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Approaches to Alternative Energy Policy: A Comparison of the United States and Germany

Martina Dzuna
Ursinus College

Adviser: Robin Clouser
Second Adviser: Patrick Hurley

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I. Introduction

With the recent upheavals in the Middle East, rising oil prices, and fears surrounding global climate change on many people's minds, energy and where it comes from, is becoming an increasingly important economic and environmental issue. Energy is a buzzword on the lips of politicians and the public alike, as solutions are sought to what may be the next energy crisis as a growing population requires more energy to support itself.

The world population is expected to grow by 50 % in the 21st century, and energy consumption is expected to grow 300 % making finding a sustainable source of energy extremely important (Hecht & Miller 2010). Currently, most of the world relies on fossil fuels such as petroleum crude oils and coal; these fuels are energy dense and easy to store and transport, which accounts for the popularity of their use (Klass 2003). However, by their definition, these fuels are also finite, especially when it comes to crude oil (Klass 2003). The supply of oil is rapidly reaching peak production, after which prices will rise making the use of oil undesirable (Klass 2003).

Improvements in energy efficiency may temporarily postpone the combined effect of growing world demand for energy and a dwindling supply (Klass 2003). The McKinsey report on energy efficiency estimates that with full implementation of currently available technologies energy consumption in the United States alone could be cut by 23 % saving more than $1.2 trillion (Granade et.al. 2009). However, misconceptions about energy savings, and difficulties achieving the behavior changes that would be required for people to adopt energy saving habits makes implementation difficult at best (Attari et.al. 2010 and Dietz et.al. 2009). The development of new, commercially viable, fuel sources to replace what will soon become a fuel source too expensive for the market is needed in conjunction with increased efficiency (Klass 2003).

One of the solutions being considered is that of alternative or renewable energy. The terms, alternative energy and renewable energy, are often used interchangeably, in that they refer to energy production methods that do not use up natural resources or otherwise harm the environment. For the purpose of this paper, the two terms will also be used interchangeably. Under the standard definition, alternative energies are those that do not use fossil fuels or nuclear power. This includes wind and solar energies, modern biomass (including the use of biomass to produce other, more traditional fuels, such as methane), wave and tidal stream energies, and geothermal energy (Gross et.al. 2003). These different types of energy are all in various stages of development and have differing degrees of commercial viability, with some already viable while others will require a substantial amount of research before they reach a point where they can compete in the market (Gross et.al. 2003).

This paper will examine the types of alternative energies that are available at this point, focus on the formation of markets for alternative energy and discuss how new energy technology enters and then diffuses into the markets. Along with energy technology diffusion, this paper will examine how policy structures make technology diffusion possible and which types of policy are most effective. To answer this question, the report uses Germany and the United States as case studies. From the case studies, we will be able to draw some conclusions about what makes some policies more successful than others, and make recommendations on how best to structure effective alternative energy policy. The paper argues that to achieve growth in the alternative energy sector requires policies that work to create market opportunities for alternative energies and that by doing so such policies will create an energy system where alternative energies become established.

II. Alternative Energies

In this section, I discuss several different forms of energy production, detailing aspects of technological development, geographies of resource availability, and social-political and economic dimensions. Each of these energy sources and forms of production are advocated as ways to replace contemporary fossil-fuel based sources. They are, to differing degrees, the targets of energy policy in numerous countries as well as state governments around the world.

Wind

Wind power is one of the most talked about alternative energies. It is also the greatest success story with regards to market growth and the most commercially viable of the available options (Gross et.al. 2003). Wind power is emission free power that is captured by wind turbines (DOE:EERE 2010 "Wind and water"). Electricity was first generated by wind in the 19th century, but it wasn't until the 1950s that the first modern wind turbine was built in Denmark (Gross et.al. 2003). The turbines went into commercial application in the 1980s, becoming progressively larger until they reached the current commercial models (Gross et.al. 2003).

Innovation in the wind power sector is immense. From the late 1980s to 2003 energy output has increased 100-fold, and the capacity of commercial turbines has increased from 55kW to 1MW or more (Gross et.al. 2003). The level of sound produced by the turbines was also halved in a three year period leading up to 2003, while the weight of the turbines per kW was halved in a five year period, lowering manufacturing and shipping costs (Gross et.al. 2003). There is also a movement for wind production to move off-shore, where there is a potential for an even larger and more stable supply of energy (Pieper 2009).

Wind energy is the one renewable energy that is consistently pushed for by most countries, since it is a ready domestic source of energy in many areas. At the windiest sites, wind farms are already close to being cost competitive with conventional power (Gross et.al. 2003). In the US alone there is the potential for up to 10,000,000MW of land-based wind power, enough to power the whole nation several times over (DOE:EERE 2010 "Wind…"). However, care must be taken in properly siting wind turbines and farms in areas that receive enough wind to keep the turbines running. Currently wind power in sites with good to moderate wind sells for about 4-6¢/kWh, and is projected to fall to about 3¢/kWh (Gross et.al. 2003).

While general public support for wind energy is very high, when it comes to siting wind farms, it is not unusual to encounter instances of "NIMBYism." NIMBYism refers to the "not in my backyard" attitude people or entire communities often take concerning new construction of so-called "locally unwanted land-uses" (LULUs), whether it is a new prison, nuclear power plant, or a wind farm (Devine-Wright 2005). With wind farms the reasons that are most often cited are the visual impact that wind turbines have on the landscape and the noise that is produced by the turbines (Devine-Wright 2005). Less often people's complaints stem from a perception that the wind turbines are unreliable or less efficient than coal-fired power plants, or the impact on birds and wildlife (Devine-Wright 2005). Typically, even when there are objections to a project, support for construction tends to remain positive (Wüstenhagen et.al. 2007). In fact, research demonstrates that renewable energies tend to follow a U-curve when it comes to community acceptance, with the siting process being the lowest point of the curve; before the project is sited and after a project is up and running, public support for renewable projects tends to be high (Wüstenhagen et.al. 2007).

Solar

Solar, like wind, is an energy source that has seen great improvement in technological advancement, acceptance and market expansion over the last few years. Solar energy can be harnessed in both passive and active ways (Pieper 2009). Passive solar refers to the capture of solar energy directly to provide heat or hot water, while active solar captures energy and converts it to electricity through the use of Photovoltaic cells (BMU 2008). Photovoltaics, however, remain expensive, with the power produced from them at 6-10 times the cost of grid electricity, mostly as a result of material and production costs (Gross et.al. 2003).

Photovoltaics were first used in the 1960s to power satellites, with their uses expanding to fill small niches in the market such as powering calculators and small-scale telecommunications (Gross et.al. 2003). Most commercial photovoltaics are made of individual crystalline silicone cells, which require sophisticated techniques to manufacture, and are therefore inherently high cost (Gross et.al. 2003). There is also worry over the supply of raw materials for the manufacturing of photovoltaic cells, which has led to more money being spent on research and development (Pieper 2009).

The newest solar technologies include thin film modules, which are less expensive and do not require the same amount of raw materials, and semi-conductive polymers (Gross et.al. 2003). Solar technologies are also being integrated into new construction, replacing conventional cladding materials such as roofing tiles with roofing tiles with built in photovoltaics (Gross et.al. 2003). When replacing other materials, the integrated photovoltaics are at or close to commercial viability (Gross et.al. 2003).

Modern Biomass

Modern biomass is perhaps the most diverse set of alternative energies including both solid and liquid biomass, as well as gases produced from the decomposition processes of waste materials (Gross et.al. 2003). Solid biomass includes sources, such as forest and agricultural industry byproducts, inputs that would otherwise simply be thrown out, as well as crops (i.e. corn, switchgrass, forests) grown directly for fuel consumption (Pieper 2009). Solid biomass can be burned directly in much the same way that coal is burned in contemporary power plants to produce energy or it can be processed to create liquid or gaseous fuels (Gross et.al. 2003).

