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The Path for Renewables in the US:
Lessons from Europe

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Abstract

The United States is currently struggling to make progress in the renewable energy industry. Policy approaches in Denmark, Germany, and Spain were examined to determine factors that promote the use of renewables. Factors influencing energy policy were compared. From this analysis ten policy approaches for promoting renewable energy in the US were developed and assessed. The most practical of these include major investment in renewable technology and the rapid development of resources when economically feasible.

Exordium

> "We are like tenant farmers chopping down the fence around our house for fuel when we should be using Nature's inexhaustible sources of energy -- sun, wind, and tide. I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that."
>
> --Thomas Alva Edison, 1931

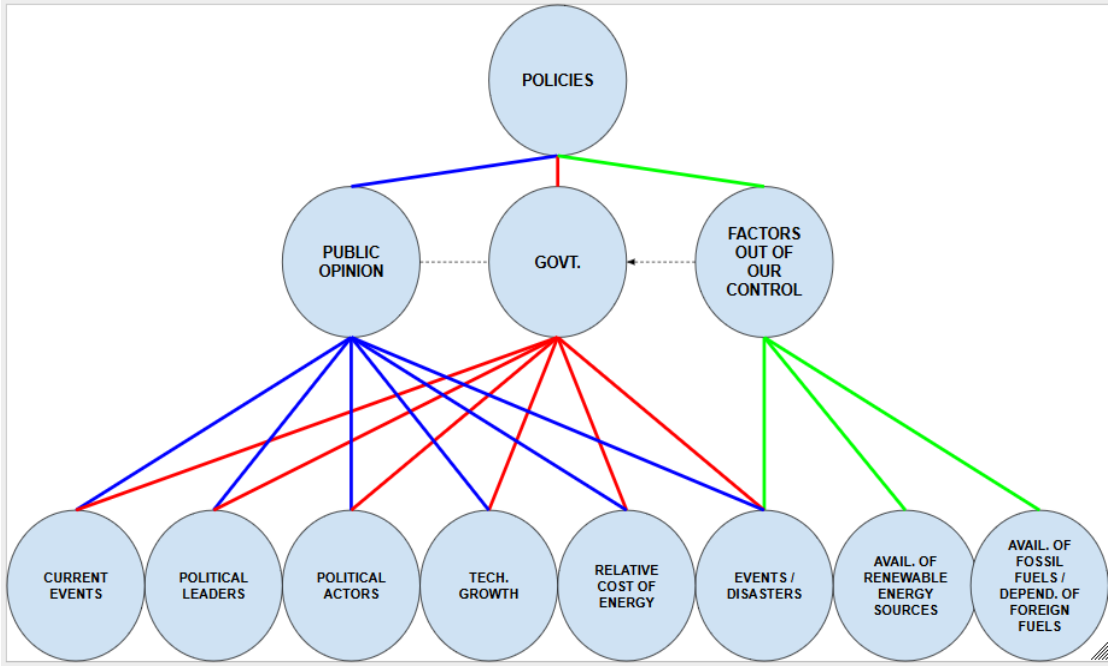
The world has never been more technologically advanced than it is right now. Almost every day, barriers previously thought to be unbreakable are shattered. So if that's the case, why does Edison's famous quote still stand true eighty-five years later? More specifically, why does his quote still pertain to the United States of America, one of the biggest, most powerful, and most influential countries in the entire world? What is happening in the U.S. that is causing such a great world power to move against the grain of renewable energy and what needs to happen for that atmosphere to change? Such a question cannot be answered directly.

In order to find ways to propel the country to the front of the renewable energy industry, one must first figure out what the country is actually doing wrong. However, to figure out those wrongdoings, the knowledge of what affects creation of policy in a country is required. Finally, in order to understand the way policy works, the country that is lacking has to be compared to other, more successful options. So in order to answer the gigantic question of what the United States can change to help it, an arduous three-step process is required.

The first part of the project required that a background of energy policy in the United States become known. After realizing the lack of such energy policy in the country, horizons were broadened and countries with energy policies were researched. The more apt countries were narrowed down to three, and the background of those countries were researched and compared to the United States. As a point of reference, certain states with better energy policy were looked at and were narrowed down to one state to contrast with the rest of the country.

Once backgrounds of all the countries were known, the question arose of what actually affects the creation of energy policy. In the second part of the project, several factors that affect energy policies were analyzed. A comparative policy analysis was performed to determine why certain policies were successful and others were not. It explains how different countries have similar policies, such as renewable portfolio standards, to promote the use of renewable energy but receive different results. An analysis on which factors most affect the progress of each country was important. A data analysis tree was created to give a visual interpretation of what affects policy. In that tree, three main factors were chosen to do research on, which were further broken down into a combination of eight sub-factors. For one main factor, data from polls taken in the past was analyzed to see what citizens think of renewable energy. The most recent polls were utilized. Trends in the data were noted and compared to the same data of the other countries. For the second main factor, technical data on the resources of each country was obtained and compared. Import and export data was closely analyzed to find trends explaining several factors in each country. R&D costs in the renewable energy industry in each country were compared. The relative costs of energies in each country were very closely analyzed along with the amount of money each country threw into its energy sector. A timeline of energy disasters along with important policy creation occasions was looked at. Geography and weather in each country was compared. For the final main factor, the political leaders of each country and their views were compared in relation to renewable energy. Some of the biggest names in the industry were also analyzed to see their effect on the market. Finally, current news stories were read as they happened and their possible effect on the industry was noted. Using the methods listed above, the eight sub-factors were researched and discussed in length. The three main factors were realized to somewhat affect each other, and the eight sub-factors were realized to affect multiple main factors. This is accurately represented in the data analysis tree below.

Figure 1: Policy Factor Tree



The research done in part two answered the questions about what affects policy. At this point, enough research had been done to compare the three European countries to the United States. The data already collected showed why certain policies are more effective in each country. In part three, the first two parts were analyzed and the biggest sources of problems in the U.S. were noted. From these problems, a list of possible solutions was created. These solutions were written about in length and then the possibility of each scenario happening was analyzed.

Part 1

Introduction

Humans live an unsustainable lifestyle. The rate at which fossil fuels are consumed is a breathtaking number; and unfortunately, that number is not going down. Actually, quite the opposite; the rate at which the world consumes fossil fuels is constantly rising. With new drilling technologies, the world has more oil to use than ever before. However, it won't last. At the current rate of consumption, scientists predict that the world will be out of oil and gas by 2060.[1] At that point, only coal would be left, which would extend that deadline to 2088. If the world is reduced to just using coal for power, it would be adding more greenhouse gases to the atmosphere than the world can handle. Coal is the 'dirtiest' fossil fuel, emitting almost twice as much carbon dioxide than natural gas.[2] Even if more fossil fuels are discovered that will extend that 2088 deadline, the world may reach a tipping point long before that. At one point in the Earth's lifetime, it was entirely covered in ice. A reduction in greenhouses gases in the atmosphere lowered the temperature of Earth slightly. This allowed the ice caps on the poles of the Earth to grow in size. Snow-covered ice is the most reflective, naturally occurring thing on the planet. Water, on the other hand, is one of the least reflective things. A short physics lesson will show that the less reflective something is, the more heat it retains, while the more reflective something is, the less heat it retains. Now imagine this on a large scale. As more ice covered the earth, it created what is called a positive feedback loop. The greater areas of snow-covered ice reflect more light, allowing the Earth to capture less vital light. This process continued until the earth was a giant snowball. Nowadays, with the amount of greenhouse gases that are being added to the atmosphere on a daily basis, this 'snowball earth' effect is going to happen again, except this time, in the opposite direction. The global temperature is slowly rising. The polar ice caps are slowly melting. With every inch that the ice caps shrink, it's less light that the earth can successfully reflect. The expanding oceans will capture more light and heat up the world. This process will eventually become self-sustaining, just as it was billions of years ago. This fate, however, can be stopped. The human race does not have to pump those chemicals into the atmosphere; there is another way.

