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Renewable Energy Development in Germany and the United States

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by

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Abstract

Germany and the United States have each made efforts to increase renewable energy production. By comparison, Germany has made significantly more progress than the United States. The types of policies implemented in each country, as well as historical, social, institutional and political circumstances best explain the differences between Germany and the United States with respect to renewable energy production. In Germany, legislation was implemented through a top-down, regulatory approach. In particular, Germany's feed-in tariff, which has been amended consistently, ensures that efforts to expand renewables will be sustained in the long term. Supplemental research and development programs and financial incentives have also maintained Germany's growing trajectory. Furthermore, concern over nuclear power, external pressure from the European Parliament and Council of the European Union and an influential red-green coalition contributed to the expansion of renewables in Germany. In the United States, however, legislation was implemented through a multi-level, voluntary approach. Specifically, the implementation of Renewable Portfolio Standards at the state level has contributed the most to increases in renewable energy production. Supplemental research and development programs and financial incentives have also helped. Nevertheless, missed opportunities following the Gulf War, an unfavorable political climate and strong interest group influences have hindered efforts to increase renewable energy production.

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Introduction

Given the rising global energy demand, the growing concerns over energy security, and the mounting effects of climate change, renewable sources of energy will become increasingly important in the years to come. As such, the shares of renewable energy used in total electricity production worldwide will increase. With the help of government policies, countries have already begun investing in renewable energies, prompting their development and growth. The purpose of this study is to analyze policies and the contexts in which they are created to determine conditions under which renewable energy production increases. This study focuses on the policies and conditions that lead to increases in renewable energy production in Germany and the United States.

Germany and the United States, two of the world's largest economies, have the means to demonstrate strong commitments to combatting climate change. As two industrialized nations with large economies, both Germany and the United States have the opportunity to be global leaders of environmental sustainability. To date, Germany has taken great strides to increase its use of renewable energy sources, earning the nation its rightful reputation as a global leader in renewable energies (Grigoleit and Lenkeit, 2). Meanwhile, the United States continues to fall short. The lack of a strong commitment to renewable sources of energy is frustrating at best.

In 2013, renewable energy as a percentage of total electricity production, including hydropower, in Germany and the United States was 24.075 and 12.525 respectively (World Development Indicators). Hydropower as a renewable source of energy, however, remains

controversial because of the negative impacts it poses to the natural environment. Therefore, hydropower is sometimes excluded when renewable sources of energy are considered. When hydropower is excluded, the percentage of renewable energy in total electricity production in 2013 was 20.897 and 6.177 in Germany and the United States respectively (World Development Indicators). Clearly, Germany produces significantly more renewable energy than the United States.

Accounting for the differences seen between the percentages of renewable energies as a share of total electricity production in Germany and the United States is, therefore, a worthwhile pursuit. To compare renewable energy production in these countries, this study describes a variety of policies that have advanced their production of renewable sources of energy. These policies involve research, development and deployment schemes, voluntary programs, regulatory instruments and financial incentives. The policies explored in this study are sourced by the International Energy Agency (IEA) and International Renewable Energy Agency (IRENA) from a joint policies and measures database focused on renewable energy. Tracking renewable energy production in Germany and the United States can also be helpful in pinpointing the significant changes and particular circumstances that led to the implementation of effective renewable energy policies.

The analysis demonstrates the particular approaches to renewable energy policies taken by both Germany and the United States. In Germany, renewable energy policies demonstrated a top-down approach, with specific targets and price-based regulations being supplemented by financial incentives. For example, much of Germany's success stems from its electricity feed-in tariff and its supplemental preferential loans program. In the

United States, renewable energy policies demonstrated a multilevel approach, with greater state than federal legislation and quantity-based regulations that were also supplemented by financial incentives. Specifically, states' renewable portfolio standards, which were supplemented by production and investment tax credits and renewable energy power incentives, contributed most significantly to the United States' success.

The conditions under which these policies were created are also considered in this study. Historical developments, for example, have influenced renewable energy policies in Germany and the United States. For example, the oil crises of the 1970s aroused concerns over energy security in both nations and presented a need for alternative sources of energy as oil prices rose (PBS; Planète Énergies). In fact, following the the energy crises of the 1970s, Germany and the United States were on very similar paths in relation to their renewable energy policies (Laird and Stefes, 2620). However, by 2000, Germany and the United States were on vastly different paths, leading to more significant progress in Germany than in the United States (Laird and Stefes, 2619).

Laird and Stefes claim that the energy paths of Germany and the United States began to diverge in the 1980s (2621). During this time, the Chernobyl disaster of 1986 in Ukraine substantially undermined German support for nuclear energy, which rivaled the support of renewable energy (Laird and Stefes, 2620; Planète Énergies). Domestic coal production, another rival to renewable energy in Germany, was also challenged during this time, as the European Union rendered massive government subsidies illegal and as climate concerns increased (Laird and Stefes, 2621). Shortly thereafter, the German government began changing its energy policies to demonstrate a stronger commitment to renewable

energy in the long term (Laird and Stefes, 2621). Meanwhile, the United States remained relatively unaffected by the Chernobyl disaster in the 1980s (Laird and Stefes, 2621). Rather, support for nuclear power remained in decline after the Three Mile Island accident of 1979, with the Exxon Valdez Oil Spill of 1989 and the Persian Gulf War of 1991 indicating a need for new energy policies (Laird and Stefes, 2621).

In addition to historical events, social developments have also influenced renewable energy policies. Under a divided Germany, green faction groups in both East and West Germany finally merged in 1980 to form Alliance '90/The Greens (Mayer and Ely, 36). Throughout the '80s and '90s, the newly formed Green Party gained significant support and overcame organizational struggles (Mayer and Ely, 37-38). In the United States, the Environmental Protection Agency (EPA) was founded in 1970, during the same year as the first Earth Day. The EPA was responsible for conducting research, passing policies and implementing programs dealing with environmental issues.

Similarly, institutions and interest groups have influenced renewable energy policies as well. For example, as a member of the European Union, Germany has faced additional pressures to impose strict, federal environmental legislation to promote renewable energies. Moreover, Germany experiences minimal opposition to renewable energy policies (Jordan-Korte, 214). Meanwhile, in the United States, vested interests, particularly from fossil fuel industries, continue to impede renewable energy policies. Consequently, the federal government remains unable to overcome the significant power held by these interest groups.

Political climates in Germany and the United States have affected renewable energy policies as well. In 1998, Germany's first Social Democratic Party and Green Party (red-green) coalition was formed. Under the red-green coalition, which remained in power for nearly a decade, existing renewable energy polices were amended or expanded, while new policies were also adopted. Thus, the red-green coalition continued the momentum in favor of renewable energies over time (Jordan-Korte, 203). As such, renewable energies became, and continue to be a key component of Germany's energy profile.

While Germany experienced significant progress, renewable energy production stagnated in the United States. During the 1990s, the United States also had an opportunity to adopt renewable energy policies under the Clinton administration; however, despite having a democratic president, a republican majority in both the Senate and House of Representatives restricted efforts. Following Clinton's administration, the two-term Bush administration dismantled federal efforts even further, though state efforts to expand renewables increased. With an unfavorable political climate during the Clinton and Bush administration, federal renewable energy policies were forestalled.

Analyzing different historical, social, institutional and political conditions can explain why renewable energy policies and production differ between nation states. This research study provides detailed chronologies of renewable energy development for both Germany and the United States. These chronologies highlight key policies, events and structures that have prompted or hindered the development and growth of renewable energy. Following these chronologies is an analysis section, which compares these factors and renewable energy production in Germany to the United States. A conclusion section at

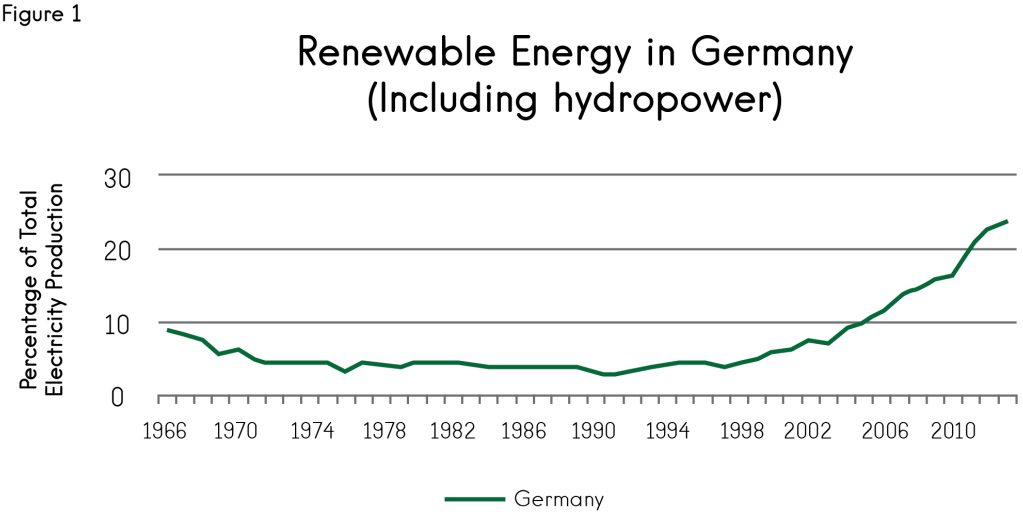
the end of this research study presents a summary of key findings, which affirm that the difference in renewable energy production between these two countries is best explained by the different policies and the contexts in which they were implemented.