In addition, there are several different processes that can be used to convert solid biomass into liquid or gas forms, including gasification, pyrolysis, anaerobic digestion, and physical-chemical conversion (Gross et.al. 2003). Through these processes, biomass is made available for use as renewable gasoline and biodiesel, thereby powering certain vehicles for transportation needs and reducing a country's dependence on oil even more (DOE:EERE 2010 "Biomass"). Brazil's use of sugar cane is one example of a country where reliance on biomass for transportation needs has accomplished this goal.

Another major source of biomass as energy is the capture of landfill gas, which can be as much as 50% methane (Gross et.al. 2003). The gas is produced through the natural decomposition of wastes stored in landfills, with most of it escaping to the atmosphere; when captured it can be used for heat and electricity (Pieper 2009).

Most forms of biomass are commercially viable, with the newer technologies slowly making their way into the market (Gross et.al. 2003). There are ongoing debates about the wisdom of growing crops to meet food-vs.-fuel needs with some biomass technologies, but the trend in many places (e.g., U.S. Midwest, parts of Brazil) has been for some farmers to transition from growing crops for food to use in fuel production (e.g., corn, soybeans), particularly when growing on marginal land or those that can be produced in mass quantities, such as switchgrass and algae (DOE: EERE 2010 "Biomass").

Water, Wave and Tidal Stream

Water has long been used as a renewable energy, with most of the attention recently focused on large-scale hydroelectric dams. Dams, however, can be very ecologically damaging (e.g., disrupting sediment flows, altering native fish communities), so the creation of new ones is considered undesirable by many ecologists? but modernization and new ecological standards can keep current dams open (Pieper 2009). With water as an energy source, most of the attention has turned off-shore to harnessing wave and tidal stream energy. Wave and tidal stream energy are not as close to commercial viability as wind and solar, but many different designs and devices exist and the research into the most effective ones is continuing (Gross et.al. 2003).

Geothermal

Geothermal energy uses the energy of the earth for heating or to create electricity (DOE: EERE 2010 "Geothermal"). The energy is very site specific, with some sites having plenty of energy, while other may have next to none (Pieper, 2009). Harnessing the energy requires drilling into the ground to first access the temperature differential, which at some sites is enough to create steam to power turbines, while on other sites it may only be enough keep a house at the temperature of the ground in that depth (DOE:EERE 2010 "Geothermal"). The research into the best ways of harnessing the geothermal power is still ongoing, with attention being paid to the best ways to produce electricity using it (DOE: EERE 2010 "Geothermal").

Advantages of Alternative Energies

Alternative energies have many advantages, including sustainability and the economic and national security that comes with local fuel sources, which is why they are an attractive prospect for replacing more conventional fuel sources. They are seen as a way to promote domestic industrial development, reduce carbon emissions, and decrease reliance on foreign fossil fuels (Komar & Bazilian 2005). In creating new industries, alternative energies also open up many job opportunities in the manufacturing, constructing and installing of the equipment, and in operating and maintaining the equipment over its lifespan (Lewis & Wiser 2005). The wind industry, for example, is credited with creating more jobs per dollar investment and per kilowatt-hour generated than the power generated by fossil fuels (Lewis & Wiser 2005). Not only do alternative energies produce more jobs, but in a time when sustainability is important, alternative energies manage to fulfill that requirement where fossil fuels fall short.

Alternative energies achieve the sustainability that is needed when looking for a new fuel source to replace fossil fuels. Sustainability is traditionally defined as "meeting the basic economic, social, and security needs now and in the future without undermining the natural resource base or environmental quality on which both life and the economy depend" (Hecht & Miller 2010). Fossil fuels fail to meet any of the criteria, as their use undermines the future resource base, and their use also contributes greatly to global climate change through the emission of greenhouse gases (GHG) (Hecht & Miller 2010). Alternative energies, on the other hand, are renewable and do not contribute to the GHG load in the atmosphere through their operation

(Gross et.al. 2003). Wind, solar, geothermal, and the various forms of water-based energy are all zero emission sources (Gross et.al. 2003). Biomass, on the other hand, releases carbon dioxide but is considered carbon neutral as the carbon dioxide that is released into the atmosphere during the use of the fuels is offset by the uptake of carbon dioxide while growing the plants that make up the fuel (Gross et.al. 2003). These factors make it clear that alternative energy is currently the best option for replacing an unsustainable energy system. Updating unsustainable energy sources, however, is not an easy process, and its success depends on the functioning of energy markets.

III. Energy Markets and the Diffusion of Technology

Energy Markets

Energy markets, like many other markets, are profit driven, and even the most beneficial of technologies may have trouble entering the market (Brown 2001). This can be explained through the set of market failures and barriers that exist which prevent newer technologies from gaining the foothold that they need to make progress (Brown 2001). The market failures and barriers can range from unpriced costs, that is, the external social or ecological costs of conventional energy that are not factored into its market price, to policies that are hostile to new technologies, with each factor affecting if and how new technologies enter a market (Brown 2001). Most of the failures and barriers to market entrance can be explained through the analytical framework on technological systems laid out by Jacobsson and Johnson (2000), and expanded on by Jacobsson and Bergek (2004).

Technological Systems Framework

The technological systems framework strives to explain how technology emerges in and diffuses through a market. The framework takes several factors into consideration, including that innovation and diffusion happen both at the level of a single firm (i.e. business) as well as at the market level, and that technology choice does not rely solely on individual firms, but that individual firms take their cues from an "innovation system" that has variables other than the price of the technology (Jacobsson & Johnson 2000). The technology system is made up of three main parts: the actors and their competence, networks, and institutions (Jacobsson & Johnson 2000). The interaction of the three groups is what can either drive a technology to become successful in a relatively short period of time, or what can cause a technology to fail to enter the market at all (Jacobsson & Johnson 2000).

The actors in the framework constitute firms, users, suppliers, venture capitalists, and other organizations with an interest in the technology being considered (Jacobsson & Bergek 2004). Especially important are those with the technical, financial or political power to influence the process of technology development or diffusion (Jacobsson & Bergek 2004).

The networks in the framework serve as channels for the transfer of knowledge between the actors (Jacobsson & Johnson 2000). The networks not only allow for the actors to gain knowledge of potential problems and the developments of solutions, but may also serve to influence the institutional set-up (Jacobsson & Bergek 2004). The more integrated actors are in their networks, the better the diffusion of information among them, but it also may color their perceptions of what is possible or desirable when it comes to the technology they are developing and so guide their decisions (Jacobsson & Bergek 2004).

The institutions in the framework create the norms and rules that the actors and their networks must follow (Jacobsson & Bergek 2004). The institutions include governments and specific legislation, policies intended to interpret legislation, long-held legal norms, the market itself, the educational system, and even local culture, as they all influence the process (Jacobsson & Johnson 2000). Institutions are very powerful when it comes to the development and use of new technologies, influencing everything from incentive and demand structures to connectivity among actors (Jacobsson & Bergek 2004). Institutional support can greatly influence the path that a technology takes, as it can work through policy changes to open markets that may be otherwise unavailable (Jacobsson & Johnson 2000). While government is usually the most important of the institutions as it creates the policies and legislation that can open markets, the long-held norms and culture also play major roles, as the public often influences the direction that the government is willing to go with legislation.

The interactions of the three sections of the technological system serve many functions. The most important of these relate to the creation and diffusion of new knowledge, the guidance of the technology both in design and in growth potential, the supply of resources, and the creation of markets for the technology (Jacobsson & Bergek 2004). Each of the functions serves to bolster the others; for example: more resources in the system will create more knowledge, and the creation of markets may bring in more resources as more firms come in to take advantage of market opportunities (Jacobsson & Bergek 2004). Since the system is reliant on feedback loops, a weak or hostile response from any of the components of the system can damage a technology's chance of entering the market (Jacobsson & Johnson 2000).