Renewable energy is defined as "any naturally occurring, theoretically inexhaustible source of energy, as biomass, solar, wind, tidal, wave, and hydroelectric power that is not derived from fossil or nuclear fuel."[3] These types of energy are relatively new in comparison to

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[1] Ecotricity. "The End of Fossil Fuels." *Our Green Energy*. N.p., n.d. Web. 16 Oct. 2015.
[2] U.S. Energy Information Administration. "FREQUENTLY ASKED QUESTIONS." *EIA*. U.S. Department of Energy, n.d. Web. 16 Oct. 2015.
[3] "Renewable Energy." *Dictionary.com*. Dictionary.com, n.d. Web. 17 Oct. 2015.

fossil fuels. As with any new technology, newer usually means more expensive, and in this case, that theory rings true. With every day that passes, more people latch on to the idea of switching to renewable energies to save the planet. Unfortunately, this trend is not catching on fast enough. While individual people's ideas can change, it takes a lot more to influence a country to change. Renewable energy, being as costly as it is, is a nightmare for country's economies. The technology is good, but it's not perfect. Some countries just don't have the resources for it. In some cases, a company with a big enough influence over the market can sway millions to one side or the other. Countries all over the world are simply reluctant to switch. In order to get the traction that it needs, something needs to happen in the industry that will influence more than just a few people. Whether it is a scientific breakthrough, or one country that decides to step forward and lead the way, something needs to change. Thankfully, some countries are trying. Quite a few countries are trying to make ground. Success varies; some countries' renewable energy industries are exploding with growth, while others end in failure. There is no formula for why and how certain cases work and other ones don't. Can a formula be made? In order to test that question, the first step would be to compare successes and failures.

In Europe alone, there are several countries that have been very successful in the renewable energy industry. Three of them stand out among the rest. Denmark, Germany, and Spain have all had fantastic successes (and even some failures along the way) in the industry. Spain and Denmark have excelled at making wind energy play a big role in their everyday lives. Germany has made renewable energy policies which promote the use of solar power and reduce the use of oil and other non-renewable resources. While these three countries are making big changes to the field of clean energy, similar progress is hampered in the United States. There is currently no federal mandate for states to produce renewable energy. Most of the states have their own mandates for renewable energy production, but few of them are enforced.[4] The United States is desperately trying to advance in the field, but relative to those European countries, it is failing. Not all of the U.S. is failing, however. Currently, Hawaii is one of the places in the United States with ambitious renewable energy goals. A success within a bigger failure could shed some light on what the problem is.

Background

The United States is known as one of the world's most successful countries, so one would assume that it is a very progressive country when it comes to renewable energy. However, it isn't. So why not; what is the problem that the U.S. is having? Can progressive laws not get through Congress? Is the country in too much debt to worry about spending even more money?

[4] Institute for Energy Research, 1. "The Status of Renewable Electricity Mandates in the States." (n.d.): n. pag. Web. 1 Nov. 2015.

What about the energy companies; are they being greedy and resisting the change? Or is it simply the weather or the geography; does it not have enough renewable resources? Is it lacking the technologies needed to make any progress? Or does it simply just have too many resources to trifle with change at the moment? To answer those questions, not only will the U.S. be researched, but it will be compared to other countries that have more successful energy programs. By looking at success stories in places such as Germany, Denmark, and Spain, and comparing them to the U.S., maybe the problems will be revealed.

Germany is one of the most successful countries in the renewable energy industry, especially with solar energy. This is rather odd because Germany does not receive quite as much sunlight as other countries. The amount of sunlight it receives is comparable to Alaska, a state well-known for having nearly no daylight during the winter. By the end of 2012, Germany had about 30 gigawatts of solar capacity installed, which provided about 3 to 10% of the nation's electricity needs. For comparison, the United States had 6.4 gigawatts of solar capacity installed.[5] One of the reasons for Germany's success is because of its policy of feed-in tariffs, which offers a long-term contract to renewable energy producers in which they are paid a certain price for generating a certain amount of renewable energy. In 2011, however, the Fukushima nuclear disaster in Japan caused by a tsunami, prompted Germany to begin closing its nuclear plants for its own safety, planning to close all of them by 2022. This set the country back in its renewable energy goals because it currently needs to temporarily use more fossil fuels to make up for the lost energy from shutting down the nuclear plants. Despite this incident, Germany still plans to lead the world in solar technology.

Denmark is currently leading the world in wind power. With 28% of its electricity made by wind, no other country comes close; making Denmark "the world's Wind Power Hub."[6] How did Denmark start thriving in the wind energy field? Back in 1973, during the first big oil crisis, Denmark was devastated. At that point, Denmark made 92% of its electricity from imported oil.[7] If it didn't find other means of energy, it wouldn't last. The government proposed the idea of nuclear energy and the public was infuriated. Anti-nuclear groups proposed the idea for clean, sustainable energies. Certain citizens started making their own wind turbines, which caught on quickly. In 1979, when the second big oil crisis hit, Denmark was ready. The government joined the clean movement and in 1985, a program to subsidize the cost of 30 percent of wind, as well as other renewable energy resources was put into effect.[8] This, combined with the fixed feed-in

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[5] Plumer, Brad. "Germany Has Five times as Much Solar Power as the U.S. - despite Alaska Levels of Sun." *Washington Post*. The Washington Post, 8 Feb. 2013. Web. 12 Oct. 2015.

[6] Danish Wind Industry Association. "Wind Energy." *Denmark*. Danish Wind Industry Association, n.d. Web. 05 Oct. 2015.

[7] Think Global Green. "Denmark." *Denmark*. ThinkGlobalGreen, 2014. Web. 06 Oct. 2015.

[8] Roselund, Christian, and John Bernhardt. "Lessons Learned Along Europe's Road to Renewables." *IEEE Spectrum*. IEEE, 4 May 2015. Web. 06 Oct. 2015.

tariff[9] made in 1993, made the wind industry in Denmark explode with growth.[10] In 2001, when the clean energy industry was at a rather large size, the government cut the subsidies. This introduced a whole new level of competitiveness to the industry.[11] Technologies and quality advanced faster than ever before and prices dropped to all-time lows. Renewable energy in Denmark was booming.

Spain is one of the current leaders in wind and solar renewable energy since it has the second largest installed capacity for wind energy in Europe. As a country it has many companies that excel worldwide at power production from renewable energy. There are many reasons why Spain is one of the best cases of renewable energy success, which the United States could learn a lot from. One of these reasons is the Spanish energy companies, which also operate on an international level. Such companies help create innovative technologies for renewable energy and therefore play an even bigger role in society. Another important reason is how the Spanish government promotes the use of renewable energy with effective policies and mandates. With goals like replacing 20.8% of the gross final energy consumption with power from renewable energy by 2020, Spain is looking to achieve a status of 100% renewable energy by 2050 (excluding nuclear energy).

As mentioned previously, the United States has been slow in its transition to renewable energy resources. However, the United States has recently been increasing its use of renewable resources greatly. The wind capacity increased by about 28% and solar capacity increased by about 83% in 2012 from the previous year.[12] The United States actually ranks rather high in the total amount of solar[13] and wind[14] capacity installed, but given the high population of the country compared to European countries, the amount of renewable power per capita in the United States is much lower than the other countries.

Although the United States as a whole is not up to par, one of its states is making huge advances in the renewable industry. Hawaii is the only state that has a proactive renewable energy goal and already has a great head start on it. In the same sort of situation as Denmark,

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[9] A fixed feed-in tariff a flat rate price for electricity that is usually higher than the price of fossil fuels, while being lower than the price of a renewable source. This makes it just as easy to invest in clean energy as it is to invest in fossil fuels.

[10] ENVIRONMENTAL DEFENSE FUND ENERGY EXCHANGE BLOG. "Blown Away by Wind Power in Denmark, a Model for Clean Energy."*Breaking Energy*. Breaking Media, 14 Aug. 2014. Web. 06 Oct. 2015.

[11] Ministry of Foreign Affairs of Denmark. "The Danish Clean-tech Sector, SUNMARK." *Denmark*. Ministry of Foreign Affairs of Denmark, n.d. Web. 06 Oct. 2015.