Section 1. Chronology of Renewable Energy Development in Germany

Germany's interest in renewable energy production began with early investment in research, development and deployment programs and voluntary mechanisms. At the same time, historical and societal events elicited stronger support for renewables. After reunification, federal, top-down regulation and supplementary funding programs spurred the growth of renewables. In addition, favorable political conditions and external pressure from the European Union secured Germany's renewable energy progress. As such, Germany's substantial production of renewable energy can be attributed to the nation's policies as influenced by historical, social, political and institutional factors.

While hydropower has played a role in Germany's energy profile since the 12th century, other renewable sources were not considered for electricity generation until the late sixties (Planète Énergies). Below, in Figure 1, the percentage of renewable energy as a share of total electricity production in Germany, including hydropower, from 1966 to 2013, is shown (World Development Indicators).

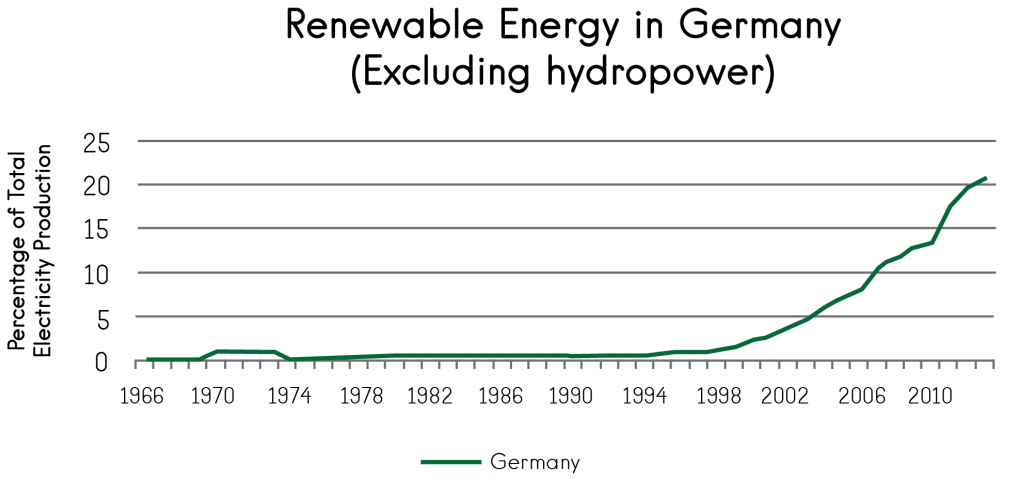
Figure 1



Source: World Development Indicators; The World Bank; 2016; Web. Source:

When hydropower is excluded, due to its negative environmental impacts, the percentage of renewable energy as a share of total electricity production in Germany, from 1966 to 2013, changes slightly (World Development Indicators). This change can be seen in Figure 2.

Figure 2



Source: World Development Indicators; The World Bank; 2016; Web.

In both figures, the percentage of renewables remains relatively consistent over the course of a few decades, with a notable spike occurring around 1998. Since 1998, the share of renewable energies used in total electricity production has risen steadily in Germany. This rise is attributed to Germany's specific renewable energy policies and the historical, social, institutional, and political conditions that influenced them.

Section 1a. Early Development (Before 1990)

In 1961, Germany's first nuclear power plant went online, with its first MWh being produced in 1966 (Planète Énergies). At the same time, however, a number of citizens began to voice concerns regarding the safety of nuclear power. With concerns over the hazards of nuclear power, alternative solutions – specifically renewable energy solutions – finally entered the energy discourse.

More than a decade later, Arab nations that were members of the Organization of the Petroleum Exporting Countries (OPEC) instituted an oil embargo (Planète Énergies). The oil embargo of 1973, in turn, quadrupled the price of oil (Planète Énergies). Consequently, West Germany began importing oil from Norway, the Soviet Union and the United Kingdom and made significant investments into nuclear development (Planète Énergies). East Germany, however, was not largely impacted by the quadrupled oil prices, as it was given lower rates by the Soviet Union (Planète Énergies). In the eighties, with the Soviet Union suffering severe economic problems, East Germany was no longer provided low rates for oil (Planète Énergies). Consequently, East Germany suffered an immense

energy shortage, forcing the GDR to return to coal and lignite mining (Planète Énergies). In lieu of the oil crisis and the immediate necessity of a secure energy supply, renewable energy development remained a part of the discourse, but was not actively pursued.

Shortly thereafter, anti-nuclear protests began to erupt in quick succession. In 1975, with a new nuclear power plant set for construction in Wyhl am Kaiserstuhl, pressure from approximately 30,000 protestors caused the plans to be withdrawn (Deutsche Welle). The anti-nuclear movement in Germany gained additional momentum after the Three Mile Island nuclear meltdown in Pennsylvania in 1979 (Deutsche Welle). Additional protests occurred in Wackersdorf, where demonstrators protested against the construction of a nuclear fuel reprocessing plant (Deutsche Welle). Plans were eventually abandoned (Deutsche Welle). In 1981, Germany's largest anti-nuclear demonstration took place in opposition to the Brokdorf nuclear power plant, with approximately 100,000 demonstrators facing off against 10,000 police officers (Deutsche Welle). Despite the desmontrators' best efforts, Brokdorf began operating in 1986. With strong public opposition to nuclear power, the eighties became a crucial time for Germany's research into and development of multiple renewable sources. In particular, West Germany commissioned its first wind farm in 1983, known as Große Windkraftanlage or GROWIAN (VSL International). Though GROWIAN only operated for four years, the turbine was the largest of its kind and catapulted Germany's wind energy production (VSL International).

With Germany still divided, federal states (Länder) began to demonstrate significant support for renewables (IEA/IRENA). Through direct investment, grants and subsidies and policy support, federal states expanded their support for renewables, albeit

to varying degrees (IEA/IRENA). To date, climate policies still vary across federal states, as they reflect regional economic interests (Monstadt and Scheiner, 386). For example, "high-carbon" Länder insulate existing coal industries by emphasizing efficiency and carbon capture and storage, while those disadvantaged economically support ambitious climate programs that further renewable energy development (Monstadt and Scheiner, 386).

At the same time, after years of competing ideologies among different environmental faction groups throughout East and West Germany, the Alliance '90/The Greens (Bündnis '90/Die Grünen) political party was officially founded (Mayer and Ely, 36). The party's mission included a number of environmental policy proposals, "framed in what as ultimately a 'utopian' design for a pacifist, environmentally compatible welfare state" (Mayer and Ely, 36). Through Germany's federal structure and the existence of Länder, there were numerous opportunities and elections granting the party access to political institutions (Evrard, 279). During its first election, the party only received 1.5 percent of the vote, despite needing a minimum of 5 percent to enter parliament (Mayer and Ely, 36). Over the next few years, the party experienced successes across state legislatures throughout Germany, broadening its reach and legitimizing its efforts. During the federal election of 1983, Alliance '90/The Greens won 5.6 percent of the popular vote (Mayer and Ely, 37). With 5.6 percent of the popular vote, the Alliance '90/The Greens party was able to send 27 members to the Bundestag for the first time (Mayer and Ely, 37). However, as new members of the Bundestag, the party was capable of only limited action, given consistent compromises among the faction groups that founded the party (Mayer and

Ely, 38). As a result, the party's impact on renewable energy policies was minimal. Within two years, membership stagnated as the party's novelty diminished and as leadership struggles persisted (Mayer and Ely, 38).

In 1986, through the mistakes of plant operators and a flawed nuclear reactor design, there was an explosion at the Chernobyl nuclear plant in Ukraine (World Nuclear Association). The nuclear explosion ultimately led to the deaths of 30 individuals, with over a hundred more individuals affected by acute radiation syndrome (ARS) (World Nuclear Association). With Germans already skeptical of nuclear power, the Chernobyl disaster further solidified their negative opinions. Subsequently, strong public opinions against nuclear energy pressured the German government to invest even further into renewable energies (Planète Énergies). As a result of the Chernobyl disaster, Germany's environmental ministry was also founded (Deutsche Welle).

The following year, in 1987, the Single European Act came into effect (Langsdorf, 5). The Single European Act was signed by each of the twelve member countries: Belgium, the Federal Republic of Germany (West Germany), France, Ireland, Luxembourg, the Netherlands, Portugal, Spain, United Kingdom, Denmark, Italy and Greece (Novak, 3). In addition to the establishment of the EEC, the new act mandated some slight environmental protections (Langsdorf, 5). Still, economic objectives were the main focus of the new legislation (Langsdorf, 5).

Section 1b. Development between 1990 and 2005

Following the reunification of both East and West Germany, Germany initiated its 100 MW Wind Programme, which was later expanded to its 250 MW Wind Programme in 1991 (IEA/IRENA). Through Germany's wind programs, grants were established for wind turbine installation and operation (IEA/IRENA). The program also required that all commissioned turbines be monitored for ten years under an added 'Scientific Measurement and Evaluation Programme' (MWEP) (IEA/IRENA). Altogether, 1,560 wind turbines were developed, with a combined capacity of 362 MW (IEA/IRENA). These Wind Programmes are examples of Germany's successful federal, top-down policies that established specific targets.

In 1990, the nation developed the 'ERP-Environment and Energy-Savings Programme' (IEA/IRENA). The national program offered low-interest, preferential loans from Deutsche Ausgleichsbank (DtA) and Kreditanstalt für Wiederaufbau (KfW) for private businesses, public-private partnerships or freelancers making efforts to save energy or planning to use renewable energies (IEA/IRENA). These low-interest, preferential loans served as successful financial incentives to supplement Germany's efforts to expand renewable energy.