The Technological System and the Formation of Markets

Technologies and industries have two main phases in their development: the formative phase and market expansion (Jacobsson & Bergek 2004). It is during the formative phase that technologies require the most support from the actors, networks, and institutions that make up the technological system as this phase features high market and legislative uncertainty (Jacobsson & Bergek 2004). Support from the actors and institutions may serve to create protected markets where the technology can grow without influence or competition from incumbent technologies, which have the advantage of the stability and legitimacy that comes with having passed from the formative stage (Jacobsson & Bergek 2004). These markets serve as "nursing markets" for the technologies, allowing the price and performance of the technology to improve, attracting new firms, and slowly building the legitimacy of the technology in the eyes of the market (Jacobsson & Bergek 2004).

Once additional firms enter a market, they bring with them new knowledge, and build greater networks among themselves (Johnsson & Bergek 2004). This also adds to the legitimacy of the technology, which may influence institutional change (Johnsson & Bergek 2004). It is institutional change that ends up making or breaking a new technology. Institutional change results in more money being spent on the research and development of the technology, as well as the creation of new policy which may give the new technology a boost to allow it to compete against the incumbents (Johnsson & Bergek 2004).

In the energy sector especially, incumbent technologies pose the greatest barrier to the adoption of new and upcoming technologies, such as alternative energy sources, as the incumbents hold most of the institutional power (Jacobsson & Johnson 2000). Since alternative energies are by their definition alternatives to the incumbent technologies such as coal and oil, their adoption involves displacing the incumbent technologies. The incumbent technologies will therefore often lobby to prevent the adoption of new technologies to protect their own position in the market, and without institutional support new technologies can be effectively prevented from gaining a foothold in the market (Jacobsson & Johnson 2000).

Effective policy support is needed to prevent incumbent technologies from closing the markets to new technologies. In the case of alternative energies, many policy mechanisms can be used, some of which have already proven successful, while other policy mechanisms are newer and have yet to be proven. In the next section, I review the cases of Germany and the United States and detail the actions that they have taken, or have not taken, through institutional policy to encourage the expansion and diffusion of alternative energy technologies in the energy markets. Before focusing on policy specifically, however, I briefly place policy formulation within the context of environmental awareness among each country's public, as the public can be a major driving force behind policy initiatives.

IV. Alternative Energy Policy in Germany

Environmental Awareness and the German State

The earliest instances of environmental awareness in the German state happened in the late 19th century when air pollution from industrial activities first became a major issue (Schruers 2002). The government gave local authorities the power to regulate those industries through a permitting process as early as 1895 (Schruers 2002). When stricter regulations were sought in 1959, due to more industries turning to highly polluting oil heating, slow progress in creating technical guidelines and opposition from the industries and from the Ministry of Economics managed to kill the law before it could be passed (Schruers 2002). This opposition was the pattern for many years; however, people were slowly becoming more environmentally aware and demanding the same of their government (Schruers 2002).

The first major turning point in environmental policy for Germany happened in 1969, when the Social Democratic Party (SPD, *Sozialdemokratische Partei Deutchlands*)[1] and Liberal Democrats (FDP, *Freie Demokratische Partei)*[2] formed a coalition. In 1970 the coalition introduced the Emergency Program for Environmental Protection, which introduced measures for issues like air and water pollution, waste management, nature protection, and even noise pollution (Schruers 2002). Then in 1971, the coalition announced its Environmental Program, elevating environmental

[1] The SPD is a center-left party traditionally representing the working class; it works towards aligning capitalism and social justice and represents a "third-way" or centrist approach to politics.
[2] The FDP is a pro-business party that promotes the free market economy, limited government and individual freedom.

protection to a similar level of importance as education, social security, and defense (Schruers 2002).

The 1970s also saw the energy crisis, which was a major turning point for energy policy (Jacobsson & Lauber 2006). Up until the 1973 OPEC oil crisis, Germany, like many other countries, enjoyed low cost oil as one of their main energy imports, but the spike in oil prices in 1973 led to a rethinking of the country's reliance on foreign energy (Wüstenhagen & Bilharz 2006). At first, the emphasis was on an increased use of coal and nuclear power; however, nuclear power soon became highly controversial with the public (Jacobsson & Lauber 2006).

The first peak of anti-nuclear protests happened in 1974, with civil society organizations protesting against a planned nuclear plant in southwestern Germany (Wüstenhagen & Bilharz 2006). Then, in 1986 the Chernobyl nuclear accident turned public opinion even further away from nuclear energy, as opposition soared to 70 % within two years, leaving the field open for other sources of energy (Lipp 2007).

Formation of the Green Party

Public opposition to nuclear power also led to the formation of the Green party (*Die Grünen*), the party that has been the most instrumental in campaigning for alternative energies (Wüstenhagen & Bilharz 2006). The Greens got their start in 1977 as a citizen initiative against a nuclear plant project in Lower Saxony (Niedersachsen) (Oberreuter 1990). Originally the party was called the *Umweltschutzpartei Niedersachsen* (USP), or the Environmental Protection party of Lower Saxony. By December of the same year the USP had joined forces with the

Green List for Environmental Protection (*Grünen Liste Umweltschutz*) to form the GLP (Oberreuter 1990). In 1981, the party in Niedersachsen officially starting calling itself the Green party and by the next election they managed to get 6.5 % of the vote, thereby securing 11 seats in the Lower Saxon parliament (Oberreuter 1990).[3] The Green party's success was similar in other federal states (*Bundesländer*), with Green parties founded in most states between the years of 1978 and 1980 (Obberreuter 1990). Most of the state Green parties also made it into their state parliaments within a few years of their founding (Obberreuter 1990). The national Green party was founded in 1980, and gained the necessary votes to enter the parliament in 1983 with 27 seats (Obberreuter 1990).

While the party initially started out as a one-issue party, their ascent to the national parliament necessitated an expansion of their ideology (Obberreuter 1990). The new ideology of the Green party centers on ecological sustainability, workers' rights, democracy, and nonviolence (Obberreuter 1990). With this new ideology the Greens stood to become one of the driving forces for change in the German government, especially in the arena of environmental issues.

Early Support for Renewable Energy

In 1980, an Enquete Commission (*Enquetecommission*) consisting of equal numbers of members of parliament and experts with the right to vote concluded that to deal with energy, Germany's first priority should be energy efficiency and renewables (Jacobsson & Lauber 2006). At the time, the commission did not take

[3] Within the German electoral system, both at the federal and state level, parties must win at least 5% of the vote before they can be awarded seats in parliament.

nuclear power off the table (Jacobsson & Lauber 2006). However, a five-year study commissioned by the Federal Ministry of Research and Technology and published around the time of the Chernobyl accident pointed out that a focus on renewable and energy efficiency would be less expensive than more nuclear power (Jacobsson & Lauber 2006).

While early commission findings were in support of renewables, this is not to say that the government fully backed renewable energy from the start. The political-economic atmosphere in Germany at the time was largely hostile to the entrance of a new technology into the market (Jacobsson & Lauber 2006). This was made even more difficult by major incentives given to the otherwise non-competitive hard coal industry after the oil crisis, and by the Ministry of Economic Affairs' unwillingness to create new markets for renewables (Jacobsson & Lauber 2006). At the time, public opinion echoed the non-action taken by the government as only 16 % of Germans thought that wind and solar could be a significant source of energy within 20 to 30 years (Wüstenhagen & Bilharz 2006).