[12] Gelman, Rachel. "2010 Renewable Energy Data Book." Ed. Mike Meshek. (2013): 18. National Renewable Energy Laboratory, Oct. 2013. Web. 12 Oct. 2015. <http://www.nrel.gov/docs/fy14osti/60197.pdf>.

[13] Shahan, Zachary. "Top Solar Power Countries Per Capita & Per GDP (CleanTechnica Exclusive)." Web log post. *CleanTechnica*. N.p., 26 June 2013. Web. 12 Oct. 2015.

[14] Shahan, Zachary. "Top Wind Power Countries Per Capita (CleanTechnica Exclusive)." Web log post. *CleanTechnica*. N.p., 20 June 2013. Web. 12 Oct. 2015.

Hawaii imports all the fossil fuels it uses. This causes a strain on the economy in the state when prices spike. It is also the reason that Hawaii has the highest cost electricity in the country.[15]

These five very different places have varying successes in the renewable energy industry. What is the cause of that variation? Why are the energy policies in Germany, Denmark, Spain and Hawaii more successful? What is the United States doing incorrectly? Is it simply the different pasts of each location, or is there a hidden underlying factor that makes all the difference? Is it possible to find this factor that will increase renewable energy production (e.g. wind, solar) in the United States to ensure a cleaner future?

Goals

The goal of this project is to analyze how and why Germany, Denmark, Spain, and Hawaii have very successful policies in promoting renewable energy sources and to find a way to adapt the successful policies to the Continental United States. U.S. policies will also be analyzed to explain why they are not as successful. The project will observe how factors such as government structure and economy affect the effectiveness of the policies. Energy companies and advances in technology will be important to look at to see how the efficiency of renewable power will increase over time and become more viable.

The project will give background knowledge and some history on the government, policies and mandates, economy, energy companies, technology, weather, geography, and energy resources of Germany, Denmark, Spain, and the United States. These topics are important to understand in order to make the first steps towards analyzing success in the renewable energy industry. The completion of this analysis will help create solutions for the United States.

Government

The first step in analyzing these different countries is to figure out what type of government each has. Different governments, whether a monarchy or a democracy, affect the processes of passing laws, how the political parties work, and how decisions are made about the country. Politics play a big role in renewable energy. Politicians have the power to economically support renewable energy by providing incentives to invest in energy with grants, loans, and tax credits. Providing national energy security by making sure that energy fuels are always available will keep the public safe and happy. Knowing how a country's government runs is essential in knowing the reasons why it makes decisions.[16]

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[15] U.S. Energy Information Administration. "U.S. Energy Information Administration - EIA - Independent Statistics and Analysis." *EIA*. U.S. Department of Energy, Aug. 2015. Web. 10 Oct. 2015.

[16] *Central Intelligence Agency*. Central Intelligence Agency, n.d. Web. 17 Oct. 2015.

Germany

Germany is a democratic republic country with three branches of government. The legislative branch is made up of the Bundestag, the Parliament of Germany, and the Bundesrat, representing the state governments. The executive branch includes the Chancellor, the President, and the Cabinet. The Chancellor is the head of the government while the President directs political and social debates and deals with international laws and treaties. The Chancellor must send bills to the Bundesrat for comments and then to the Bundestag for debates in order to be passed as law.[17] The judicial branch has different types of courts to interpret the constitution and deal with court cases.

There are two large political parties in Germany, with one of them considered as two "sister" parties. The "sister" parties are the Christian Democratic Union (CDU) and the Christian Social Union (CSU), which share a common parliamentary group, but the difference is that the CSU represents the state of Bavaria while the CDU represents the rest of Germany. The second major political party is the Social Democratic Party (SPD). The current Chancellor, Angela Merkel, leads the CDU party. She proposed a policy after the Fukushima nuclear disaster that would shut down all of Germany's nuclear power plants by 2022, which was passed by Parliament. Each party's views on this policy can exhibit its views on clean energy. The CDU party supports the use of coal for power to substitute for the loss of nuclear energy, as long as the coal is of environmentally friendly technology. The SPD party is ambivalent about the use of coal. Members of the SPD party representing the coal-mining regions support the use of coal while other members do not support it. The SPD have also proposed to stop supporting the construction of new nuclear power plants, which would be ideal for the progression of solar and wind energy, but may cause blackouts if too much nuclear power is shut down too quickly. Both the CDU and the SPD are against the use of hazardous chemicals used in a method to extract natural gas called fracking. The SPD party generally favors economic growth and supports energy price regulations. A smaller party in coalition with SPD, The Greens, is against the use of coal because of the environmental effects it can cause. Members of The Greens are also against fracking to extract natural gas.[18] Although the parties may disagree about certain issues, they seem to generally agree that the future of clean energy use is important.

[17] "Passage of Legislation." *German Bundestag*. N.p., n.d. Web. 17 Oct. 2015.
[18] Newman, Nicholas, and Cornerstone. "German Federal Energy Policy: Party Platforms." *Cornerstone* (n.d.): n. pag. *CORNERSTONE MAG*. Web. 16 Oct. 2015.

Denmark

The country of Denmark is a constitutional monarchy. The role of king/queen has to sign all acts in addition to a cabinet member, so the monarch cannot make decisions alone.[19] In short, the prime minister is the head of government, while the monarch is the head of state. Additionally, the monarch chooses the new prime minister once they have deliberated with the new parliament after legislative elections. Most of the time, the prime minister is chosen from the party with the most backing in parliament. Denmark has eight main political parties. Since 1909, no one party has held the majority of parliament. Favorably for renewable energy, much political support rests on the premise that building onshore wind is cost competitive with any other energy type, and wind has the bonus of being perpetual.[20] With not many parties against renewable energy in Denmark, getting pro-clean-energy policies to pass is much easier than it is in other countries.

Spain

The Spanish government type is parliamentary monarchy. The monarchy is hereditary; following elections, the leader of the majority party usually proposed by as president by the monarch and indirectly elected by National Assembly. There are approximately 15 political parties, with PP (People's Party), a conservative party, leading.[21] The two major green parties are EQUO and ICV. EQUO promotes green jobs (employment created through the overhaul of the Spanish energy sector, the development of greener transport systems, etc.). It also advocates a change of model that would allow Spain to reach a stage of 100% renewable energy in 2050. Moreover it rejects nuclear energy (supports a nuclear phase-out in Spain).[22]

United States

The United States government is similar to Germany's government; it is a republic with three branches of government. The legislative branch is the Congress, which includes the House of Representatives and the Senate, who are responsible for making laws. The President and the Cabinet make up the executive branch. The President is the head of the state and government, deals with international treaties, and signs or vetoes laws passed by Congress. Congress can override vetoes if the majority votes for it. The judicial branch is made of the Supreme Court and other smaller courts to interpret the constitution.

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[19] Ministry of Foreign Affairs of Denmark. "Tasks & Duties." *The Official Website of Denmark*. Denmark, n.d. Web. 11 Oct. 2015.
[20] Danish Wind Industry Association. "Wind Energy."
[21] *Central Intelligence Agency*. Central Intelligence Agency, n.d. Web. 17 Oct. 2015.
[22] "EQUO." *European Greens*. N.p., n.d. Web. 17 Oct. 2015.

The Democratic and the Republican parties are the two largest parties in the United States. The Democrats seem to support the move toward clean energy. They aim to reduce the amount of foreign oil that the United States imports, promote the use of natural gas in transportation, increase energy efficiency and conservation in public buildings and private homes, and provide tax credits for private investment in clean energy.[23] The Republicans are mostly concerned about the economy and the current energy needs. Instead of promoting one source of energy, they want the public to choose their own source of energy, based on their preferences. They are encouraging the use of domestic sources of energy to avoid foreign reliance on energy and to create more jobs in the energy industry. The Republicans also support construction of more coal and nuclear power plants because of the need for the energy they provide.[24] These different political party platforms affect how the United States promote renewable energy.