In 1991, Germany passed Stromeinspeisungsgesetz (StrEG), an Electricity Feed-in Law (EFL) created to guarantee grid access for electricity produced from renewable energy sources. Under the new law, the electricity produced from renewable energy power plants would be paid for by utility companies (IEA/IRENA). The premium prices paid for by utility companies "were calculated annually as a percentage of the mean specific revenues

for all electricity sold via the public electricity grid in the previous year, i.e., the average electricity price for all customers" (IEA/IRENA). Thus, under the feed-in law, the premiums changed annually (IEA/IRENA). Both solar and wind power plants received the highest premiums at 90% of the mean specific revenues (IEA/IRENA). The new feed-in tariff, along with the '100 MW Wind Programme' of 1989, created a surge in new installations of wind turbines (Laird and Stefes, 2622). Altogether, wind power surged from 68 MW to over 6000 MW – a factor of almost 100 (Laird and Stefes, 2622). The EFL, though eventually replaced in 2000 by the Renewable Energy Sources Act, remains one of Germany's most successful and enduring federal renewable energy regulations.

Similarly, in 1993, full cost rates (Kostendeckende Vergütung) helped to expand photovoltaic installations. Local governments compelled municipal utilities to create schemes requiring them to pay premiums for electricity produced by photovoltaics (IEA/IRENA). Consequently, approximately 1,000 photovoltaic installations were established with a total capacity of 4.5 MW (IEA/IRENA). Ultimately, full cost rates created the necessary financial incentives to expand photovoltaic installations.

With the expansion of renewable energy installations underway, there was a push for additional research, development and deployment (RD&D). Known as the Fourth Energy Research Programme (Energieforschungsprogramm), it was a program that established federal RD&D funds, as well as some support for other programs including the 250 MW Wind Programme (IEA/IRENA). While top-down regulations and supplemental financial incentives expand Germany's renewable energy production, continued technological advancement and understanding remain a priority.

In 1997, Germany signed the Kyoto Protocol, an agreement committing nations to binding emission reduction targets. Given the extent to which developed countries have increased the levels of greenhouse gas emissions in the atmosphere, a disproportionate burden falls upon those nations. In signing the Kyoto Protocol, Germany committed itself to reducing its greenhouse gas emissions by 21 percent by 2012, based on 1990 levels (BMUB). By 2008, Germany had exceeded its goal, a feat made possible by significant expansion of renewables and other mechanisms (BMUB).

The following year, the Social Democratic Party and Alliance '90/The Greens formed a coalition for the first time at the federal level. The resulting agreement was ultimately deemed a win for both parties. The Alliance '90/The Greens party, in particular, won an irreversible commitment to nuclear power withdrawal, which was to be achieved through negotiations with industries, or through federal legislation if necessary (Richter, 28). In lieu of a nuclear phase-out and a lack of industry opposition, renewable energy production rose steadily. In addition, a number of other environmental policies were agreed upon, including more direct forms of participation at the federal level (Richter, 28).

In 1999, Germany introduced its 100,000 Roofs Programme, an expansion of its earlier 1000 Roofs Programme. The program contributed to new installations and expansions of photovoltaic systems larger than 1 kW (IEA/IRENA). Under the new legislation, low interest loans were offered with a ten-year repayment period and a two-year deferment period; after 2001, the loan limitations would be reduced five percent annually (IEA/IRENA). Loans were also limited based on the capacity of installations (IEA/IRENA). This federal program, which created financial incentives to expand

photovoltaics, successfully contributed to approximately 55,000 installations and 261 MW of added capacity (IEA/IRENA). The program, however, ceased in 2003.

The turn of the century was also met with new environmental policy measures, particularly with the introduction of Germany's Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz EEG) (IEA/IRENA). In replacing the Electricity Feed-In Law of 1991, grid access provision to renewable energy plants and electricity purchases at premiums costs was no longer the responsibility of utilities, but of grid operators instead (IEA/IRENA). Grid operators were also obliged to bear any necessary costs of grid reinforcements, though the grid connection would still be covered by plant operators (IEA/IRENA). The new legislation thus solved the problem of unequal burden distribution and sought to double the shares of electricity produced by renewables by 2010 (IEA/IRENA). With subsequent amendments made to the Renewable Energy Sources Act since its adoption, the act proves to be one of Germany's most crucial top-down regulatory policies.

The following year, the European Parliament and Council of the European Union instituted the 2001 Directive, which was designed to promote electricity production from renewable sources of energy. In an effort to increase the contribution of renewables to electricity production, the 2001 Directive instructed member states to take steps to meet national and community targets established under the Kyoto Protocol (EUR-Lex). In doing so, the Parliament and Council required two sets of reports from each member state, one outlining the steps to be taken and another analyzing one's success (EUR-Lex). The Parliament and Council, in turn, would publish a report assessing the measures and

successes of the member states (EUR-Lex). As such, the 2001 Directive elicited greater efforts from Germany to meet its 21 percent target and the European Union's 8 percent target by 2012 (BMUB; European Commission).

Section 1c. Recent Development (After 2005)

Superseding the Fourth Energy Research Programme in 2005, Germany's Fifth Energy Research Programme (Energieforschungsprogramme) continued to support RD&D of renewable energy technologies (IEA/IRENA). In addition to the funding provided through this program, renewables received project-based or institutional funding, via the Federal Environment Ministry (BMUB) and the Federal Ministry for Education and Research (BMBF) respectively (IEA/IRENA). Therefore, the new research program created financial incentives to develop renewable energies even further.

Similarly, a program for producing solar power was launched, under which low-interest loans were offered for investments in solar photovoltaic generation (IEA/IRENA). The program limited investments up to EUR 50,000, thereby benefitting private investors (IEA/IRENA). The program was relatively flexible, with terms varying between ten and twenty years and offering a 'redemption-free' trial phase of two or three years (IEA/IRENA). By July of 2006, more than 25,000 loans had been disbursed, totaling EUR 784 million for an additional capacity of 199 MW (IEA/IRENA). In doing so, the loan program helped to incentivize and expand renewable energy production.

In 2006, funding was allotted for a solar power development facility, at which manufacturers of solar cells and systems could test new products (IEA/IRENA). Funding

also went towards equipment at the appropriate scale of a modern, industrial production line (IEA/IRENA). The facility, known as the Photovoltaic Technology Evaluation Center (PV-Tec), comprises part of the Fraunhofer Institute for Solar Energy Systems (ISE) (IEA/IRENA). As such, the increased funding not only helps to develop solar energy, but ensures technological advancement in the long-term as well.

The 'Klimazwei Research Programme,' a program dedicated to the research and development of technologies and other schemes for climate change mitigation and adaption, was established in 2006 as well (IEA/IRENA). The program would last until 2009, with 39 different projects associated with mitigation and adaptation being financed (IEA/IRENA). Some projects include 'Wind Propulsion for Cargo Ships,' 'Biogas Feed-in,' 'Smouldering Waste Dumps' and 'GEKKO' (IEA/IRENA). Approximately EUR 35 million, financed by the Federal Ministry of Education and Research (BMBF), was set aside for this program (IEA/IRENA). While the research program does not directly increase renewable energy production, the program demonstrates Germany's broad climate change concerns that continue to inform its policies.

In 2007, Germany adopted an 'Integrated Climate Change and Energy Program' to satisfy the integrated climate and energy policy set forth by the European Council (IEA/IRENA). The program's underlying principles are based on energy security, economic efficiency and environmental protection (IEA/IRENA). Furthermore, the new program sought to reduce greenhouse gas emissions by 40 percent by 2020, based upon 1990 levels (IEA/IRENA). With 29 separate measures, a wide variety of issues were addressed and, ultimately, Germany's lower parliament approved fourteen draft laws in

accordance with the program's underlying goals and principles (IEA/IRENA). These laws, in turn, would take effect in 2008 (IEA/IRENA).

In addition to the fourteen draft laws, a second set of measures was enacted in 2008. These measures dealt primarily with electricity, with aims to double electricity generation via combined heat and power technology to 25 percent (IEA/IRENA). The second set of measures also aimed to increase the share of green electricity to 20 percent, particularly through off-shore wind farms (IEA/IRENA). Subsidies for off-shore wind farm development would be provided in addition to an approved underground grid construction project – totaling 850 km – by which this energy could be transported (IEA/IRENA). Taken together, both sets of laws were enacted as a result of pressure from the European Council.

In 2009, the KfW Mittelstandsbank – the merger of KfW and DtA – consolidated its support programs for renewable energy investments via a Renewable Energies Programme (Programm Erneuerbare Energien) (IEA/IRENA). The new legislation was comprised of two parts: a standard program that offered loans for electricity generated by photovoltaic, biomass, biogas, wind energy, hydropower, geothermal, or combined heat and power sources and a premium program that offered loans and repayment bonuses for heat generated by renewables in larger plants (IEA/IRENA). The loans, in turn, served as financial incentives for the development of renewable energy. In addition to consolidating its support programs, the federal government, a coalition formed by the Christian Democratic Union and Free Democratic Party, cancelled the nuclear phase out that began in 1998 (Planète Énergies; World Nuclear Association).

At the same time, the European Parliament and the Council of the European Union established the 2009 Directive, which made specific national targets mandatory for member states (EUR- Lex). Specifically, the community targeted a 20 percent share of energy from renewable sources in gross final consumption of energy by 2020 (EUR-Lex). To meet their targets, member states were advised to create support schemes or partner with other states (EUR- Lex). Furthermore, member states were required to submit action plans to reach their targets, making any necessary amendments if deemed necessary by the commission (EUR-Lex). The 2009 Directive augmented Germany's efforts to produce and consume more renewable energy.