While the Ministry of Economic Affairs was largely uninterested in renewable energies, the Ministry of Research tried to support renewables through research funding (Jacobsson & Lauber 2006). The research funding was not anywhere near the funding that was provided to projects for nuclear and coal power development, reaching a peak of about 300 million DM (Deutsche Mark) in 1982 (Jacobsson & Lauber 2006). One of the highest profile projects supported by the Ministry worked to create the largest wind turbine in the world (Wüstenhagen & Bilharz 2006). The project, unfortunately, proved to be a failure, giving traditional utilities a seeming confirmation to their skeptical attitudes toward alternative energies (Wüstenhagen & Bilharz 2006). After the failure of the large-scale project, attention turned to smaller wind turbines, which proved to be much more successful (Wüstenhagen & Bilharz 2006).

In 1982, another change in governments occurred, as the SPD/FDP coalition was turned out by a more conservative coalition of the Christian Democratic Union (CDU, *Demokratische Union Deutschlands*)[4] and the FDP (Jacobsson & Lauber 2006). At that point funding for Research & Development (R&D) for renewable energy dropped dramatically, but projects to demonstrate the viability of wind and solar continued as small farmers and a rising demand for green power created niche markets (Jacobsson & Lauber 2006). More firms continued to enter the market during the 1980s, mostly in the wind turbine industry, although market success in installed power by 1989 was limited at only 20MW (Wüstenhagen & Bilharz 2006).

More changes to the energy market came as a result of the Chernobyl accident in 1986 (Jacobsson & Lauber 2006). As public approval of nuclear power fell, the SPD committed to the phasing out of nuclear plants, and the Greens demanded an immediate shutdown, necessitating the development of another energy source to replace it (Jacobsson & Lauber 2006). That same year a report was published warning of a potential climate disaster if carbon dioxide emissions were not curtailed (Jacobsson & Lauber 2006). Worries over increased oil consumption increased as oil

[4] The CDU is Germany's main conservative party, advocating creating and maintaining government frameworks for fair competition in the economy, low unemployment, and social welfare. They often share power with the Christian Social Union (CSU, *Christlich-Soziale Union in Bayern*), their counterpart in the state of Bavaria, although their relationship is often uneasy due to the CSU's more conservative stance on social issues.

prices fell, leading to a general agreement in the government that the way energy was used needed to be dramatically changed (Jacobsson & Lauber 2006).

Among the first steps that the German government took towards a renewable energy policy came in 1989; new policies aimed at installing 100MW of wind power by providing incentives to generators (Wüstenhagen & Bilharz 2006). The program was ambitious, as the total installed wind power at the time was just 20MW. The program offered wind power generators 3 Cents/kWh, and by 1991 the production goal was expanded to 250MW (Wüstenhagen & Bilharz 2006). To promote solar power, the Ministries of Research and of the Environment created a "1,000 roofs" program, which aimed at installing solar cells on 1,000 roofs in Germany (Jacobsson & Lauber 2006). Arguably, the most significant renewable energy policy came in 1990, with the passing of the Feed-in Law that came into effect in 1991.

Stromeinspeisungsgesetz (StrEG)

The Feed-in Law of 1991(*Stromeinspeisungsgesetz,* StrEG) was Germany's most important step toward renewable energy, and one that received unanimous support from the parliament (Wüstenhagen & Bilharz 2006). The list of supporters of the law spanned almost the entire political spectrum, with support from the CDU/CSU, the SPD, and the Greens (Wüstenhagen & Bilharz 2006). The FDP was the only party that did not fully support the law, partly because they viewed it as too interventionist (Wüstenhagen & Bilharz 2006).

The law was first introduced by solar associations such as Association for the Advancement of Solar Energy (Förderverein Solarenergie, SFV) and Eurosolar, and an association of about 3,500 small hydro power plant owners (Jacobsson & Lauber 2006). The owners of the hydro power plants were mostly conservatives, and so were able to lobby the conservatives in the government for their support (Jacobsson & Lauber 2006). The only real opposition that the StrEG faced was from the power companies, which believed that the law would result in a reduction of their influence (Wüstenhagen & Bilharz 2006). Even so, the opposition was not very strong as the utilities did not believe that they had anything to fear from small hydro power projects, and were instead focused on the takeover of East Germany's electric grid as a part of the reunification process (Jacobsson & Lauber 2006).

The law itself was a price regime law, as it set the prices for renewable energies and let the market determine how much electricity would be produced (Wüstenhagen & Bilharz 2006). The StrEG had two main components: compensation for the renewable generators determined as a percentage of the average tariff, and the obligation for the grid operators to buy the renewably generated electricity (Lipp 2007). These factors together created a relatively stable market for firms to enter, where they were guaranteed both a buyer and a price that could compete with conventional energies, taking away some of the investment risk inherent in the system (Wüstenhagen & Bilharz 2006).

The parliament had also declared that the purpose of the StrEG was to level the playing field between renewable and conventional energies by factoring in the external costs of conventional energy (Jacobsson & Lauber 2006). The external costs are a range of negative impacts from the "discovery, distribution, and consumption of fuels and power," and as most of those costs are social, including things such as pollution or GHG emission, they are often unpriced (Brown 2001). Conventional fuels produce many of these costs, and society as a whole bears the weight of them, whereas most alternative energies do not produce the same externalities for society (Brown 2001). The German government at the time priced the externalities of coal at 3-5 cents per kWh, and so adjusted the price of renewables accordingly (Jacobsson & Lauber 2006). However, no one foresaw just how successful the combination of price adjustment and grid access would be.

The StrEG led to 490MW of installed wind power by 1995, up from just 20MW in 1989, while also creating new networks for the wind suppliers (Jacobsson & Lauber 2006). Even more importantly, it led to a growth in the political power of the wind industry, which was able to add economic factors to their arguments for policies that supported the development of more wind power (Jacobsson & Johnson 2000). This political power was then brought to bear when it came time to update the StrEG, this time without the benefit of unaware incumbent power producers.

Once it became clear the wind power and other alternative energies could pose a threat to conventional power generators, the conventional power generators began to attack the StrEG (Jacobsson & Lauber 2006). They argued that the burden of supporting alternative energies unfairly fell to specific geographical locations, as those locations with the largest wind resources were the ones to develop wind power and the power utilities in those areas had to pay to support them, and that the subsidies that supported the law were too great (Jacobsson & Lauber 2006). The German Association of Electric Utilities (VDEW, *Verband der Elektrizitätswirtschaft*) also filed a lawsuit with the European Commission alleging that the StrEG violated state-aid rules (Wüstenhagen & Bilharz 2006). The objections by the power companies also led to uncertainty in the market, as investors wondered if the law would change, and the market stagnated between 1996 and 1998 (Jacobsson & Lauber 2006).

The objections to the StrEG led to amendments to the law in 1998 (Wüstenhagen & Bilharz 2006). The amendments updated hardship clauses for the utilities, allowing for a twofold 5 % cap, which first moved the obligation to pay to the upstream grid operator after the 5 % of renewable energy was reached in a supply area, and then took away the obligation to pay once the upstream grid operator also reached 5 % (Wüstenhagen & Bilharz 2006). 1998, however, also saw the turnover of the government with the CDU/FDP coalition giving way to a SDP/Green coalition, a coalition that declared itself for "Ecological Modernization" with a focus on renewable energies and energy efficiency as one of its main goals (Wüstenhagen & Bilharz 2006).

100,000 Roof Program and the Erneuerbare-Energie-Gesetz (EEG)

Following further changes in the federal government, the new coalition set its sights on improving the renewable energy policies. While wind power benefited the most from the StrEG, solar power was also fairly successful under the 1,000 roof program. Solar firms such as Eurosolar lobbied in 1993 and 1996 for an expansion to the program to expand the market for solar that the 1,000 roof program had created (Jacobsson & Lauber 2006). The proposed 100,000 roof program was unsuccessful under the CDU/FDP coalition, but the SDP and Greens committed themselves to the market expansion of solar and pushed the program through by January 1999 (Jacobsson & Lauber 2006). Later in the same year, the coalition launched reforms to the StrEG, which were mostly ignored by the Ministry of Economics, the ministry that was charged with the regulation of the law (Jacobsson & Lauber 2006). In response the parliament submitted a member's bill, (unclear) which despite the Ministry's attempts at diluting it, passed, becoming the *Erneuerbare-Energie-Gesetz* (EEG) or the Renewable Energy Sources Act (Jacobsson & Lauber 2006).