Hawaii

Being part of the United States, Hawaii's government does not differ. Its current governor is part of the Democratic Party, which is the party more proactive towards clean energy. In addition to the governor, both of the senators as well as both of the representatives are democrats. This means that the left-leaning Hawaii faces very little opposition from the right when making decisions on the state level. Less opposition allows for laws and mandates to get passed at a higher percentage. Just because the United States as a whole does not have a federal mandate for renewable energies; that doesn't stop Hawaii from making its own. In the U.S., states can make their own mandates as long as they don't directly contradict the constitution or federal law. This is currently one of the only ways for laws or mandates concerning renewable energies to get passed. The Senate as well as the House of Representatives both lean to the right. Many Republicans currently don't believe that global warming or fossil fuels are an issue, so passing renewable energy mandates at a federal level is nigh impossible. State mandates are currently much easier to pass.

Policies and Mandates

The different policies a country makes towards renewable energy has a big role in determining the effort the country will put forth in reaching its goal. Some countries have policies that have aggressive goals that may be reached quickly, showing the dedication they

[23] "The 2012 Democratic Platform." *Democrats*. Democrats, n.d. Web. 12 Oct. 2015.
[24] GOP. "America's Natural Resources." *GOP*. GOP, n.d. Web. 12 Oct. 2015.

have in promoting renewable energy, while other countries have smaller goals, showing that they do not promote renewable energy as much.

Germany

Germany has had multiple major national policies that encouraged the use of renewable energy. In 1991, the Electricity Feed-in Act, or Stromeinspeisungsgesetz, was passed, which set the feed-in tariff rate to be at least 90% of the "average revenue per kilowatt-hour from the delivery of electricity by electricity utilities to all final consumers"[14] for electricity from solar and wind energy. It also required electricity utilities to accept and pay for electricity fed into the grid.[25] In 2000, the Renewable Energy Act replaced the Electricity Feed-in Act. The feed-in tariffs were modified to be fixed for a 20 year period, with the amount depending on the yield of the renewable energy, and would decrease over time. The decrease in the feed-in tariffs encourages manufacturers to reduce technology and production costs and find more efficient products to use. The policy also implemented that the total amount of feed-in reimbursements would be evenly distributed among grid operators. This policy was amended in 2004, 2009, and 2014. In the 2004 amendment, the share of renewable energies in the total electricity supply was increased to be at least 12.5% by 2010 and at least 20% by 2020. In 2009, the feed-in tariff for onshore wind energy increased from 8.03 to 9.2 EUR cents per kWh for the first five years of operation and would decrease by 1% every year. Previously, the decrease was 2% per year. Tariffs for solar technology decreased, with the exact amount depending on the strength of the system. For up to 30kW, the rate was 43.01 EUR cents.[26] The policy was modified once again in 2014. It stated that new operators of renewable energy plants must market their electricity directly, whether it be independently or through a direct marketer. In addition, the renewable portfolio standard set higher goals for Germany to reach. It hopes to have 40-45% of its electricity to be from renewable energy by 2025. 55-60% of the electricity should be renewable by 2035 and 80% by 2050.[27]

Denmark

Denmark is one of those countries that sets a goal and reaches it way quicker than imagined. Mandates that it set in the past were steamrolled by its wind industry. With each goal, it reaches higher and higher. One of its current goals is to be completely independent from fossil fuels by 2050.[28] Considering its progress in already lowering its carbon footprint by a

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[25] "Germany Feed Law." *WIND-WORKS*. Trans. Paul Gipe. N.p., 1 Jan. 1991. Web. 12 Oct. 2015.
[26] IEA. "Global Renewable Energy." *IEA*. IEA, 2015. Web. 12 Oct. 2015.
[27] Ibid.
[28] Ministry of Foreign Affairs of Denmark. "Independent from Fossil Fuels by 2050." *The Official Website of Denmark*. Denmark, Sept. 2015. Web. 11 Oct. 2015.

considerable amount, this should not be hard. However, its success with this goal depends of its success with its other two mandates. It plans to produce 33% clean energy, as well as have 50%[29] of its electrical system fulfilled by wind power alone by 2020. It currently powers about 28% of its electrical grid from wind energy.[30] It may seem like it is far away from its goal, but it is actually much closer. At most times, Denmark doesn't even use half of the energy it produces. During some days, it exports most of its wind energy because its production exceeds its needs.

Spain

As far as energy policies in Spain are concerned, the biggest goal is to replace 20.8% of the gross final energy consumption with renewable energy by 2020. An increase of approximately 7% is expected from 2020 to 2030. Also, Spanish policies aim to cover 10% of transport fuel demand with renewable energy resources by 2020. There are more policies for 2020, such as meeting 40% of national electricity demand by power from renewable energy and a goal to reduce GHG (greenhouse gases), by 40% for 2030.[31] As mentioned before, green political parties are also working on renewable energy plans, in order to achieve a state of 100% renewable energy by 2050.

United States

Energy policies in the United States do not seem to put an emphasis on immediately converting to clean energy. The United States passed the Energy Policy Act in 2005, which has many statements and goals to try to either increase the use of clean energy or increase energy efficiency of the current energy sources. Some of these include: 7.5 billion gallons of biofuels must be mixed with gasoline by 2012, $200 million dollars will be funded for clean coal initiatives, $50 million in grants will be used for biomass resources, incentives for companies to drill for oil in the Gulf of Mexico, and tax reductions to encourage domestic energy efficiency and production. Following the 2005 policy was the Energy Independence and Security Act, also known as the Clean Energy Act of 2007. There were many statements and goals in this policy as well, such as: 36 billion gallons of biofuels must be mixed with gasoline by 2022, incandescent light bulbs must be replaced by more efficient light bulbs, incentives are provided for the use of hybrid automobiles, and grants to build energy efficient schools are included.[32] Currently, there is no national renewable portfolio standard; many states have their own goals regarding renewable energy.[33]

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[29] Discrepancy in percents is caused by Denmark exporting a big chunk of its renewable energy.
[30] Ministry of Foreign Affairs of Denmark. "Independent from Fossil Fuels by 2050."
[31] "Renewable Energy Plan 2011 - 2020." *IEA*. N.p., n.d. Web. 17 Oct. 2015.
[32] Robinson, Brandi. "History of Major Energy Policy Landmarks." *E-Education*. Pennsylvania State University, 2014. Web. 16 Oct. 2015.
[33] N.C. Clean Energy Technology Center. "Database of State Incentives for Renewables and Efficiency."

Hawaii

Currently having the most proactive renewable energy goals in the country, Hawaii is leading the United States in renewable energy. The progressive goal to be fossil fuel-free by 2045 is no small feat. It plans to power 100% of its electrical system by renewable energy[34] while also making a point of skipping the switch to natural gas as many other places are doing. Governor David Ige opposes the idea of transitioning to a fuel that has to still be imported.[35] Ige, as well as Representative Chris Lee, think that switching to natural gas in Hawaii won't be cheaper as most people think because of the whole new infrastructure that would have to be built. They believe that the focus should be on new technologies, not old ones.[36]

Economy

The economy of a certain country can affect decisions that a country makes about renewable energy. A successful economy may indicate that the government would be willing to invest more money into promoting renewable energy and technologies. An unsuccessful economy would mean that the government must spend less money on promoting renewable energy. The GDP, debt and the unemployment rate of each country will be examined to see how its policies could be affected.

Germany

Germany is an economically successful country, ranking 19th in the world based on GDP per capita based on current prices.[37] As of 2015, its GDP is $3.2 trillion, or nearly $40,000 per capita. Germany's debt is $2.2 trillion, averaging to about $27,500 per capita.[38] The unemployment rate in Germany averaged about 5.95% from 1950 to 2015, but dropped to 4.5% in August 2015, which was the lowest it has ever been since 1981.[39]

DSIRE.U.S.Department of Energy, 2015. Web. 28 Oct. 2015.

[34] Hawaii State Energy Office. "Hawaii State Energy Office." *Hawaii State Energy Office*. State of Hawaii, Aug. 2015. Web. 10 Oct. 2015.

[35] Page, Samantha. "Hawaii's Going 100 Percent Renewable, And It's Not Using Natural Gas As A 'Transition'." *Think Progress*. CENTER FOR AMERICAN PROGRESS ACTION FUND, 28 Aug. 2015. Web. 11 Oct. 2015.