A significant amendment to the Renewable Energy Sources Act (EEG), which implemented different tariff schemes for renewables, also went into effect (IEA/IRENA). The amendment increased the feed-in tariffs for wind energy and offered an increased repowering bonus to assist the transition from old to new turbines (IEA/IRENA). New turbines had to be located in the same administrative district and could only replace those that were at least 10 years old (IEA/IRENA). New turbines also had to be equipped with double the capacity of former turbines, but not exceed five times said capacity (IEA/IRENA). Similarly, tariffs for hydropower, biomass, biogas, geothermal and combined heat and power sources increased (IEA/IRENA). Tariffs for photovoltaics, on the other hand, were reduced for all capacity sizes (IEA/IRENA). Amendments to the EEG served to keep renewables competitive.

In 2010, Germany instituted its Energy Concept, which combined policy goals of energy security, climate protection and industrial competition and growth (IEA/IRENA).

The following specific targets were adopted: “a 40 percent cut in greenhouse gas emissions by 2020, 55 percent by 2030, 70 percent by 2040 and between 80 and 95 percent by 2050,” based on 1990 levels (IEA/IRENA). The share of renewables in final consumption would also be increased from roughly 10 percent to 60 percent by 2050 (IEA/IRENA). Furthermore, primary energy consumption would be reduced by 20 percent by 2020 and 50 percent by 2050, as compared to values from 2008 (IEA/IRENA). Beginning in 2013, and for every three years thereafter, the federal government would monitor the implementation and progress of the Energy Concept (IEA/IRENA).

In the same year, Germany drafted and submitted its multi-sectoral National Renewable Energy Action Plan (NREAP) following the 2009 Directive (IEA/IRENA). Germany’s NREAP outlined targets for an 18 percent share of renewable energy in final energy consumption, a 15.5 percent share of renewable energy for heating and cooling, a 37 percent share of renewable energy for electricity demand and a 13 percent share of renewable energy for transportation (IEA/IRENA).

In 2011, a devastating earthquake led to a 15-meter tsunami that ultimately caused the nuclear disaster of three Fukushima Daiichi reactors (World Nuclear Association). Each of the three reactor cores melted for three days and caused significant radiation leaks (World Nuclear Association). The reactors were finally stabilized after 2 weeks, though cooling did not begin until July (World Nuclear Association). After the disaster, German Chancellor Angela Merkel reintroduced plans for a nuclear phase out (Planète Énergies).

In 2011, Germany launched its Sixth Energy Research Programme (Energieforschungsprogramme) (IEA/IRENA). The program focused on Germany’s

energy future, with emphasis on RD&D for forward-thinking, renewable energy technology (IEA/IRENA). The legislation particularly demonstrated Germany's commitment to renewable tech, with approximately EUR 3.4 billion being made available for research between 2011 and 2014 (IEA/IRENA). This represents an increase in funding of approximately 75 percent, when compared to the period from 2006 and 2009 (IEA/IRENA). The funding also contributed to a newly created 'Energy and Climate Fund' that would be disbursed to prioritized projects for Germany's energy transition (IEA/IRENA).

The 'Energy and Climate Fund' (Energie- und Klimafonds (EKFG)) was also created in 2011 to encourage a reliable, economic, and environmentally-friendly energy future (IEA/IRENA). In addition to funding from the Sixth Energy Research Programme, revenues would originate from extra profits earned by nuclear power plant operators (IEA/IRENA). With the nuclear power phase out from 2012 onwards, revenues would come from a European emissions trading scheme (IEA/IRENA). Taken together, the Sixth Energy Research Programme and the 'Energy and Climate Fund' supported both renewable energy development and Germany's broader goals.

With Germany's energy future at the forefront of environmental discourse, a monitoring process was outlined via an Energy of the Future policy (IEA/IRENA). The process requires the Federal Economics Minister and Federal Environment Minister to compile a yearly, factually-based monitoring report with additional input if sought, the first of which would report on the 2011 year (IEA/IRENA). Every three years, beginning in 2014, a progress report would also be composed (IEA/IRENA). In this way, the federal

government could monitor the progress of Germany's Energy Concept, with respect to its implementation and target achievements, as well as indicate any challenges or suggestions for future action (IEA/IRENA). Thus, the new policy demonstrates Germany's commitment to and preference for a sustainable energy future.

In an effort to quickly expand off-shore wind energy, the KfW Mittelstandsbank began financing projects on behalf of the federal government (IEA/IRENA). Financing was made available "for the construction of up to ten offshore wind farms in the German Exclusive Economic Zone (EEZ) or in the 12 nautical-mile zone of the North Sea and the Baltic Sea for project companies regardless of the company background" (IEA/IRENA). Although no more than EUR 700 million per project could be financed, the financial support helped to expand the wind industry in Germany (IEA/IRENA).

Section 1d. Summary

At length, the implementation of research, development and deployment programs as well as voluntary mechanisms launched Germany onto its renewable energy path. Shortly thereafter, the oil crises and frequent nuclear power plant disasters signaled the need for alternative energy solutions, prompting the RD&D of renewables. Strong public opposition to nuclear power, a new green party and a lack of industry opposition also fueled the pursuit of renewable energy development. Meanwhile, with Germany divided, a lack of over-arching legislation resulted in voluntary federal state action in support renewable energies. After reunification, however, effective, top-down regulations, including Germany's feed-in tariff, were implemented, in addition to a number of supplemental

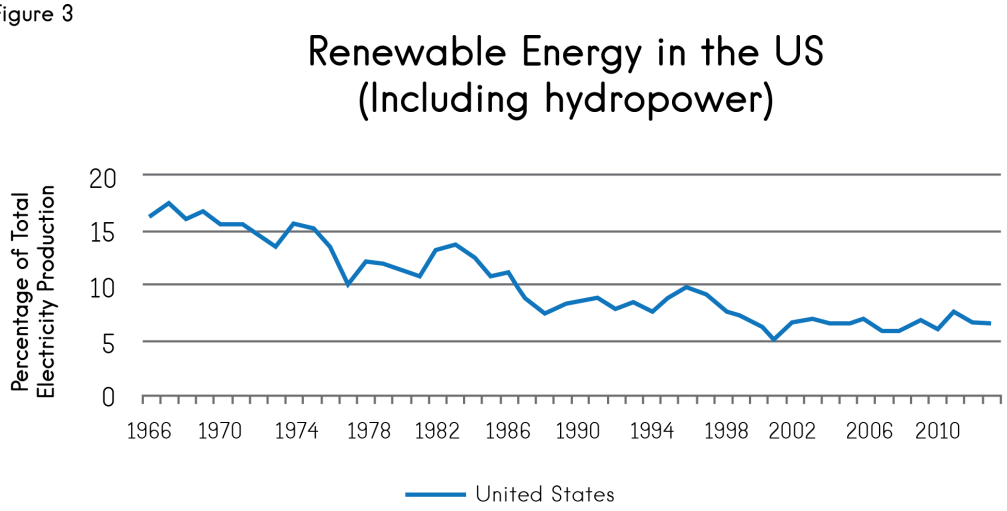
incentivized programs. Financial support schemes, including loan and grant programs reinforced efforts to expand renewable energies. The red-green coalition continued these efforts, making necessary amendments and policy changes to obsolete policies. In addition to these efforts, external pressure from the European Parliament and the Council for the European Union ensured Germany's growing renewable energy trajectory. To date, Germany's federal government has maintained renewable energy progress, as noted by the steadily increasing share of renewables in total electricity production in Figures 1 and 2. Therefore, Germany's renewable energy policies, as influenced by historical, social, institutional and political developments have contributed to the nation's undeniable success.

Section 2. Chronology of Renewable Energy Development in the United States

Interest in renewable energy development in the United States began with early research, development and deployment measures and voluntary programs. Despite historical circumstances and public support that provided an opportunity to expand renewables nationwide, strong, federal legislation was nonexistent. Unfavorable political circumstances and strong interest group influences dampened efforts even further. However, state legislation helped to expand domestic production of renewable energy. Still, this multi-level, voluntary approach is insufficient when compared to Germany. As such, the nation's lag behind Germany is best explained by domestic policies as influenced by historical, social, institutional and political factors.

Hydropower has been used in the United States since the late 1800s (National Hydropower Association). However, as in Germany, other renewable forms of electrical energy did not enter the energy discourse until later. The graph below, Figure 3, shows the percentage of renewable energy as a share of total electricity production in the United States, including hydropower, from 1966 to 2013 (World Development Indicators).

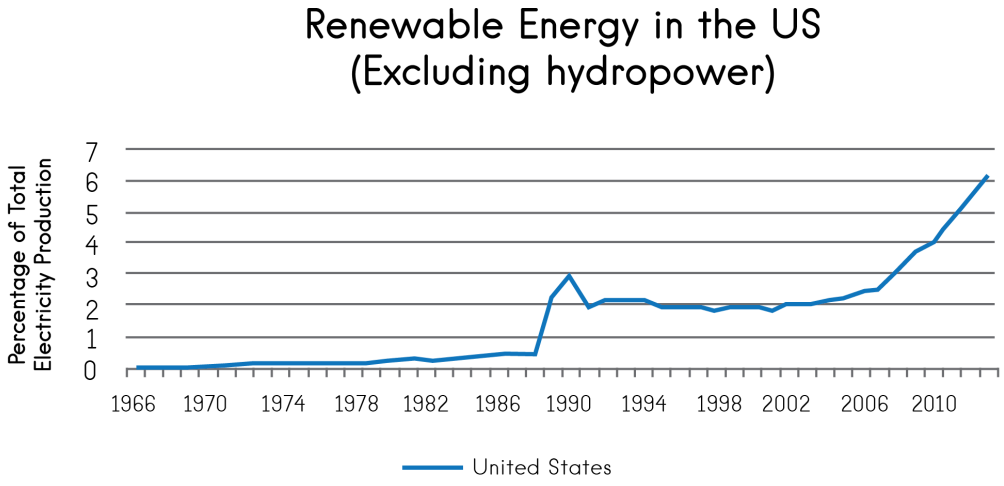
Figure 3



Source: World Development Indicators; The World Bank; 2016; Web.

