, much larger than its remaining conventional resources of 273 trillion cubic feet.
cubic feet. The United States could therefore be completely independent in electricity generation based on fossil fuels if it chose to do so. On the other hand, the United States also has abundant renewable energy resources. Several studies have shown that wind resources alone exceed the total projected demand for electricity in the United States. Especially in the Southwest, there are also excellent conditions for solar energy.

With its exceptional renewable resources, the United States has a natural potential to become a leader in renewable energy despite its large fossil resources. Other countries with less favorable conditions for renewable energy deployment, such as Germany or China, have enacted far more ambitious policies. The only practical policy implication that can be derived from my analysis is that those technologies that are most suitable to the local conditions should be pursued, rather than fighting against comparative advantage. A national policy framework would support renewable energy in regions that are most appropriate for the respective technology, and therefore would be more economically attractive.

Political System. Some have argued that the U.S. political system is less conducive to the formation of effective renewable energy policies at the national level. According to one argument, there is often one party controlling one house of Congress and another controlling the presidency and/or the other house of Congress, leading to stalemate. Another argument is that the incumbent fossil fuel firms in the United States are so strong politically that they can prevent any major changes to current policies. While both of these issues may reinforce difficulties in achieving a national framework and may slow the process, they fall short as an explanation for inactivity at the national level over such a long period of time, especially given that there have been periods when one party has controlled all three institutions. Recall also that thirty-nine U.S. states have managed to enact renewable energy policies. One could even argue that the U.S. political system, requiring strong majorities, should promote compromises that are more stable than in parliamentary system, whereby one party in control of the executive branch and legislature pushes through a policy on its own.

In the United States, because two Senators are elected per state, those states with smaller populations have a larger voice in the Senate than they do in the House. During past congressional debates about energy and climate change, the Senate proved to be the greater obstacle to passage of major legislation because coal, oil, or gas states could exercise their influence to a greater degree than they could in the House. Moreover, the United States has only two main political parties, which have become increasingly polarized. As in the United States, Germany and Denmark elect representatives to parliament on a constituent basis, but the key difference is that there is a second vote for the party, which determines the representation of the different parties in the parliament. Where more parties exist, there seems to be greater policy compromise on energy topics. China is a one-party state, so it does not have to compromise with other political parties; but it does have to achieve consensus within the party elite. A key difference is that this consensus-building is not done publicly.

Cultural Factors. In countries like Germany or Denmark, cultural factors appear to have aided the enactment of renewable energy policies. By comparing the United States to such countries, one notices three cultural factors that may have held back national policy formation in the United States. First, U.S. society has a more pronounced belief in the “free market,” lead-
ing to greater resistance to government intervention in the market. Second, there is a deeply ingrained expectation in the United States that abundant and cheap energy should be available just as it has always been. Third, there is much less environmental concern about climate change in the United States than in most other countries. Only a thin majority in the United States believes that climate change is already happening, and U.S. public opinion on climate change has become more polarized along conservative/liberal lines and by party affiliation. Yet Americans are very supportive of clean energy on other environmental and public health grounds.

In summary, the lessons from these cases suggest that it is possible to develop a national policy framework to spur clean energy in the United States. Barriers to developing renewable energy markets should be removed because the current patchwork of state-level approaches creates complexity, instills uncertainty, and inhibits opportunities to optimize resource allocation. A national framework would have to recognize the value of local forces in creating renewable energy supply through utilization of local renewable resources, as well as the need for local communities to benefit through ownership opportunities and improved local environmental conditions. Such a policy would be a significant departure from the preemptive nature of many prior federal regulations. A national policy framework would need to be designed to provide stability and predictability, but this does not mean that renewable energy would need to be subsidized forever. Supportive deployment policies could be scheduled to rise and fall over time. The main selling points for a national policy should be improved economic growth, jobs, and competitiveness, as well as reduced local air pollution, improved public health, and enhanced energy security.

ENDNOTES
1 I gratefully acknowledge the research assistance of Lasse Eisgruber, who also provided German translations.
7 Ibid.
Why & How Governments Support Renewable Energy


17 Ibid.


19 Calculations based on data from ibid.


21 Agentur für Erneuerbare Energien, “Die Geschichte des Erneuerbare Energie Gesetzes.”


23 See the website of Professor Geert Hofstede, who has conducted a comprehensive study of how national and organizational culture interacts with workplace values; http://geert-hofstede.com/germany.html (accessed May 14, 2012).


34 Danish Energy Agency, “New Danish Energy Agreement.”


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56 “Gamesa Back in Wind Top-Five as GE Drops Out.”


60 Data from ibid.

61 Ibid.


69 U.S. Energy Information Administration, “Colorado Energy Fact Sheet.”


81 U.S. Energy Information Administration, “Ohio Energy Fact Sheet.”