[36] Ibid.

[37] Knoema. "GDP per Capita Ranking 2015 | Data and Charts." *Knoema*. N.p., 2015. Web. 12 Oct. 2015. <http://knoema.com/sijweyg/gdp-per-capita-ranking-2015-data-and-charts>.

[38] National Debt Clocks. "Germany National Debt Clock." *National Debt Clocks*. N.p., n.d. Web. 12 Oct. 2015. <http://www.nationaldebtclocks.org/debtclock/germany>.

[39] Taborda, Joana. "Germany Unemployment Rate." *Trading Economics*. N.p., 30 Sept. 2015. Web. 12 Oct. 2015. <http://www.tradingeconomics.com/germany/unemployment-rate>.

Denmark

Denmark is also in a good situation economically. It has the 22nd highest national debt with just under 600 billion dollars, which is much smaller than the other countries on this list. Its debt per capita, however, is just under $30,000. It has a gross domestic product of 340.8 billion dollars, which puts it 58th in the world. That may not seem that good compared to other countries, but its small population gives it a 30th highest ranking in GDP per capita with $44,300. A 53rd unemployment rate of 6.5% suggests that Denmark is just as, if not more stable economically than many other countries.

Spain

Spain's economy isn't doing so well. Its national debt is $2.278 trillion, which puts it in 10th place worldwide. Unemployment rate is pretty high, too, at 24.5% (172nd). Compared to the other 4 countries Spain is in the worst situation. Gross domestic product (GDP) is $1.566 trillion (17th) and $33,700 per capita (51st), which places the country pretty high in world rankings.[40]

United States

The United States is the 10th highest ranked country in the world based on GDP per capita and on current prices.[41] Its GDP is $17.4 trillion, or about $54,000 per capita as of 2015. Its debt is $18.2 trillion, which is about $57,000 per citizen.[42] The unemployment rate in the United States averaged about 5.83% from 1948 to 2015 and is currently at 5.10% in September 2015.[43]

Hawaii

As of 2014, Hawaii's GDP per capita was almost exactly the same as the national average. At $54,516 it fell $500 above the national average.[44] As a state, Hawaii has a debt of about ten thousand dollars per citizen, compared to the country as a whole, which has a debt of

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[40] *Central Intelligence Agency*. Central Intelligence Agency, n.d. Web. 17 Oct. 2015.
[41] Knoema. "GDP per Capita Ranking 2015 | Data and Charts." *Knoema*. N.p., 2015. Web. 12 Oct. 2015. <http://knoema.com/sijweyg/gdp-per-capita-ranking-2015-data-and-charts>.
[42] National Debt Clocks. "United States National Debt Clock." *National Debt Clocks*. N.p., n.d. Web. 12 Oct. 2015. <http://www.nationaldebtclocks.org/debtclock/unitedstates>.
[43] Ferreira, Joana. "United States Unemployment Rate." *Trading Economics*. N.p., 2 Oct. 2015. Web. 16 Oct. 2015. <http://www.tradingeconomics.com/united-states/unemployment-rate>.
[44] "Per Capita GDP by Year." *Data.Hawaii.gov*. N.p., 2014. Web. 2 Mar. 2016. <https://data.hawaii.gov/Economic-Development/Per-capita-GDP-by-Year/qnar-gix3>.

about sixty thousand dollars per citizen.[45] These numbers put the state at a much better place financially than any of the countries being compared.

Energy Companies

Energy companies, being the giants that they are, have a huge influence on the economy as well as the entire energy industry. Many big oil companies have revenues upwards of 400 billion dollars and are some of the biggest companies in the world, only second to banks.[46] This causes an oil company's decision to be worth a lot. It's a well-known stereotype that oil tycoons are greedy, and many of them fall into that category because they refuse to stop making money. How can renewable energy companies compete? A big factor in whether or not a company can thrive is the owner of the company. If the company is state-owned, it is more likely to comply with energy policies set by the state. If it is privately owned, it may or may not comply with energy policies, depending on which option will result in more money.

Germany

There are several major electric companies operating in Germany. E.ON is a private limited company and is the largest grid in Germany. This company is also one of the leading companies in renewable energy in the world. Vattenfall is a company that is owned by the Swedish state and provides about 13% of Germany's electricity. There was an incident with Vattenfall due to the Fukushima nuclear disaster, where two smaller companies owned by Vattenfall, Krümmel and Brunsbüttel, had to close their two nuclear power plants because of the policy set by Chancellor Merkel. The two companies filed suits with the Federal Constitutional Court of Germany because of their enormous losses.[47] This may lead to the companies not willing to comply with future policies that try to push renewable energy technology forward. EnBW is a company that has the state of Baden-Württemberg and the Oberschwäbischen Elektrzitätswerken, a municipal association of regional and local authorities, as the major shareholders, each with 46.75%.[48] Its goal is to have 40% of its energy renewable by 2020.[49]

[45]"U.S. National Debt Clock : Real Time." *U.S. National Debt Clock : Real Time*. N.p., 11 Oct. 2015. Web. 11 Oct. 2015.
[46] "Fortune 500." *Fortune*. Time, n.d. Web. 18 Oct. 2015.
[47] Vattenfall. "Germany." *Vattenfall*. N.p., 2 Oct. 2013. Web. 16 Oct. 2015.
[48] EnBW. "EWE and EnBW agree restructuring of their shareholdings." *EnBW*. N.p., 2015. Web. 16 Oct. 2015.
[49] EnBW. "Our strategy for the future: Energiewende. Safe. Hands On." *EnBW*. N.p., 2015. Web. 16 Oct. 2015.

Denmark

Being a relatively small country, Denmark doesn't need that many energy companies. One of the few big ones, DONG Energy, is a state-owned company. In other countries, being state-owned could be a blessing or a curse for the clean energy industry. In this case, since the government and the public of Denmark are both in support of renewable energy, DONG Energy has very little trouble in making a switch towards a clean future. It is making strong goals for the year 2020 of things such as quadrupling its offshore wind capacity and doubling its share of biomass at Danish power stations.[50]

Spain

Spain has many energy companies. The biggest one is Iberdrola, being a world leader in wind power and also one of the top electric utilities company. Besides operating in Spain, it has acquired an international reference position, becoming one of the leading operators in the UK, one of the largest producers of wind energy in the U.S.A. and the main private generator in Mexico.[51] Another company giant is Enel Green Power (owned by Endesa and Enel Group). This company is fully dedicated to the development and management of renewable energy sources at both the international and national level, with operations in Europe, the Americas and Africa. It generated 31.8 TW/h by harvesting wind, solar, as well as geothermal energy, enough to meet the needs of more than 10 million households. Also, the emission of approximately 16 million tons of CO2 in the atmosphere was avoided. Enel Green Power has an installed capacity of 9.6 GW and has produced 731 plants (wind, solar, hydro and geothermal) in 15 countries.[52]

United States

There are many different energy companies in the United States due to the amount of power that is needed for a population of over 300 million people. National Grid is the largest company in the Northeast, providing service to Massachusetts, New York, and Rhode Island. It is an investor owned company and a public limited company. National Grid operates 50 fossil fuel power stations in New York and generates 4.6 megawatts of solar capacity in Massachusetts. A solar cost adjustment factor is added to the electricity rates of those who purchase solar power from National Grid.[53] The Pacific Gas and Electric Company is one of the largest natural gas and electric utilities operating in California. The company is owned by Pacific Gas and Electric Corporation, which is investor owned, and is regulated by the California Public Utilities

[50] DONG Energy. "Our Vision and Values." DONG Energy. Denmark, 2012. Web. 11 Oct. 2015.
[51] "Iberdrola." *About Us.* N.p., 2015. Web. 17 Oct. 2015.
[52] "About Us." - *Enel Green Power*. N.p., n.d. Web. 17 Oct. 2015.
[53] National Grid. "Electricity." *National Grid*. N.p., n.d. Web. 12 Oct. 2015.