Meanwhile, Figure 4, which shows a slightly different picture, indicates the percentage of renewable energy as a share of total electricity production in the United States, excluding hydropower, from 1966 to 2013 (World Development Indicators). Hydropower is excluded due to its negative impacts on the environment.

Figure 4



Source: World Development Indicators; The World Bank; 2016; Web.

In Figure 3, shares of renewable energy as a total of electricity production begin at a much higher percentage when compared to the shares displayed in Figure 4. In both figures, the percentage of renewables used in total electricity production increased slightly in 1990, but fell shortly thereafter before rising again in 2002. These patterns are attributed to energy policies in the United States that have been influenced by historical, social, institutional and political factors. As a result of energy policies and their influences, current percentage uses of renewable energy as a share of total energy production are significantly lower when compared to Germany.

Section 2a. Early Development (Before 1990)

Development of nuclear power to produce electricity in the United States began as a program in the late 1940s following the Manhattan Project (World Nuclear Association). In 1951, the first nuclear reactor to produced electricity in Idaho (World Nuclear Association). Beginning in the 1950s, private industries began producing electricity from nuclear power sources (World Nuclear Association). The first nuclear power plant in the United States was located at Shippingport, Pennsylvania; it was owned by the US Atomic Energy Commission but it was built and operated by the Duquesne Light and Power Company (World Nuclear Association). To date, mostly all commercial reactors in the nation are owned by private companies, with the nuclear industry experiencing significantly greater private participation than any other nation (World Nuclear

Association). Thus, the nuclear power industry represents one of the many influential interest groups that exist in the United States.

In 1970, the first national Earth Day took place (PBS). Across the nation, 20 million people participated in what was deemed at the time the largest demonstration in United States history (PBS). In doing so, demonstrators alike publicized their legitimate environmental concerns and called on the nation to act. Shortly thereafter, the Natural Resources Defense Council (NRDC) was founded, which provisioned tools for drafting and lobbying environmental legislation (PBS). Furthermore, on December 2, 1970, the United States Environmental Protection Agency (EPA) was founded. The new agency was charged with the passage of environmental policies, programs and related research (PBS).

Then, in 1973, the oil embargo against the United States caused a strain on the economy. A barrel of oil, initially priced at USD 3.00, escalated to USD 12.00 (PBS). Given the United States' dependence on foreign oil, the embargo ultimately catalyzed research into renewable sources, along with efforts to become more energy independent in subsequent years (PBS). For example, during the following year, the Solar Energy Research Act was passed. The act secured funds for researching and developing solar energy, supported incentives to expand commercial uses of solar technology and created the Office of Solar Energy Research in the U.S. government (IEA/IRENA). Furthermore, during his term as president in 1977, Jimmy Carter announced his plans to reduce energy demands, limit oil imports, and increase the use of solar energy (PBS). President Carter also founded the Department of Energy (DOE) in 1977 (PBS). The DOE was responsible for research, development, implementation, regulation, data collection and analysis of

various energy sources (PBS). Together, these pieces of legislation demonstrate the nation's interest in energy security and the development of alternatives sources of energy.

In 1978, the federal Energy Tax Act was implemented, establishing tax credits for households and businesses. For households, tax credits for solar and wind energy equipment were set at 30 percent of the first USD 2000 and 20 percent of the next USD 8000 (IEA/IRENA). On the other hand, businesses received a 10 percent tax credit for investments in solar, wind and geothermal sources (IEA/IRENA). This 10 percent credit was even offered in addition to a standard 10 percent investment tax credit (ITC) made available on a variety of equipment (IEA/IRENA). Ultimately, credits offered to households and businesses were extended and improved in 1980 (IEA/IRENA). These tax credits offered financial incentives to assist the expansion of renewable energies in the United States.

Alongside the Energy Tax Act, the Federal Energy Management Program (FEMP) was created. The FEMP was established to further energy efficiency, increase renewable energy use and encourage better utility management decisions (IEA/IRENA). Though the FEMP served to demonstrate the federal government's leadership in and commitment to improved energy decisions, the legislation seemed to focus on economic rather than environmental objectives. In an attempt to demonstrate its commitment to renewable energy sources even further, the federal government passed the Solar Photovoltaic Energy Research, Development and Demonstration Act. As its name suggests, the act re-established and funded RD&D for photovoltaic systems (IEA/IRENA). Federal legislation at this time continues to focus on research programs rather than regulations.

Shortly thereafter, a Public Utility Regulatory Policies Act (PURPA), to be overseen by the DOE, was established. Under PURPA, electric power generated from non-utilities could enter the market (IEA/IRENA). Utility companies were required to purchase power from non-utilities for an "marginal cost" (IEA/IRENA). In other words, utility companies would buy power at a rate less than what it would have cost the utility to generate the extra power (IEA/IRENA). Though PURPA helped to initially increase the shares of geothermal, biomass, waste, solar and wind in electricity production, its impact diminished over time as states made clarifications and switched to competitive bidding to meet needs (IEA/IRENA).

Then disaster struck in 1979. At Three Mile Island, a nuclear power plant near Harrisburg, Pennsylvania, the core of the second reactor melted after a cooling malfunction (World Nuclear Association). Though some radiation was released, the accident did not cause any adverse effects (World Nuclear Association). The accident served to confirm and further public concerns about the safety of nuclear power. After the incident, the nuclear industry came to a halt; no nuclear plants were commissioned afterward (Behr). In fact, none of the nuclear plants that were commissioned after 1974 were completed (Behr).

In 1980, the federal government introduced its Wind Energy Systems Act, which was created to increase RD&D of wind energy (IEA/IRENA). Federal legislation continues to support research programs, but fails to establish specific targets or other regulatory mechanisms. The Wind Energy Systems Act, along with the Solar Photovoltaic Energy RD&D Act of 1978, was superseded by the American Recovery and Reinvestment Act: Appropriations for Clean Energy of 2009 (IEA/IRENA).

A national Tax Reform Act that impacted the tax credits provided to businesses under the Energy Tax Act of 1978 was enacted in 1986 (IEA/IRENA). The new act eliminated business tax credits for wind energy, phased out credits for biomass, but continued providing credits for solar and geothermal for an additional two years (IEA/IRENA). The extension for solar and geothermal was periodically renewed until 1992, with the additional standard 10 percent investment tax credit received by businesses eventually being phased out as well (IEA/IRENA). In addition, the act stipulated an alternative minimum tax (AMT) to ensure that investors would not take advantage of tax credits (IEA/IRENA).

Section 2b. Development between 1990 and 2005

The first Gulf War, occurring between 1990 and 1991, erupted when Saddam Hussein ordered an invasion into nearby Kuwait after accusing the nation of illegally siphoning crude oil (History). Then-president George H.W. Bush condemned Hussein's invasion and occupation of Kuwait, and ultimately intervened (History). The war caused oil prices to increase, offering an opportunity for more investments into renewable energy (Laird and Stefes, 2624). In response, the Bush administration passed the Energy Policy Act of 1992 (EPACT 1992), which incentivized the development of renewables. The 10 percent tax credit for investment in solar and geothermal was permanently extended and a new production tax credit (PTC) was generated for wind and "closed-loop" biomass (IEA/IRENA). The PTC was available to both investor-owned utilities and non-utility generators, while publicly-owned utilities were permitted to receive a production incentive

payment because they were ineligible to receive the PTC (IEA/IRENA). Known as the Renewable Energy Production Incentive (REPI), the payment was offered for the production of solar, wind, biomass (excluding municipal solid waste) and geothermal energy (IEA/IRENA). Still, the act failed to fund further investments into renewable energies (Laird and Stefes, 2625).

In 1994, the Federal Utility Partnership Working Group (FUPWG) encouraged partnerships and better communication between federal agencies, utility companies and energy service companies (ESCOs) (IEA/IRENA). Through these partnerships, the implementation of cost-effective, energy efficient measures and renewable energy projects at federal sites was discussed (IEA/IRENA). Other objectives of FUPWG included helping federal agencies meet energy standards required by law, prepare for an evolving energy landscape and broaden knowledge surrounding newly developed technology (IEA/IRENA). Though useful, the FUPWG confirms the United States' prioritization of economic over environmental objectives.

The State Energy Program (SEP), which allocated funds to states for renewable energy and energy efficient programs, was developed two years later (IEA/IRENA). Specific goals of the SEP were as follows: (1) maximizing an energy efficient U.S. economy, (2) minimizing energy costs, (3) increasing energy security, (4) developing renewables, (5) supporting economic growth while improving environmental conditions and (6) reducing reliance on foreign energy supplied (IEA/IRENA). Financial incentives provided by the SEP encouraged greater state action, which was particularly important in the absence of top-down, federal legislation that was typified in Germany.