The EEG strived to address many of the problems that created market uncertainty under the StrEG. While the StrEG was considered a general success, the liberalization of the energy markets that occurred in 1998 threatened its function (Wüstenhagen & Bilharz 2006). Under the liberalization, energy prices started to drop, and with them so did the compensation to renewable energy developers, providing them with less money for their investment and jeopardizing their competiveness with conventional energies (Lipp 2007). In direct response to the uncertainty caused by the StrEG's pricing scheme, the EEG created a price scheme that featured prices that would be set for a period of 20 years and not reliant on market price (Wüstenhagen & Bilharz 2006). This created a very stable market for firms to enter, as they were not only guaranteed a price, but were guaranteed it for a set period of time. The EEG also addressed concerns about geographic burdens by creating a system to settle regional cost disparities and to entitle the utilities to compensation under the law if they themselves built plants to generate renewable energy, something they were previously exempt from (Wüstenhagen & Bilharz 2006).

While allowing utilities to access the incentives provided by the EEG broke up some of the opposition, most of the opposition that the law faced still came from the utilities and their industry associations, with very little opposition actually coming from the other parties in parliament (Wüstenhagen & Bilharz 2006). This is not to say that the EEG was passed under an all-party consensus like the StrEG, since while the other parties did not disagree with the law fundamentally, they did disagree with the details of the draft (Wüstenhagen & Bilharz 2006). Most of the disagreement from the conservatives in the CDU/CSU and the liberals in the FDP was tempered by the lobbying from the wind and solar industries, which had gained considerable economic power under the StrEG (Jacobsson & Johnson 2000). The issues raised concerning the law's interventionist nature, and its impact on energy prices did not prevent the law from passing with clear majorities in both chambers of the parliament (Wüstenhagen & Bilharz 2006).

After the law passed, there was still a lack of policy commitment as the Ministry that was charged with the enforcement of the law still did not believe in the viability of renewable energies (Lipp 2007). In the 2002 elections, the Green party gained more support over the SPD, which gave them the power to move the responsibility over renewable energies from the SPD-held Ministry of Economics to the Green-held Ministry for Environment, Nature Conservation and Nuclear Safety (BMU) (Jacobsson & Lauber 2006). The BMU was more willing to support the renewable energy sector with more cohesive policy application (Lipp 2007).

Effectiveness of the EEG

The passing of the EEG was a testament both to the dedication of the SPD/Green coalition and to the growing power of wind and solar industries. Since then, there have been several attacks on it, such as when Conservative and Liberal leaders attacked the EEG subsidies for being a burden on the budget in 2003, even though the subsidies are paid for by the consumers (Jacobsson & Lauber 2006). Most of the opposition, however, has been mostly "half-hearted" as those that oppose renewable energy tend to lose popularity among voters (Wüstenhagen & Bilharz 2006). Even the CDU/CSU and SPD coalition elected in 2005 has been hesitant to completely criticize the law due to the number of jobs it has created (Lipp 2007).

Since the passing of the EEG, the act has been amended in 2004, 2008, and 2010, keeping the same basic framework. The 2004 amendments to the act added hardship clauses for medium and large consumers (Wüstenhagen & Bilharz 2006) and added provisions to make sure that renewable energy expansion was compatible with nature conservation objectives (BMU 2007). The act states that its purpose is to "facilitate sustainable development of energy supply, particularly for the sake of protecting our climate and environment" and has provisions for monitoring its effectiveness in various sectors, including environmental and economic factors as well as the amount of renewable energy power that is installed (BMU 2008).

By 2006, the amount of installed wind power in Germany had reached 20,622MW, with 2,224MW installed during that year alone (BMU 2007). This number is up dramatically from the inception of the original Feed-in tariff law. The other sources of renewable energy also saw growth under the law with 598.4MW of biomass power installations in 1996, and 950MW of photovoltaic solar installations (BMU 2007). The act also met its goals in regard to environmental and economic impacts. In 2006 the carbon dioxide emissions avoided through the use of renewable energies totaled about 44 million tons, more than any other policy aimed at energy or environmental reform (BMU 2007). Meanwhile, the number of jobs available in the renewable energy sector has increased from 160,000 to 236,000 between 2004 and 2006, with 134,000 of the jobs directly attributed to the EEG (BMU 2007).

The EEG also set goals for the increase in the share of renewable energies used in energy generation, which the progress report indicates have been exceeded ahead of time, as the 2010 target of 12.5% was reached by 2007 (BMU 2007). The progress report also points out that because of the EEG, Germany should have no problem of reaching the European Union's target of 20% by 2020, and should come in at about 25-30% by that year (BMU 2007).

The success of the EEG has led to the new policies aimed at targeting development of other sources in the energy sector as well. The *Erneuerbare-Energien-Wärmegesetz* (EEWärmeG) or Renewable Energies Heat Act, is a relatively new act passed in 2008 that aims to increase the amount of renewable energies used to heat buildings (BMU EEWärmeG 2008). The act stipulates that all new construction built after January 1, 2010 must use renewable energies to provide a certain percentage of their heating and cooling, with the percentage being regulated depending on the type of renewable energy used (BMU EEWärmeG 2008). The act is set up in much the same way as the EEG to encourage market expansion for renewable heating and cooling technologies to accomplish the act's goal of 14% of all heating in Germany being from renewable energies by 2020.

V. Alternative Energy in the United States

Environmental Awareness in the United States

The modern environmental movement in the United States started early. Books such as Rachel Carson's *Silent Spring*, Barry Commoner's *The Closing Circle* and Paul Ehrlich's *The Population Bomb* played a major role in bringing the topics of pollution, nuclear testing, and the pressures of a rising population to the public eye in the 1960s (Schreurs 2002). Groups such as the National Resources Defense Council (NRDC), the Friends of the Earth, and Greenpeace soon organized on the national level, with others such as the Sierra Club broadening their missions from a focus on nature protection, in order to pressure the government and industries to change their policies with regard to resource consumption and pollution production (Schreurs 2002).

Until the 1960s, environmental issues were mostly considered a problem to be handled by governments at the local or state level, with little intervention from the federal government (Schreurs 2002). The first nationally enacted law that addressed environmental issues was the 1955 air pollution act, which passed only after health concerns were raised as dozens of people died from "killer smog" (Schreurs 2002). The act was updated in 1963 with passage of the first Clean Air Act, but this act suffered from a general unwillingness on Congress' part to allow for federal regulatory authority over the enforcement of the environmental standards. Instead, the legislation relied on the states to voluntarily comply with regulations (Schreurs 2002). It took the death of an estimated 80 people in New York City from the effects of air pollution during a four-day atmospheric inversion, in which smog became trapped near the earth's surface by a layer of air above it, for Congress to finally allow the federal government to enforce federal standards under the newly created Air Quality Act of 1967 (Schreurs 2002).

After passage of the Air Quality Act, the environment became one of the most important issues facing the government, as pressure mounted for the federal government to create more regulations (Schreurs 2002). This pressure resulted in a massive burst of new environmental policy starting with the National Environmental Protection Act (NEPA), which required government agencies to consider the environmental impacts of their actions (Dryzek et.al. 2002). The US also set up the Environmental Protection Agency, and passed more laws on air and water pollution, and set out to protect endangered species (Dryzek et.al. 2002).

During this era, the United States was the leader in environmental policy and environmental awareness, with many other countries using the enacted laws as their guide to create their own laws (Dryzek et.al. 2002). The laws of other countries were rarely as strong as those in the US, since these other countries often lacked the sense of urgency that American environmental groups had brought to the process (Dryzek et.al. 2002). However, this era was exceedingly short, and when the 1973 oil crisis hit, all new steps to strengthen environmental policy were halted (Dryzek et.al. 2002).