Commission.[54] Another major energy company is NextEra Energy, which operates in 27 states and Canada. It is one of the leading companies in clean energy and is investor owned.[55] Duke Energy is the largest electric company in the United States, providing power to the Carolinas, Florida, and the Midwest. Duke Energy is a Fortune 250 company traded on the New York Stock Exchange, shared by private and institutional investors. It has 6 nuclear plants in the Carolinas and 16 coal plants, 10 oil and natural gas plants, and 18 small hydro plants scattered around the Carolinas, Florida, Indiana, Ohio, and Kentucky.[56]

Hawaii

Normally, electric companies are reluctant to switch to renewable energies because of the cost. Hawaii is a different story. There is only one big electric company in the state, Hawaiian Electric, and it is very ready for change. Since all the oil in the state is imported, a switch to clean energy isn't a big change in price. The company's current goals are to have greater than 65% of its energy from renewables, and to nearly triple the amount of distributed solar.[57]

Currently, a big energy company by the name of NextEra Energy is merging with Hawaiian Electric Company and is also fully committed to Hawaii's goal of 100% clean energy by 2045.[58] NextEra Energy produces 20% of its current energy from natural gas[59], so Hawaii wants to make sure that there will be no switch to the transitional fuel.

Technology

A single technological breakthrough can change history forever. Advances in technology can greatly reduce the price of renewable energy or increase the efficiency of collecting renewable energy resources. Fantastic new technology, however, doesn't make itself. Innovative companies are needed to make inventions that will shape the energy industry. In some countries, strict governments or bad economies affect how many of these companies exist. If there is no money in the industry, no one will want to build technology for it.

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[54] Pacific Gas and Electric Company. "Company Profile." *Pacific Gas and Electric Company*. N.p., 2015. Web. 18 Oct. 2015.
[55] NextEra Energy. "Our Company." *NextEra Energy, Inc.* N.p., n.d. Web. 18 Oct. 2015.
[56] Duke Energy. "Regulated Utilities." *Duke Energy*. N.p., n.d. Web. 16 Oct. 2015.
[57] Hawaiian Electric Company. "Clean Energy for Hawaii." *Hawaiian Electric*. Hawaiian Electric Company, 8 June 2015. Web. 11 Oct. 2015.
[58] NextEra Energy Resources. "NextEra Energy and Hawaiian Electric Merge for Clean Energy." *For Hawaii's Future*. NextEra Energy & Hawaiian Electric Industries, Sept. 2015. Web. 11 Oct. 2015.
[59] NextEra Energy Resources. "Fossil Fuels." *Fossil Fuels*. NextEra Energy Resources, LLC., 2015. Web. 11 Oct. 2015.

Germany

Nearly all of Germany's solar power comes from photovoltaic systems installed on the rooftops of homes. These systems are usually made of silicon with added impurities because it is a semiconductor that can absorb radiation at wavelengths in the visible light spectrum, allowing it to collect energy from the sun and convert it to electric energy. Silicon is not the most efficient material to absorb sunlight, but it is very common and cheap.[60] A small amount of solar energy comes from solar farms, with the largest one being the Erlasee Solar Park.

Recently in 2014, a German architect, André Broessel, invented a new device called the Beta.ray. The Beta.ray is a glass sphere filled with water that acts as a lens to concentrate sunlight by up to 10,000 times. This device uses a dual-axis tracking system that allows it to monitor the position of the sun and adjust itself to maximize the amount of energy it receives. Unlike the current photovoltaic systems, the Beta.ray can also be used on cloudy days. Broessel estimated that the Beta.ray would improve solar power efficiency by 50% annually.[61] Although this technology is new, it shows very high potential for the future of Germany because the general public of Germany is familiar with the technology and supports it.

Denmark

What technology does Denmark have that gives it an advantage over other countries? Denmark is far ahead of other countries in its technology pertaining to wind energy. "The industry has developed through innovative thinking and experience which has helped create core competencies in production, design and installation of wind turbines that are sought after worldwide."[62] For example, Liftra is a Danish company that has revolutionized the wind industry. Inventing several technologies that turned how turbines can be installed from a difficult process into an easy one, Liftra is even exporting some of its technology for the U.S. to use. Another Danish company, SSP Technologies, makes turbines bigger, lighter, and more efficient.

Spain

Renewable energy technologies are very advanced in Spain. The company SENER completed Andasol 1 and Andasol 2 in 2009, the first parabolic trough plants in Europe, a 50 MW system outside Granada. The technology is based on a series of parabolic-shaped, curved mirrors. Both of them are latest-technology plants, as they can either transfer the energy or store it for later use. They can operate 24 hours a day and improve production costs as well as

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[60] Mayer, Marie. "Why Are Solar Cells Made of Silicon?" Web log post. *Berkeley Energy & Resources Collaborative*. N.p., 14 Feb. 2012. Web. 12 Oct. 2015.

[61] Nguyen, Tuan. "This Orb-Shaped Solar Power Device Works On The Cloudiest Days." *Smithsonian*. N.p., 8 Jan. 2014. Web. 16 Oct. 2015.

[62] Danish Wind Industry Association. "Wind Energy."

personnel productivity costs for maintenance and operation. Many more plants like that were in development.[63] By 2014 another company, named Abengoa Solar, owned and operated 9 of those parabolic trough plants and 5 PV (photovoltaic) plants. This adds up to a total capacity of 492 MW. The Solucar Complex is a unique technological center, the only one in the world which gathers together 3 types of solar technology (tower, parabolic trough and PV) in commercial operation. It provides clean electricity (from solar power) to approximately 94,000 households, while eliminating 114,000 tons of CO2 emissions each year. The complex covers 2,471 acres and contains 7 commercial plants (183 MW total capacity) and 3 parabolic trough plants (150 MW total capacity). [64]

United States

Solar power in the United States is mostly generated by photovoltaic systems installed on rooftops. These systems are also used in large solar farms located in California. One of the largest farms in the world is Solar Star, which has a 579 megawatt capacity from approximately 1.7 million solar panels.[65] Some of the solar power generated by the United States also comes from solar power plants that convert solar power to electricity by using concentrated solar power (CSP). This method uses mirrors and lenses to focus a large amount of sunlight to a smaller area and then using the heat generated to power a generator to make electricity. Another form of technology that functions similar to CSP is the concentrator photovoltaic (CPV). This technology also uses mirrors and lenses to focus sunlight to a smaller area, but does not use the heat from the sun for power. Instead, the energy is directly converted to electric energy by the photovoltaic effect, similar to photovoltaic panels.

Wind turbines have been growing taller and larger in the United States. The height of the turbine's central rotor hub has increased by about 50% since 1999, up to 82.7 meters. The diameter of the rotor increased to 99.4 meters in 2014, which is an increase of over 100% since 1999.[66] Larger wind turbines allow more wind energy to be captured and more electricity to be generated from larger rotors. There are many wind farms operating in the United States. Currently, the largest wind farm in the nation is located in California, called the Alta Wind Energy Center. It supplies 1,548 megawatts of energy to customers in Southern California and plans to increase this amount in the future.[67]

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[63] "SENER - Power and Process Projects." *SENER - Power and Process Projects*. N.p., n.d. Web. 17 Oct. 2015.
[64] "Abengoa Solar." *Abengoa Solar*. N.p., 2014. Web.
[65] Wesoff, Eric. "Solar Star, Largest PV Power Plant in the World, Now Operational." Web log post. *Greentech Media*. N.p., 26 June 2015. Web. 14 Oct. 2015.
[66] Mooney, Chris. "The U.S. Wind Energy Boom Couldn't Be Coming at a Better Time." *Washington Post*. The Washington Post, 10 Aug. 2015. Web. 17 Oct. 2015.
[67] California Energy Commision. "ALTA WIND FARM POWERS HOMES." *California Energy Commision*. N.p., 2015. Web. 17 Oct. 2015.