Thus, states began to demonstrate substantial commitments to renewable energy, developing portfolio standards which have contributed most significantly to renewable energy production in the United States. For example, in 1997, Massachusetts' Renewable Portfolio Standard (RPS) was "designed to diversify the state's electricity supply portfolio, stabilize rates, increase energy security, improve environmental quality, and invigorate the clean energy energy industry" (IEA/IRENA). The Massachusetts' Department of Energy Resources (DOER) was ultimately tasked with communicating and implementing new regulations (IEA/IRENA). By 2003, 1 percent of electricity sales were to come from renewables, increasing to 4 percent by 2009 and increasing 1 percent every year thereafter (IEA/IRENA). However, when the law was amended in 2002, electricity producers were able to avoid state targets simply by purchasing credits; in 2003, the credits were set at USD 50 per MWh and were intended to be higher than the incremental cost incurred through additional renewable energy sources (IEA/IRENA).

At the federal level, an initiative known as Wind Powering America (WPA), which sought to reduce barriers to wind energy deployment in the U.S. and thus cause the wind industry to proliferate, launched in 1999 (IEA/IRENA). Proliferation of the wind industry, in turn, was expected to help meet a growing demand for green power and generate income for rural states (IEA/IRENA). Through WPA, analysis tools, outreach information and partnerships between states, regions and communities were developed (IEA/IRENA). While the new initiative sought to expand the wind industry, it failed to establish a specific and achievable target.

The turn of the millennium was met with local efforts to expand renewables. San Francisco, in particular, developed a Solar Energy Incentive Program in 2001. Designed to expand photovoltaic installations, various incentives were offered based on the type of property: residential, low-income residential, commercial, non-profit, etc. For example, residential installations received between USD 2000 and USD 3000, low-income residential installations received up to USD 7000, commercial installations received up to USD 10000 and non-profits remained uncapped (IEA/IRENA). While there was no maximum size to be eligible, all installations had to have a capacity of at least 1 KW (IEA/IRENA). In this way, local efforts, in addition to state efforts, facilitate greater commitments to renewable energy production and typify the multi-level policy approach taken by the United States.

In 2001, renewably-sourced energy was promoted via voluntary actions. One such voluntary-based program was the Clean Energy Supply Program, a multi-sectoral policy that sought to increase the usage of green power among notable U.S. organizations through partnership opportunities (IEA/IRENA). The Green Power Partnership provided advice, expert and technical support, as well as any necessary tools and resources; in return, U.S. organizations were required to sign a contract, in which they agreed to purchase green power that met or exceeded initial benchmarks (IEA/IRENA). To date, more than 1,300 U.S. organizations have joined the Green Power Partnership, purchasing more than 17 billion kWh of green power each year (EPA). Similarly, the State and Local Climate and Energy Program, a voluntary-based program, provided state and local governments with technical assistance, tools and support to assist their clean energy efforts (IEA/IRENA).

Specifically, policies and other projects promoting clean energy were identified and documented, benefits of clean energy projects were measured and evaluated and information on best practices and policies was shared amongst officials (IEA/IRENA). Such voluntary programs, though helpful in catalyzing the nation's initial renewable energy production efforts, are unsurprisingly ineffective and contribute to the nation's lag behind Germany.

Meanwhile, states continued to ratify renewable portfolio standards. For example, California's RPS proposed to have renewable energy constitute 20 percent of the state's total electricity mix by 2017; in 2006, the program was accelerated, with utilities expected to procure a 20 percent share of renewable energy by 2010 (IEA/IRENA). In 2008, the program was advanced even further, with utilities expected to reach a 33 percent renewable share by 2020 (IEA/IRENA). Ultimately, California's RPS remains one of the greatest commitments to renewables in the United States. Colorado also ratified an RPS, though through a ballot initiative approved by voters in the state (IEA/IRENA). Initially, utilities were required to have renewables account for 10 percent of their sales by 2015; in 2007, the law was amended, requiring a 20 percent share by 2020 (IEA/IRENA). Three years later, the law was accelerated in hopes of achieving a 30 percent share of renewables by 2020; investor-owned utilities (IOUs), however, were required to meet higher standards and provide an accounting of renewable energy percentages (IEA/IRENA). Likewise, Nevada expanded its RPS in 2005; by 2015, 20 percent of the state's electricity was expected to come from renewable energy sources (IEA/IRENA). Utilities were also offered credits if they adopted other energy efficient measures, up to 25 percent (IEA/IRENA). In

2009, the RPS was expanded once more, requiring a share of 25 percent renewables by 2025 (IEA/IRENA). By no means an accounting of all RPSs in the nation, these examples exemplify the United States' successful, multi-level approach to renewable energy policies, particularly in the absence of top-down regulations.

Section 2c. Recent Development (After 2005)

In 2005, another Energy Policy Act (EPACT 2005) was signed into law (IEA/IRENA). Some aspects of EPACT 2005 include: (1) a standard for shares of renewable energy at federal facilities, (2) subsidies for wind energy, (3) added wave and tidal power sources for the first time, (4) support for making geothermal energy more competitive, (5) mandatory reporting on renewables by the DOE, (6) support for greater energy security and (7) an expanded PTC (IEA/IRENA). Despite these provisions, EPACT 2005 generously compensated nuclear and oil industries with heavy subsidies. Unlike Germany, fossil fuel industries in the United States have substantial political clout, influencing policies and actively opposing threatening renewable energy legislation. Therefore, prioritization of the fossil fuel industry over the renewable energy industry is representative of the Bush administration's reluctance towards federal environmental legislation.

In lieu of the Bush administration's opposition to renewable energy development, another voluntary-based program was initiated. Known as the State and Climate Energy Program, it intended to provide support for states. Under the program, the first U.S. guide to best practices was published, detailing 16 clean energy policies or programs from

different states that provided them with opportunities to reduce costs, reduce emissions, improve energy security, foster economic growth and more (IEA/IRENA). Policies and programs included in the guide dealt with energy efficiency, clean energy supply and distribution, and targeted policymakers and utility commissioners (IEA/IRENA). Consequently, the guide served to bridge communications between states, thereby fostering more comprehensive state action plans.

In 2006, the DOE founded Solar America, a new initiative designed to enhance the competitiveness of photovoltaics. The initiative sought to improve research and development (R&D) and remove any deployment barriers; R&D focused on material sciences and solar manufacturing processes, whereas removal of barriers required market transformation (IEA/IRENA). Together, benefits included growing the economy, ensuring energy security, minimizing power outage impacts and reducing reliance on fossil fuels (IEA/IRENA). However, Solar America was ultimately discontinued in 2009 during the Obama administration (IEA/IRENA). Nevertheless, the Bush administration continued to support research and other voluntary programs rather than mandatory regulations.

In 2008, support for research programs continued. For example, the DOE signed a Memorandum of Understanding (MOU) with the following energy companies: GE Energy, Siemens Power Generation, Vestas Wind Systems, Clipper Turbine Works, Suzion Energy and Gamesa Corporation; together, the DOE and wind companies planned to address "research and development related to turbine reliability and operability; siting strategies for wind power facilities; standards development for turbine certification and universal interconnection of wind turbines; manufacturing advances in design, process automation,

and fabrication techniques; and workforce training and development" (IEA/IRENA). In addition, off-shore wind and ocean energy testing was permitted off the coasts of California, Delaware, Florida, Georgia and New Jersey (IEA/IRENA). Short-term leases were allotted for these testing sites, and those wishing to participate had to submit detailed information (IEA/IRENA). Commercial energy production was prohibited at testing sites; testing sites were solely leased for data collection and technological testing (IEA/IRENA). As of 2014, 16 projects were being considered for further pursuit, while other nominations were still being evaluated (IEA/IRENA). Furthermore, The Western Renewable Energy Zones (WREZ) project, established by the Western Governors Association (WGA), a regionally-based group, in conjunction with the DOE, was brought into effect (IEA/IRENA). The WREZ project sought to realize the WGA's goal of developing 30,000 MW of clean power by 2015 (IEA/IRENA). To do so, the WREZ provided information for decision-makers promoting the development of renewables, as well as transmission plans for delivering clean power (IEA/IRENA).

Meanwhile, due to expire in 2008, production and investment tax credits were renewed through the Energy Improvement and Extension Act (IEA/IRENA). For example, the PTC for wind was extended one year and the PTC for geothermal, biomass, and solar was extended two years (IEA/IRENA). Additionally, wind gained a 30 percent ITC through 2016, solar gained an eight-year extension of its ITC, and marine and other hydropower energies gained a new ITC (IEA/IRENA). Under the act, utilities were no also longer excluded from obtaining an ITC (IEA/IRENA).

In 2009, on-shore and off-shore projects gained some momentum. For example, The DOI Bureau of Land Management (BLM) sought to develop renewable energies on public lands, working alongside local communities, regulators, industries and other federal agencies (IEA/IRENA). Projects on public lands were comprised of wind, solar, geothermal, and biomass energy sources, as well as additional transmission facilities (IEA/IRENA). On the other hand, there was a significant push for off-shore renewable energy development. Specifically, a Final Rule on Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf (OCS) was proposed (IEA/IRENA). The rule gave regulatory authority to the Department of the Interior's (DOI) Mineral Management Services (MMS) – eventually renamed the Bureau of Ocean Energy Management (BOEM) – over renewable energy projects on the OCS (IEA/IRENA). Additionally, a framework for energy production and a system for granting leases, easements and rights-of-way was outlined; the new program also outlined ways by which to share revenues from OCS installations with adjacent states (IEA/IRENA). In particular, BOEM introduced its Off-Shore Renewable Energy Program (IEA/IRENA). "The program promotes the development of the vast wind potential – including Outer Continental Shelf (OCS) Atlantic winds – of the United States and works to ensure that the process of issuing leases for renewable energy energy development on the OCS is streamlined and facilitates environmentally responsible development" (IEA/IRENA). Accomplishing these objectives required a thorough, fast-track leasing scheme for Atlantic wind, a simplified approval process for wind projects and a simultaneously quick process for handling transmission line applications (IEA/IRENA).