The US Response to the Oil Crisis

In 1973 members of the Organization of Petroleum-Exporting Countries (OPEC) made major changes to their policies, and limited the supply of oil available to drive up prices (Klass 2003). The ensuing price increases–from $2 a barrel to $13 a barrel—left the economies of countries reliant on oil, such as the United States, reeling (Klass 2003). In response, the US began focusing much of its attention on supporting the economy instead of environmental laws (Dryzek et.al. 2002).

The energy crisis shook the US and demonstrated that its economy was vulnerable to the whims of the OPEC nations, and so the US began focusing on ways to prevent this from happening again. Money was put towards R&D efforts in nuclear and alternative energies, principally as a way of guaranteeing domestic energy sources (Kobos et.al. 2006). By1978, the passage of the National Energy Act resulted in new regulations that were meant to stimulate the growth of alternative energies (McVeigh et.al. 1999). The Committee on Nuclear and Alternative Energy Systems in 1979 predicated that the US would reach around 140,000MW of wind power by the year 2000, with private sector estimates mostly agreeing and even surpassing the Committee's estimates (Kobos et.al. 2006). However, these estimates would not be met.

After the oil crisis was over and prices started to drop, so did the interest in non-fossil fuel energies (Kobos et.al. 2006). Nuclear power saw a decline in popularity after the Three Mile Island accident in 1979 with worries over the safety of nuclear power at the forefront (McVeigh et.al. 1999). Alternative energies, however, were dealt an even worse blow. With the arrival of the Reagan Administration, the 1980s saw a resurgence in the "free-market" ideology, and the federal government cut off R&D funds dramatically (Kobos et.al. 2006). Between 1980 and 1996 the energy technology budget in the US decreased by 74%, preventing the kind of advancement in technology that Germany saw (Margolis & Kammen 1999). The lack of R&D funding came coupled with price subsidies to conventional fuels, and overall falling fuel prices, with the result that alternative energies looked even less attractive to the market, which led many to turn away from alternative energies completely (McVeigh et.al. 1999).

Public Utility Regulatory Policies Act and Energy Tax Act of 1978

Given the low political priority for alternative energies and the low prices and high subsidies enjoyed by conventional technology, policies in the US for alternative energies have been few and far between. Two of the first policies that addressed alternative energies in any significant way were the Public Utility Regulatory Policies Act (PURPA) and the Energy Tax Act of 1978.

PURPA served to open the door for non-utility power generation for resale (McVeigh et.al. 1999). The act itself was part of the National Energy Act, and was aimed at the "conservation of energy supplied by electric utilities, optimal efficiency of electric utility facilities and resources, and equitable rate for electric consumers" (Rose & Meeusen 2006). The language of the act, however, required actions only among those utilities that have natural monopolies, with state regulated utilities and unregulated utilities being exempt (Rose & Meeusen 2006). The most that state and unregulated utilities are required to do in terms of the act is to "consider" the standards for electric utilities including: cost of service, declining block rates, time-of-day rates, seasonal rates and interruptible rates (Rose & Meeusen 2006). The natural monopoly utilities are forced to buy power from more efficient providers at an "avoided cost" price (Sissine 2001). This price was based on the energy and capacity costs that would be incurred by the utility if the utility were generating the power itself, or were buying the power from somewhere else (Sissine 2001). This was meant to encourage the development of renewable technologies in the free market by providing them access to the grid in places where they otherwise may not be able to access it due to the presence of energy monopolies (Sissine 2001).

The National Energy Act also featured the Energy Tax Act, which provided tax incentives to stimulate the commercialization of renewable energies (Wiser & Pickle 1998). The purpose of the act was to offset the tax-related barriers that alternative energies faced in the market (Sissine 2001). These barriers were often the tax breaks that were provided to conventional energies but not to alternative energies (Sissine 2001). The act strove to correct this imbalance by providing tax breaks to residential users of alternative energies, with a focus on solar power (Sissine 2001). Later tax breaks in 1982 targeted businesses with Investment Tax Credits (ITC) (Wiser & Pickle 1998).

The tax credits, however, faced a major problem in their implementation. Since they were tied to capital investment and not project performance, they resulted in large additions to renewable energy capacity, but little was done in the way of improving that capacity afterward (Wiser & Pickle 1998). This in a sense stalled the new renewable energy plants, as the tax breaks encouraged building them, but not running them or improving their efficiency or output. As a response to this problem, the 1986 Tax Reform Act reduced the incentives available (Wiser & Pickle 1998).

Energy Policy Act of 1992

The Federal government launched another set of tax incentives as a part of the omnibus energy legislation created with the Energy Policy Act of 1992 (Wiser & Pickle 1998). This law permanently extended the 10% ITC for non-utility investors in solar and geothermal, and created a 10 year 1.5¢/kWh Production Tax Credit (PTC) for wind and closed-loop biomass (Wiser & Pickle 1998). The law also created a renewable energy productive incentive (REPI) of the same value as the PTC, but available as a cash incentive to non-profit groups and local government agencies that wish to produce electricity from wind and close-loop biomass (Sissine 2001). By creating a Production Tax Credit (PTC), the US government solved the problem of plants being built and then not run efficiently or improved, but the REPI brought with it its own set of problems (Wiser & Pickle 1998).

In theory, these federal tax credits should have provided enough incentive to get new firms into the market; however, the way the credits were set up created a situation where many of the firms that would have benefited from them, could not fully utilize them (Wiser & Pickle 1998). To fully benefit from tax credits an investor must have a sufficient income for a tax load, which many investors in the renewable energy field do not (Wiser & Pickle 1998). Often these investors fall under the alternative minimum tax (AMT) requirements that were set up with the 1986 Tax

Reform (Wiser & Pickle 1998). The AMT guarantees that taxpayers pay a minimum level of taxes, with most tax credits not counting towards it, and the tax is calculated less favorably than the normal tax system (Wiser & Pickle 1998). If the tax calculated by the AMT is higher than the regular tax, then the firm must pay the AMT (Wiser & Pickle 1998). This can result in the tax credits either being postponed, during which time they lose their value, or not being used at all if the firm is perpetually limited by the AMT (Wiser & Pickle 1998).

REPI faced even larger problems than the PTC, as the funding for the project is subject to yearly congressional appropriations (Wiser & Pickle 1998). The 1992 Act only authorized appropriations for 1993-1995, requiring Congress to also renew the authority to make the appropriations (Wiser & Pickle 1998). This served to create major uncertainty for non-profit renewable projects, as they had no assurance that they'll receive their payments from year to year, especially since as of 1996 Congress has not appropriated enough funds to cover the claims of eligible projects (Wiser & Pickle 1998). The Department of Energy tried to reduce some of the risk associated with the projects by determining beforehand if a project is eligible for REPI, but they cannot guarantee payment (Wiser & Pickle 1998).

Energy Policy Act of 2005

The Energy Policy Act of 2005 was the first omnibus energy legislation enacted since the 1992 Energy Policy Act (Holt & Glover 2006). This act features many of the same standards for tax incentives for domestic energy production, with about $4.5 billion for renewables, and $5.6 billion for oil, gas and coal (Holt &

Glover 2006). It also repealed PURPA's purchase requirement for utilities from all qualified facilities, if the Federal Energy Regulatory Commission (FERC) determines that a qualifying facility has adequate market access (Holt & Glover 2006).

The Act also addressed Renewable Fuel Standards (RFS) by requiring that motor fuels contain at least 4.0 billion gallons of renewable fuel in 2006 and increase by 700 million gallons each year through 2011 (Holt & Glover 2006). In 2004, about 3.5 billion gallons of ethanol was used in motor fuels, with the eventual goal being 7.5 billion gallons in 2012 (Holt & Glover 2006). The REPI payments were also broadened allowing for more producers to become qualified facilities, but the funding still remains subject to the same appropriations as before (Holt & Glover 2006). Congress did, however, authorize making appropriations for REPI between 2006 and 2026 (Holt & Glover 2006).