Hawaii

If Hawaii is going to make a complete switch to renewable energy, it needs to find a way to make it cost effective and efficient. At the Hawaii Natural Energy Institute, that is the goal. Currently researching many new technologies in clean energy fields, it hopes to make progress that will help Hawaii surge to the forefront of the industry.[68] Additionally, many companies are testing different types of wave energy in Hawaii to see if it is a practical resource.[69]

Weather

Solar panels cannot work without sunlight and wind turbines cannot work without wind, so weather is very important in deducing if a country can build these renewable energy systems. If a country has mostly overcast weather, then maybe solar energy might not be a good idea; and if it isn't habitually windy, wind energy isn't viable either.

Germany

Germany has rather warm summer days that can reach up to 80°F and cold winter days that often drop below 32°F.[70] The city of Berlin receives an average of 205 rainy days and 49 snowy days per year.[71] The country is cloudy all year, meaning that solar energy is not ideal, although Germany still manages to have the most amount of installed solar capacity in the world. The northern half of Germany also receives a good amount of wind that is able to be used.

Denmark

The climate of Denmark brings mild summer months and very cold winter months. This causes the energy needed for heating to spike in the winter. It also rains a large portion of the year in Denmark[72], making solar energy difficult to produce efficiently. However, the amount of wind that Denmark receives makes wind a very viable resource.

Spain

Spain has a warm climate. The average temperature is fairly high throughout the year with clear, hot summers, more moderate along the coast and cloudy, cold winters. Bad weather

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[68] Hawaii Natural Energy Institute. "Hawaii Natural Energy Institute | Renewable Technologies." Renewable Technologies. Hawaii Natural Energy Institute, n.d. Web. 12 Oct. 2015.
[69] AENews. "AMERICA'S PREMIERE WAVE POWER FARM SETS SAIL." *ALTERNATIVE ENERGY*. N.p., 14 Mar. 2015. Web. 11 Oct. 2015.
[70] Amondson, Birge. "How Is the Weather in Germany?" *About.com Travel*. N.p., 2015. Web. 16 Oct. 2015.
[71] Weatherbase. "Berlin, Germany." *Weatherbase*. N.p., 2015. Web. 12 Oct. 2015.
[72] Weather Online. "Denmark." *Climate of the World*. Weather Online, n.d. Web. 12 Oct. 2015.

makes it difficult for the production, mostly for solar, as well as the transportation of energy.[73] The company REE (Red Electrica de España) has made a new interconnection with France in order to supply energy from renewable resources. Weather plays a major role for the success of this relationship with France, because it is one of the factors that affect the demand for energy.[74]

United States

The United States, being so large, has varying weather, depending on the location. The northeast and the southeast receive quite a bit of rain. Boston, Massachusetts receives an average of 43.8 inches of precipitation annually. It has about 126 days of precipitation. Miami, Florida has 135 days of precipitation per year with 61.9 inches of precipitation. The southwest receives much more sunlight than the rest of the nation. Phoenix, Arizona only has 30 days of precipitation, giving about 8.2 inches of precipitation annually.[75] For the United States, success with solar and wind energy depend on the location. While many states will be able to use those energy sources, some will not.

Hawaii

Hawaii's warm climate makes the energy need slightly less than it is in other places. With an average temperature around 83ºF for the whole year, and with the temperature only dropping approximately 10ºF at nighttime[76], there isn't much need for heating. Rain is localized in Hawaii; it rarely ever rains over the whole state at once.[77] This is good for solar energy, allowing almost year round sun power with most of the islands being sunny at any one time. Most of the rainstorms occur in the mountains and valleys, where it would be hard to put solar power in the first place. The state also has trade winds that are almost always blowing. Sometimes, however, they will switch direction and bring storms.[78] Wind power in Hawaii could be almost constant year round, save for a few times of different direction wind.

Geography

A country's geography affects the type and amount of renewable energy that it can produce. The location of a country on the earth affects how many hours of sunlight it gets, as

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[73] *Central Intelligence Agency*. Central Intelligence Agency, n.d. Web. 17 Oct. 2015
[74] "Red21." *Integration of Renewables*. N.p., 2014. Web. 17 Oct. 2015.
[75] "Average Annual Precipitation by City in the United States." *Current Results*. N.p., n.d. Web. 16 Oct. 2015.
[76] Hawaiian Tourism Authority. "Hawaii Weather." *Hawaiian Islands*. Hawaiian Tourism Authority, n.d. Web. 12 Oct. 2015.
[77] Ibid.
[78] Ibid.

well as what angle the sun is in its sky, drastically changing how efficient solar energy can be. Location affects other energies as well. If a country is in a desert, it isn't going to have much fuel if it decides to burn biomass. The same situation applies if a country decides to build geothermal plants without any geothermal activity near it.

Germany

The geography of Germany affects its weather and renewable energy resources. Most of the northern half of Germany is part of the Northern European Plain, meaning there is a large amount of flat land. This is ideal for wind farms because these areas get a lot of wind. Central Germany is hilly and mountainous countryside. Southern Germany is more mountainous, containing the Franconian and Swabian Alps. These areas do not get as much accessible wind, and therefore, are not ideal for wind farms. There are forests in the southern half, such as the Black Forest, Bohemian Forest, and the Bavarian Forest. These areas have wind potential, but the challenge is finding a way to obtain it. In total, Germany has about 350,000 km^2 of land available containing potential wind resources.[79] Most of the land available is agricultural areas or forests. The solar resources mostly depend on the location of the country relative to the equator. The northern half of Germany receives approximately 1000-1100 kWh/m^2 annually. The majority of the southern half receives approximately 1200 kWh/m^2 annually.[80] Solar resources are certainly not too high, but Germany's policies allow them to use these resources more efficiently than many other countries, which is why it is a leading country in renewable energy.

Denmark

Denmark being located in northern Europe means that it gets fewer daylight hours than much of the world.[81] This hurts the solar power industry, lowering the amount of energy that can be produced. However, Denmark being an archipelago, there is water everywhere. This makes offshore wind easy to make, considering the coasts are so windy. Denmark is also relatively flat, made of rolling plains[82], so any on-land energy source wouldn't be difficult to place anywhere on the country.

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[79] European Environment Agency's European Topic Centre. *Europe's Onshore and Offshore Wind Energy Potential*. Rep. no. 6/2009. European Environmental Agency, 2009. Web. 12 Oct. 2015. <https://www.energy.eu/publications/a07.pdf>.

[80] SolarGIS. "Free Download of Solar Radiation Maps:Global Horizontal Irradiation (GHI)." *SolarGIS*. N.p., 2015. Web. 16 Oct. 2015. <http://solargis.info/doc/free-solar-radiation-maps-GHI>.

[81] Visit Denmark. "The Weather in Denmark." *VisitDenmark*. VisitDenmark, n.d. Web. 12 Oct. 2015.

[82] Central Intelligence Agency. "Denmark Geography." *World Atlas*. World Atlas, 12 Aug. 2015. Web. 12 Oct. 2015.

Spain

Spain comes 52nd in size worldwide (505,370 sq. km), reaching almost 5 times the size of the state of Kentucky. As a country it has large flat terrains surrounded by rugged hills. Portugal is one of Spain's neighbors, bordering at the southwestern part, and France is the other, having the Pyrenees Mountains separating them in the north.[83] This has not been a problem, since Spanish energy companies have made interconnections with France for exporting reasons, meaning that Spain's geography allows the transportation of energy without problems. Although Spain is one of the leaders in renewable energy capacity and production it has quite a few pollution problems. Other problems include deforestation and air pollution, usually in large cities.

United States

The United States receives a wide range of wind and solar resources due to the various physical features found around the country. The southwestern states, including Southern California, Arizona, and New Mexico, contain quite a bit of desert land. They receive the most sunlight, with up to 2300 kWh/m^2 annually. The northeastern states, including Maine, New Hampshire, Vermont, and New York, receive the least amount of sunlight with approximately 1200 kWh/m^2 annually.[84] The coast of New England, however, is ideal for wind technology because 80-100% of the land is exposed to wind. The Midwestern United States, from North Dakota down to northern Texas, contains the Great Plains. These lands also have nearly all of the land exposed to wind. The mountainous regions, including the Rocky Mountains in the western third of the country and the Appalachian Mountains in the east, and the Southeastern states, including Virginia down to Florida and East Texas, only have 0-20% of the land exposed to wind.[85] The amount of renewable resources in the United States is very high, especially considering how large the country is, however, a very low percentage of these resources are used.