In 2013, a thorough US Climate Action Plan was enacted. The action plan was comprised of three pillars: (1) to reduce carbon pollution in the US, (2) to prepare the nation for climate change impacts and (3) to be a leader in the global climate change fight (IEA/IRENA). With respect to renewable energies, the plan established a long-term investment in clean energy innovation, with up to USD 8 billion in loan guarantees. In addition, goals to expedite clean energy implementation were outlined (IEA/IRENA). To accelerate clean energy, the DOI was directed to permit 10 GW of renewable capacity on public lands by 2020. In addition, the goal to add 100 MW of renewables to federal housing by 2020 was announced and plans to deploy 3 GW of renewable capacity for military installations were established (IEA/IRENA). Overall, the new Climate Action Plan represents significant progress in terms of federal legislation and addresses broader environmental issues. However, the legislation faces overwhelming pushback from states and industries alike. Unlike Germany, significant opposition continues to block renewable energy policies.

Section 2d. Summary

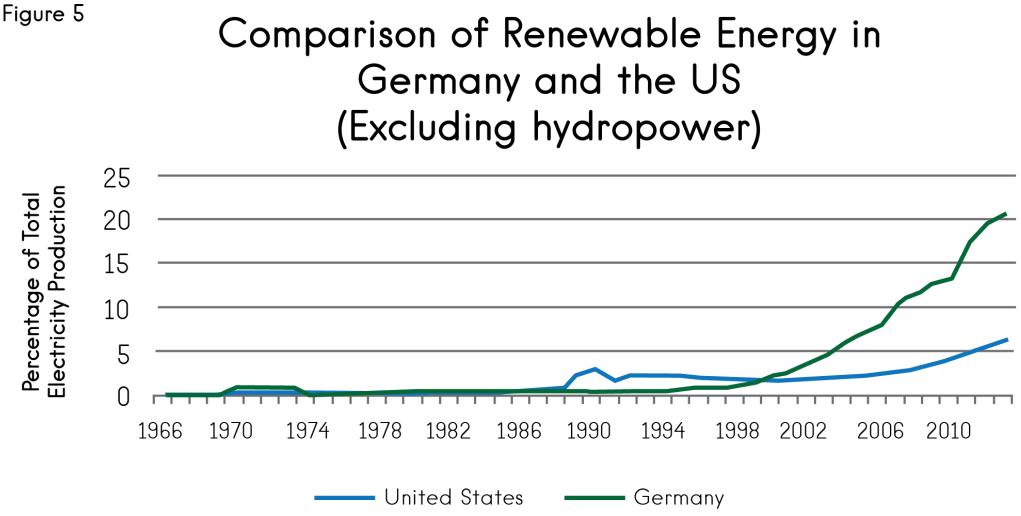
Ultimately, as in the case of Germany, research, development and deployment measures, as well as voluntary mechanisms initiated the establishment of renewables in the United States. The oil crises of the 1970s stressed the importance of energy security and facilitated further renewable energy research. Federal legislation in subsequent years was characterized by research programs and tax credit regimes for both investment and production of renewables. The Gulf War set an optimistic tone for the 1990s, presenting

an opportunity for the United States to expand renewables as oil prices spiked. However, unfavorable political climates stagnated federal efforts, which continued well into the new millennium under the new Bush administration. In addition to political opposition, vested interests from the fossil fuel industries continue to prevent renewable energy policies. With federal legislation at a stand still, much of the United States' successes stem from state legislation. States began implementing renewable energy standards in quick succession and as targets were reached, the standards were updated. Therefore, unlike Germany, renewable energy legislation was mainly implemented with a voluntary, multi-level approach. As such, the United States' approach to renewable energy policies, as influenced by historical, social, institutional and political factors, explain the nation's lag behind its German counterpart.

Analysis

In as early as the 1960s, Germany and the United States began to consider renewable energy as a viable source for electricity production, with the exception of hydropower sources, which had been used much earlier in both countries. Since the 1960s, Germany and the United States have implemented a number of policies to expand renewable energy and increase its share in total electricity output. Figure 5 shows the shares of renewable energy in total electricity production, excluding hydropower, in both countries.

Figure 5

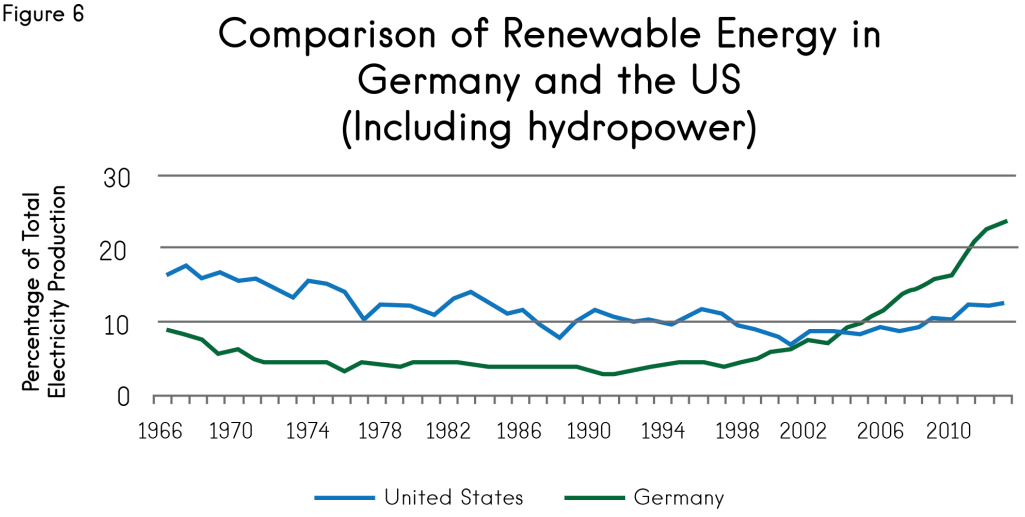


Source: World Development Indicators; The World Bank; 2016; Web.

As can be seen in Figure 5, the percentage of renewable energy used in Germany's total electricity output began to dramatically increase in 1998. Meanwhile, in the United

States, the percentage sharply increased around the late ‘80s-early ‘90s, remaining relatively consistent until the mid-to-late 2000s when it increased again. If hydropower sources are included into the energy mix, the graph looks a bit differently, which can be seen in Figure 6 below.

Figure 6



Source: World Development Indicators; The World Bank; 2016; Web.

In Figure 6, both Germany and the United States began with larger shares of renewable energy in total electricity production. As in Figure 5, Germany’s percentage use of renewables sharply increased beginning in 1998. Similarly, Figure 6 confirms the United States’ percentage use of renewables increasing in the late ‘80s-early ‘90s, declining shortly thereafter, and increasing once more in 2002. Understanding these patterns in context will demonstrate the similarities and differences in renewable energy approaches taken by Germany and the United States. Specifically, policies and their historical, social,

institutional and political influences result in the differences between Germany and the United States noted in both figures.

A number of policy instruments exist for both nations to further renewable energy generation on their respect sides of the Atlantic. Some common policy instruments include research, development and deployment programs, financial incentives, regulations and other voluntary mechanisms. While Germany and the United States have each implemented these policy instruments in the past fifty years, significant differences remain between the percentage of renewables used for total electricity production in both countries. Consequently, the prioritization of certain policies may account for these differences.

In Germany, renewable energy policies were implemented top-down and were largely price-based. For example, Germany's Electricity Feed-In Law (EFL) of 1991, which required utilities to purchase a portion of their electricity from renewables at rates calculated from the previous year's electricity rates, was consistently renewed until 2000. However, the feed-in tariff remains in effect through Germany's Renewable Energy Sources Act (EEG), which was implemented in 2000 and has been amended frequently over the past decade. The original act, replacing the EFL, shifted some of the burden from utilities to grid operators and focused on doubling the amount of electricity produced by renewables (IEA/IRENA). When EEG was amended in 2004, the tariffs were set to reflect generation costs of different renewable energies, installation size and year of commissioning, with remunerations being reduced annually to encourage further cost reductions (IEA/IRENA). The 2009 amendment adjusted tariff rates for different

renewable sources even further (IEA/IRENA). Subsequent amendments in 2012 and 2014 set ambitious future targets for increasing the percentage of total electricity production derived from renewables and expanding installation capacity of different sources (IEA/IRENA).

In addition to price-based regulation, some of Germany's financial incentives have also led to significant increases in renewable energy production and continue to remain in effect. For example, through Germany's preferential loans program, beginning in 1990, reduced interest loans were offered by both the German Kreditanstalt für Wiederaufbau (KfW) and the Deutsch Ausgleichsbank (DtA) for renewable energy installations (Jordan-Korte, 79). Between 1990 and 2005, more than EUR 10.7 billion was approved by the KfW and DtA (Jordan-Korte, 79). The funds were not only essential for developing and deploying renewable energies, but for supporting smaller renewable power generators as well (Jordan-Korte, 79). The institutions ultimately merged in 2003, with approximately EUR 500 million being offered annually from 2009 (Jordan-Korte, 80).