Energy Independence and Security Act of 2007

Following the Energy Policy Act of 2005, Congress also enacted the Energy Independence and Security Act of 2007 (EISA). The law focuses on improving energy efficiency and increasing the availability of renewable energies; however, the biggest renewable provisions were excluded from the law (Sissine 2007). The law itself features a Corporate Average Fuel Economy Standard (CAFE), which requires that cars and light trucks in fleets must have a fuel economy of at least 35 miles per gallon by 2020 (Sissine 2007). The RFS from the Energy Policy Act of 2005 was modified to set the standard at 9.0 billion gallons by 2008, and 31 billion gallons by 2022 (Sissine 2007).

Two major provisions that never made it into the law were the repeal of $22 billion of oil and gas subsidies and a national Renewable Energy Portfolio Standard (RPS) (Sissine 2007). The repeal of the subsidies was supposed to fund more programs for renewable energy and energy efficiency, but it was stripped from the bill in the Senate (Sissine 2007). The RPS was also stripped from the bill, as the House proposed that a national RPS target of 15% should be set up and met by 2020 (Sissine 2007). RPS are quantity regimes where the government sets an amount of renewable energies that must be achieved and leaves it up to the market to determine price, working as an opposite to feed-in laws which set price and let the market determine quantity (Wüstenhagen & Bilharz 2006).

State-Level RPS Standards

While a national RPS has not been set up, many states have taken the initiative to do so. As of 2004, 13 states in the US have some form of RPS standard in place, including states such as Texas, Iowa, Minnesota, Maine and Pennsylvania (Wiser et. al. 2004). In terms of success the results of the RPS have been mixed, with some states setting up highly successful RPS, while others have fallen short (Wiser et.al. 2004).

Texas's RPS, in particular, has been very successful at driving the development of new wind power capacity, with over 900MW installed in 2001 (Wiser et.al. 2004). Texas's policy has a target of 2000MW of additional renewables by 2009, which amounts to about 2.5% of the state's electricity load, and has explicit penalties for non-compliance (Wiser et.al. 2004). The electricity produced averages about an extra 3¢/kWh, which is passed on to the consumers (Wiser et.al. 2004).

Iowa's and Minnesota's policies have also been successful. Iowa required the state utilities to purchase 105MW of renewables, which the utilities complied with, although no new legislation to expand from the 105MW has been created (Wiser et.al. 2004). Minnesota required Xcel, the largest utility in the state, to purchase 425MW of wind and 125MW of biomass by 2002, with an additional purchase of 400MW by 2006, and made a statewide RPS goal of 10% by 2015 (Wiser et.al. 2004). The mandates for Xcel have resulted in new wind and biomass development, and the utilities have been compliant in striving for the 10% goal (Wiser et.al. 2004).

By contrast, Maine and Pennsylvania are at the other end of the spectrum. Their standards have failed to stimulate new renewable energy growth. Maine had a very aggressive 30% RPS standard beginning in 2000, but due to the fact that the law allowed existing renewables and a broad base of fossil fuel resources to count toward RPS goal, it has ensured that no new renewable development would occur (Wiser et.al. 2004). Pennsylvania faces a similar problem, as new and existing renewable generation is eligible, but compounds it by applying a low standard to only a very small subset of energy suppliers (Wiser et.al. 2004).

The other states that have RPS goals fall on the spectrum between Texas's success and the structural failures of Maine and Pennsylvania (Wiser et.al. 2004). Lately, more states have been implementing their own RPS, with the total as of 2009 at 33 states (DOE: EERE 2009). It remains to be seen if more states will be as successful as Texas or if they will follow Maine and Pennsylvania's examples.

VI. Conclusions

As mentioned earlier, Germany has been consistently meeting and exceeding its goals regarding renewable energies while the United States has been reluctant to even set goals on a nationwide scale. While some of Germany's success can be attributed to luck as the laws were passed in a time where the conventional power generators were distracted, most of the success is due to policy design (Wüstenhagen & Bilharz 2006). The feed-in-tariffs opened the energy markets to new firms and then allowed the technology to diffuse naturally (Wüstenhagen & Bilharz 2006). This created a number of positive feedback loops which worked to strengthen the position of alternative energies in the system and allowed for the system to become self-sustaining (Jacobsson & Bergek 2004).

By comparison, the US's policies have fallen short of accomplishing this type of marked increase in production. Whereas Germany's policies have actively encouraged market entrance, the US's policies tried to do the same thing, but were generally unsuccessful. The US is also, however, very fragmented in its policy creation and application, with many alternative energy policies being only implemented at the state level. Each state is different, and has different norms and attitudes surrounding things like alternative energies. This creates cultural and institutional barriers that vary from state to state, fragmenting the policy landscape even further.

Importance of Policy Design

To design a successful alternative energy policy several things need to be kept in mind: the systems that govern technologies are complex and feedback loops may create unforeseen effects, the time frame involved is very long, and the political struggle for institutional support will be intense (Jacobsson & Bergek 2004). This necessitates providing new technologies with certainty when entering the market; otherwise the risk for a firm's investment may be too great, and it will discourage them instead.

The Germans solved this by guaranteeing prices over a long period of time. This gave firms the certainty they needed to make investing their money into the system less risky. The US version of Germany's strategy, however, did not create any guarantees. By subjecting REPI to congressional appropriations, there is no way to tell whether or not there will be enough money for the government to pay firms (Wiser & Pickle 1998). This means that only the firms that can enter the market without support can risk doing so. By precluding many of the small firms that may wish to enter the market, the knowledge base suffers and not as many networks are built. The lack of strong networks then prevents the gathering of political power that could lead to a stronger lobbying force. The positive feedback loops that made Germany's policy successful are therefore not achieved and the growth of alternative energies isn't as strong as it could be.

This long-term certainty does not need to come from a price regime as it does in Germany. Texas has already demonstrated that a quantity regime can create the market opportunities that are needed for firms to consider taking the risk on a non-incumbent technology. Texas created an RPS with a set date and created heavy punishments for cases of non-compliance (Wiser et.al. 2004). In this type of strategy, it is the penalties and legislative certainty that are important. Arizona, for example, has an RPS but it is under review, creating uncertainty over eventual targets (Wiser et.al. 2004). The uncertainty coupled with a lack of enforcement has created a situation of under-compliance. The utilities don't want to spend money on renewable energies that may end up exceeding the eventual RPS target, and as there is no punishment for their hesitation, very little progress is being made (Wiser et.al. 2004). By creating a policy that is set for a number of years and enforced, this kind of situation can be avoided.

The Way Forward

Uncertainty and a lack of enforcement prevent the market for renewable energies from forming. To create effective alternative energy policy, the US has to tackle those two factors. The creation of an effective policy will not be easy as the US does not have the benefit of a distracted conventional energy lobby as Germany did. There does, however, need to be some motion forward. The current energy system is unsustainable and prices will inevitably rise as they did in the past. But if the US sets appropriate policies in place, the effect of market forces and declining resources does not need to be as devastating as it was in 1973.

VII. Grundsätze der Erneuerbaren Energie:

Ein Vergleich zwischen denVereinigten Staaten und Deutschland

Energie wird heute unter den allerwichtigsten Fragen der Welt betrachtet. Der Preis von Benzin und Heizöl geht immer höher, weil die Versorgung des Erdöls ausläuft. Meistens suchen die Länder eine Lösung zu der Energiekrise. Eine Lösung ist die Benutzung von mehr erneuerbaren oder alternativen Energien, wie Solarenergie, Windenergie, oder Wasserkräften. Dieser Aufsatz bespricht die Energiepolitik der Vereinigten Staaten und Deutschland, und was sie voneinander lernen können.