The United States also experienced success by offering financial incentives at the federal level. These financial incentives included production tax credits, investment tax credits, and renewable energy production incentives. Production and investment tax credits each help to finance renewable energy power projects. Specifically, production tax credits are served over time and are based on the amount of renewable energy generated, whereas investment tax credits are provided upfront to develop new renewable energy installations. Meanwhile, the renewable energy production incentives were payments made available for solar, wind, biomass, geothermal, tidal, wave and ocean energy. However, these payments

were subject to appropriations by the US Congress (Jordan-Korte, 85). In other words, each year, the REPI needs to be approved. From 2003 to 2006, the REPI was not authorized, and thus limited its impact on renewable energy production (Jordan-Korte, 85).

Where federal legislation was lacking, state legislation had successfully closed the gap with quantity-based policies. At the state level, renewable portfolio standards proved to be extremely successful. In most states, renewable portfolio standards have a minimum purchase requirement of renewables built into the policy framework, with many policies also establishing credit trading schemes for additional support (Jordan-Korte, 88). While renewable portfolio standards differ from state to state, with different targets, specified rates and qualifying renewables, quotas for utilities are similar in that they are typically set for 10-15 years (Jordan-Korte, 88-89). Still, many states continue to amend their portfolio standards, setting more ambitious, long-term goals as strides are made (IEA/IRENA; Jordan-Korte, 88). Furthermore, portfolio standards have helped to expand the distribution of renewable energy installations (Jordan-Korte, 88).

Based on the prioritization of policies in Germany and the United States, similarities and differences can be seen with respect to their approaches. Both countries made investments into research, development and deployment when renewable energy sources were first recognized as potential sources of electricity production in the ‘60s and ‘70s. However, since then, Germany has continued to implement top-down, price-based policies, whereas the United States has focused on multi-level, voluntary- and quantity-based policies. In addition, both nations have relied upon financial incentives to further and supplement efforts to expand renewable energy.

Rather than these different approaches, Jordan-Korte, argues that the emphasis on different goals, instead, may explain the significant difference between these countries (214). For example, she explains that while environmental benefits and energy security are both strong reasons for supporting renewables for either country, "the creation of new industrial opportunities by the countries and their political actors varies" (Jordan-Korte, 214). Jordan-Korte, explains that in Germany, economic benefits of renewables, coupled with a lack of significant industry opposition, has contributed to the nation's success (214). On the other hand, in the United States, interest in renewable energy has lacked until recent years, with energy security being the nation's primary concern (Jordan-Korte, 215). Consequently, the economic benefits of renewable energy production have gained minimal consideration in the United States (Jordan-Korte, 215). Rather, fossil fuel industries maintain significant influence over the energy discourse and the policies that are implemented. Unfortunately, renewable energy in the United States, was, and remains unable to overcome the political clout maintained by these interest groups (Jordan-Korte, 216).

While Jordan-Korte's argument enhances the understanding of policy decisions made by Germany and the United States, her explanation alone does not justify the increases in renewable energy production seen in 1998 and 2002 respectfully. Besides the policies themselves, historical, social, institutional and political developments may account for the differences seen between these countries.

In 1998, the governing coalition of Germany was the Social Democratic Party and Alliance '90/The Greens, which formed a red-green coalition for the first time. Under the

red-green coalition, a number of renewable energy policies were adopted. In fact, the Renewable Energy Sources Act (EEG) was amended and the preferential loan program was expanded under the governance of the red-green coalition. The red-green coalition was also responsible for the initial phase-out of nuclear power (1998), an ecological tax reform (1999), and the 100,000 Roofs Programme (1999) (IEA/IRENA; Richter, 28). The red-green coalition remained in power until 2005. Still, some of the ideals of the red-green coalition were shared by other parties, namely those where the environment is concerned. As such, even when the red-green coalition was replaced, Germany remained on a steady renewable energy production trajectory.

During its governance, the Social Democratic Democratic Party and Alliance '90/The Greens coalition also experienced external pressure from the European Parliament and the Council for the European Union. Specifically, the 2001 Directive supported Germany's efforts to meet its national target and the community target established via the Kyoto Protocol. When the red-green coalition was replaced, Germany continued to produce greater amounts of electricity from renewable energy as subsequent international directives were published.

In comparison, during the late '80s-early '90s in the United States, renewable energy production increased, around the same time that oil prices soared as a result of the Gulf War. The war offered an opportunity for the United States to continue expanding renewable energy production, especially with 1990 marking the twentieth anniversary of the first Earth Day. However, as oil prices dropped, investments in renewables lagged. Under the Clinton administration, further investments in renewable energy production

were difficult to achieve with a republican majority in both congressional houses. Consequently, renewable energy production remained static throughout the decade.

Renewable energy production in the United States did not begin to increase until approximately 2002, during the Bush administration. However, renewable energies were substantially disadvantaged during Bush's two terms as president. In a particularly extensive energy bill, the Energy Policy Act of 2005 (EPACT 2005), some provisions were made for renewable energies, but the bulk of the new energy plan involved heavily subsidizing the nuclear and oil industries. Under the Bush administration, the influence of the the fossil fuel industry blossomed, using its power to shape some policies while blocking others. With an administration unwilling to act in favor of the environment, individual states began to implement renewable portfolio standards; the mid-2000s, in fact, were characterized by significant increases in the number of states voluntarily implementing these standards.

Despite increases in renewable energy production across state lines, the United States continues to lag behind its German counterpart. Not only does the United States' approach to renewable energy policies leave the nation without a clear federal target, but the promotion of renewable energies remains minimal at the federal level as well. In addition, the legislative process and system of checks and balances has created challenges for expanding renewables. The legislative process also remains susceptible to strong interest group influences. Meanwhile, in Germany, clear targets are outlined, there are consistent investments in renewable energy infrastructure and amendments to policies to further incentivize action. The red-green coalition also successfully linked the economic

and environmental benefits of renewable energy promotion, thereby encouraging further investment into renewables (Jordan-Korte, 214).

Taken together, the factors that seems to influence renewable energy production are the policies that are implemented and the historical, social, institutional and political environments in which policies are created. Germany and the United States have each relied upon research, development and deployment and financial incentives. However, Germany's regulatory feed-in tariff policy, former red-green coalition and place in the European Union have worked to noticeably advance renewable energy production in the country from 1998 onward. The United States, on the other hand, has been set back due to political and institutional barriers and a lack of federal regulation. Still, increased state-level action has contributed to the slowly increasing production of renewable energy production from 2002 onward. Ultimately, these factors explain the difference in renewable energy production as a share of total electricity production in both countries.

Conclusion

This research study presents a comparison of renewable energy production in Germany and the United States. Data presenting renewable energy production as a percentage of total electricity output between 1966 and 2013 in both nations, including and excluding hydropower, demonstrated Germany's substantial lead over the United States. Based on this data, the aim of this study was to analyze renewable energy policies in historical, social, institutional and political contexts to determine their influences on renewable energy production and account for the difference between Germany and the United States.

Empirical analysis of Germany's renewable energy policies indicates that regulations were largely implemented through a top-down, price-based approach following German reunification. In particular, Germany implemented an Electricity Feed-in Law (EFL) that guaranteed grid access to renewable energy generators (IEA/IRENA). After operating for nearly decade, the feed-in law was replaced by Germany's Renewable Energy Sources Act in 2000, which continues to be amended to ensure efforts to expand renewables are sustained in the long-term. Germany also continually mandates new research, development and deployment programs and offers substantial financial support, including loan, grant and subsidy programs, for the renewable energy industry.

Empirical analysis of renewable energy policies in the United States indicates that legislation followed a largely voluntary and quantity-based approach. Although research, development and deployment programs and incentivized tax credit programs were

common policy instruments at the federal level, federal legislation was drastically limited in comparison to Germany. Rather than top-down regulations, the implementation of Renewable Portfolio Standards at the state level contributed to increased renewable energy production. Renewable portfolio standards are not required, so adoption of these standards remains voluntary. States, which recognize and consider the economic benefits of energy transitions more than the federal government, continue to improve their portfolio standards as goals are met.

Analysis of the historical, social and political conditions surrounding these policies also demonstrates the influences of these factors on renewable energy production. Historically, the energy crises of the 1970s prompted both nations to consider renewable energies. In Germany, nuclear energy failures – Three Mile Island, Chernobyl and Fukushima Daiichi – reinforced interest in renewables. Environmental concerns furthered public interest in pursuing renewable energy sources. Politically, the red-green coalition (1998-2005) advanced environmental legislation, with minimal resistance from stakeholders. Pressure from the European Parliament and Council of the European Union has also advanced Germany's production of renewable energy. Fortunately, the strength of Germany's Green Party is able to easily overcome resistance from stakeholders. In the United States, the Gulf War offered opportunities to expand the renewable energy industry. Environmental concerns, though strong in the 1970s, did not increase until much later. Meanwhile, a hostile political climate and strong opposition from interest groups in the United States in the late 20th century preempted environmental legislation well into the new millennium.

In conclusion, understanding the influence of policies in context will hopefully necessitate more effective renewable energy policies in the future. With rising concerns about global climate change, and its unforeseeable impacts, it is important that industrialized nations demonstrate global leadership and make substantial efforts to reduce carbon emissions. Doing so will become increasingly important in the coming years if the global community does not intend to exceed the 2.0°C benchmark. However, through effective national and international policies, the global community can create the prevailing, transformative solutions needed to address the concerns of this century. In an era of increasing technological development and profound pressure from the global community to reduce greenhouse gas emissions, however, the future has never been more promising.

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