Alternative Energien sind die Energien, die keine fossilen Brennstoffe benutzen. Fossile Brennstoffewerden heute häufig verwendet, weil sie vorher billig und leicht verfügbar waren, aber die Brennstoffe sind nicht ohne Probleme. Fossile Brennstoffe sind nicht unbegrenzt und mit dem globalen Populationswachtstum werden sie nicht ausreichen, um den Energiebedarf zu decken. Fossile Brennstoffe produzieren auch Kohlendioxid, das zum Klimawandel beiträgt. Alternative Energien haben weniger Probleme, als die fossilen Brennstoffe.

Alternative Energien sind erneuerbar, und werden nicht auslaufen, wie die fossilen Brennstoffe. Diese Energien können die Anforderungen einer größeren Weltbevölkerung befriedigen. Da sind fünf verschiedene Typen von Alternativen Energien: Solar, Wind, Wasser, Biomasse, und Erdwärme. Die verschiedenen Typen von Energie sind alle an verschiedenen Punkten in ihrer Marktentwicklung, wobei einige billiger als andere sind. Zum Beispiel, Wind kann mit fossilen Brennstoffen konkurrieren, während Solar teurer ist, und Hilfe von der Regierung braucht, zu konkurrieren.

Die Wirksamkeit einer Politik kann dadurch gemessen werden, wie effektiv diese Politik ist, insofern eine Technologie innerhalb eines Marktes bewegt. Es gibt drei wesentliche Teile, aus denen das System der Technologie verstanden werden soll: die Unternehmen, die Netzwerke und die Institutionen. Die Unternehmen machen und verkaufen die Technologie, während die Netzwerke Kenntnisse zwischen den Unternehmen übertragen. Institutionen schließen die Regierung und die Kultur ein und können die Technologie entweder helfen oder behindern. Gemeinsam können die Wechselwirkungen der drei Teile zeigen, wie eine Technik im allgemeinen verwendet wird. Wenn die Gesetze von der Regierung wirksam sind, bringen sie mehr Unternehmen hinein und schaffen mehr Netzwerke, die dann Lobbys schaffen können, die die Regierung für mehr Gesetze ermutigen, ihnen zu helfen. Wenn die Gesetze nicht wirksam sind, dann treten die Unternehmen nicht in den Markt ein, und die Technologie wächst nicht in der Popularität.

Die Regierungen in Deutschland und in den Vereinigten Staaten haben Gesetze gemacht, die Alternative Energie zu konkurrieren helfen sollen. Deutschland hat sein erstes großes Gesetz für Alternative Energien im Jahr 1991 erlassen. Das Stromeinspeisungsgesetz (StrEG) war ein Einspeisentarif, der ursprünglich für Wasserkräfte gemacht worden war. Es hat den Herstellern von alternativen Energien den Zugang zum Stromnetz gegeben und subventionierte Stromerzeugung für die alternativen Energien. Die Subvention aus alternativen Energien macht die Energien wettbewerbsfähiger mit konventioneller Energie, und so sind mehr Unternehmen in den Markt eingetreten. Das StrEG war sehr wirksam und hat eine große Wind energieindustrie erzeugt. Die Windindustrie betrieb dann lobbying für die Schaffung eines neuen alternativen Energien-Gesetz, das einige der Probleme, die die StrEG hatte, beheben würde. Dieses neue Gesetz war das Erneuerbare Energie Gesetz (EEG), das im Jahr 2000 erlassen wurde. Es hat genaue Preise für alternative Energie Subventionen aufgestellt, die Prozentangaben angelegt und breitete die Last der Subventionen über das ganze Land. Das EEG regelt auch den Netzzugang und garantiert den Preis für 20 Jahre, und das hat eine noch bessere Markt Gelegenheit für Unternehmen in dem Markt geschaffen.

Die Gesetze der Vereinigten Staaten waren weniger erfolgreich. Die Vereinigten Staaten haben vor allem auf Steuererleichterungen als ihr wichtigstes Mittel zur Förderung alternativer Energien verlassen. Im Jahr 1978 haben die US eine Steuergutschrift für Investitionen geschaffen, um den Bau von alternativen Energieanlagen zu fördern. Diese Steuergutschrift hatte keinen Anreiz, um die Anlageeffizienter zu machen oder für die Anlage mehr Energie zu produzieren, und so war die Anlage nicht benuzt. Um dies zu korrigieren wurde 1992 eine Produktion Steuergutschrift (PTC) gegründet. Die Produktion Steuergutschrift gab der Anlage einen Anreiz, Energie zu produzieren. Im Jahre 1992 hatte auch die USA einen Anreiz für die Produktion erneuerbarer Energien (REPI) für gemeinnützige Organisationen geschafft, weil die gemeinnützigen Organisationen Steuergutschriften nicht benutzen durften. Die Wirksamkeit des PTC war jedoch begrenzt, da viele der Unternehmen, die den Anspruch hätten nehmen dürfen, ihn unter die eingestellte Minimum Steuer (AMT) fallen liessen. Das AMT ist weniger günstig als die normale

Steuerschuld berechnet, und wenn es höher als die normale Steuer ist, müssen die Unternehmen die AMT zahlen. Man kann Steuergutschriften nicht für die AMT verwenden. Das bedeutet, dass die Unternehmen, die unter das AMT gefallen sind, die Steuergutschriften nicht benutzen durften und so sind weniger Firmen auf den Markt eingetreten. Die REPI hatte auch seine eigenen Probleme. Der Kongress muss das Geld für REPI verwenden, etwas, was oft nicht passierte. REPI war seit 1996 unterfinanziert, und so war es kein Anreiz für die Unternehmen in den Markt einzutreten.

Einige der Staaten in den USA haben mehr Erfolg bei Erstellen von Richtlinien, um alternative Energien zu fördern. Erneuerbare Energie Portfolio Standards (RPS) in den Staaten setzen eine Energiemenge, die aus alternativen Energiequellen in einem Staat produziert wird. Abhängig von dem Aufbau der RPS, kann ein RPS Gesetz wirksam Markt Gelegenheit für alternative Energien schaffen. In Texas, wo der RPS hoch eingestellt ist, und die Strafen für die Nichteinhaltung der Norm steil sind, sind die Energie-Unternehmen schnell nachzukommen. In Arizona sind die Standards nicht durchgesetzt und die Gesetzgebung steht ständig zur Diskussion, so sind Energie-Unternehmen da nicht gewachsen.

Eine Politik ist am effektivsten, wenn sie mehrere Unternehmen in die Investition in eine Technologie bringen. Die Politik muss die Gefahr, die in dem Markt findet, reduzieren, weil das mehr Unternehmen in den Markt bringen wird. Es ist der deutschen Politik gelungen, das zu tun, indem sie einen festen Preis und einen stabilen Markt geschaffen hat, und so sind viele Firmen in den Markt gekommen. Diese erfolgreiche Politik liess die Geschäftszweige wachsen und machte

Deutschland zu einem Land der weltweit führenden alternativen Energie Technologien. Die Politik in den USA war nicht so erfolgreich, weil viele der Firmen die Anreize nicht benutzen dürfen. Dies bedeutet, dass nicht so viele Firmen in den USA in den Markt eingetreten sind, so dass die Industrie in den USA nicht so stark als in Deutschland ist. In den USA liegt die Hoffnung für alternative Energien bei den Staaten, von denen einige erfolgreich beim Bau ihrer alternativen Energiewirtschaft gewesen sind. Um mehr Erfolg zu haben, müssen die USA eine Politik schaffen, die mehr Anreize bieten, für Unternehmen in den Markt einzutreten. Dann, vielleicht würden die USA den gleichen Erfolg mit alternativen Energien wie Deutschland erfahren.

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