Hawaii

The most important part of Hawaii's geography is the fact that it is made up of dormant and active volcanoes. This means that this island state has a head start on geothermal power; it's literally right under Hawaii's feet. The archipelago feature, like Denmark, also helps the state

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[83] *Central Intelligence Agency*. Central Intelligence Agency, n.d. Web. 17 Oct. 2015

[84] SolarGIS. "Free Download of Solar Radiation Maps:Global Horizontal Irradiation (GHI)." *SolarGIS*. N.p., 2015. Web. 16 Oct. 2015. <http://solargis.info/doc/free-solar-radiation-maps-GHI>.

[85] Sikora, Aaron M., Steven T. Ruo, and Jonathan W. Naumowicz. *The Upcoming Energy Crisis. WPI*. WPI, 29 Apr. 2003. Web. 6 Oct. 2015.

build offshore wind resources. Hawaii is made up of eight big islands and 124 small islands.[86] All of the islands are mountainous, making building clean energy sources slightly more difficult.

Resources

A country's willingness to switch to clean energy depends on the resources it has. A country that owns a lot of resources will be less inclined to stop using them, while a country that has to import most of its resources will be more than willing to find an alternative. Some countries struck gold with the amount of oil they have under their ground, while other countries have very little, or none at all.

Germany

Uses of nonrenewable resources are still very high for Germany due to the need for electricity and other power needs. As one of the highest energy consumers of Europe, Germany must continue to rely on resources such as oil and coal. Germany's consumption of petroleum has generally been decreasing over time, but it still consumed about 2.4 million barrels per day in 2013. The consumption level did slowly increase since 2011, most likely because of the policy influenced by the Fukushima disaster. It only produced about 160,000 barrels of petroleum per day, meaning that it must import a large amount of petroleum to meet its energy needs. A similar case is seen with natural gas in the fact that Germany consumed about 3037 billion cubic feet and produced only 524 billion cubic feet in 2011. It imported 3166 billion cubic feet and exported 622 billion cubic feet. Germany, however, has a large resource of coal, mining 210 million short tons while consuming 270 million short tons in 2013. Despite having one of the highest electricity consumption rates of 540 billion kWh in 2012, it was able to generate 585 billion kWh and export 67 billion kWh, making it the top exporting country of electricity in the world.[87]

Denmark

Unfortunately for Denmark, it doesn't really have its own fuels, causing it to import most or all the oil and gas that it has to burn for energy. This is one of the reasons that Denmark got into the renewable energy field in the first place. Since wind power is sporadic, sometimes it can generate more than the country can handle. One day in July, the turbines in the country generated 140% of what the country could use.[88] Its relative closeness to Germany, Sweden, and Norway

[86] NETSTATE. "Hawaii Geography." *NETSTATE*. NSTATE, n.d. Web. 12 Oct. 2015.
[87] EIA. "International." *EIA*. EIA, n.d. Web. 6 Oct. 2015. <http://www.eia.gov/beta/international/?fips=gm>.
[88] Nelsen, Arthur. "Wind Power Generates 140% of Denmark's Electricity Demand." *The Guardian*. Guardian News

allow it to export all of its extra energy to those countries. Germany and Norway stored that excess energy in hydropower, while Sweden used the energy. In times of low wind, those three countries can help Denmark out by importing the vital energy it needs.

Spain

As far as resources are concerned Spain is doing fairly well. Production, in most cases, is higher than consumption and therefore exports exceed imports. While that is the case with electricity and refined petroleum products, Spain imports all of its crude oil as well as almost all of its natural gas. During 2012 it ranked 20th in the world in carbon dioxide emissions from consumption energy, approximately 312 million Mt. This led to a turn towards renewable energy, as the government created policies addressing all the issues. Energy companies found a way to advance their business and in a few years renewable energy started playing an increasingly big role in society.[89]

United States

The United States has been one of the top consumers and generators of power from nonrenewable resources for many years. The production of petroleum in the United States generally decreased over time since 1980, but began to rise after 2005 partly because the Energy Policy Act had incentives for companies to drill for oil in the Gulf of Mexico. The consumption level of petroleum has remained somewhat constant for many years. In 2013, nearly 14 million barrels of petroleum were produced per day and nearly 19 million barrels were consumed per day. Another 9 million barrels were imported per day, which was the most in the world in 2013. The remaining amount was either exported or kept in reserve. The production of natural gas was slowly rising since 1980, but began to rise quicker after 2005, up to nearly 23 trillion cubic feet in 2011. About 24.5 trillion cubic feet of natural gas was consumed. The United States did end up importing 3.469 trillion cubic feet in 2011, which was the second highest rate in the world. Since 2005, coal consumption has generally been decreasing to 924 million short tons in 2013. The production rate of coal was 985 million short tons in 2013, which is more than the consumption rate, meaning that the United States did not import much coal, but did export quite a bit. The United States is also consistently one of the top producers and consumers of electricity, producing 4,048 billion kWh and consuming 3,832 billion kWh in 2012. It was also the top importer of electricity in 2012, importing 59 billion kWh.[90] The leftover electricity was either kept in reserve or exported.

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and Media Limited, 10 July 2015. Web. 12 Oct. 2015.

[89] *Central Intelligence Agency*. Central Intelligence Agency, n.d. Web. 17 Oct. 2015

[90] EIA. "International." *EIA*. EIA, n.d. Web. 6 Oct. 2015. <http://www.eia.gov/beta/international/?fips=gm>.

Hawaii

As mentioned before, Hawaii doesn't really have its own resources. It imports all of its fossil fuels, making the cost of electricity in the state around 33% higher than the next most expensive state. In 2013, 91% of the energy Hawaii used was from imported fuels.[91] This is one of the main causes of Hawaii wanting to become energy independent.

Conclusion

At the conclusion of part one, an adequate background of the three European countries, the U.S.A., and Hawaii in relation to the renewable energy industry was known. Denmark, Germany, and Spain, while slightly different, shared many similar aspects relating to clean energy. This allowed for speculation to be made and theories to be created about how energy policy is affected in each country. Hawaii, on the other hand, was very similar to the U.S. in aspects such as government and economy, but vastly different in aspects such as geography and weather. This meant that Hawaii would not be an accurate comparison to the United States when talking about renewable energy. At that point, it was decided that Hawaii was too much of an outlier compared to the continental 48 states and that it would not be researched in the next two parts. The data, however, will be left in part one as an example of a specific area of the country that is not following current trends and to show how the vast size of the country is more important than people think: as shown later in part three.

Literature Review

A previous IQP project, *U.S. Energy Goals and Policy,* has goals similar to this project. The goal of their project was to develop a plan to promote solar and wind energy technologies in order to reduce the use of fossil fuels in the United States. The project group analyzed and compared the environmental effects and the cost of different fossil fuels and renewable energy sources available in the United States. Surprisingly, they also looked at the successes of energy policies in Germany, Denmark, and Spain and analyzed why those policies have not been implemented in the United States yet. Using data on energy cost and consumption over time, they suggested an economic strategy that the United States should consider to promote renewable energy.[92] This project is a good beginning guide for our project. A similar analysis

[91] U.S. Energy Information Administration. "Hawaii." *EIA*. U.S. Department of Energy, 17 Sept. 15. Web. 12 Oct. 2015.

[92] Chan, Philip, Corey Christous, and Joseph L. Grollman. U.S. *ENERGY GOALS AND POLICY. WPI*. WPI, 6 Mar. 2007. Web. 17 Oct. 2015.

should be made on the cost and consumption of energy sources using more recent data to determine how the United States can economically promote renewable energy. Because a few states have begun to adopt the feed-in tariff policies of Germany, Denmark, and Spain, a thorough analysis on government, policies, energy companies, and technology is required to explain why every state has not adopted the successful policies of these countries yet.

A second IQP project, *The Upcoming Energy Crisis*, has relatively similar goals to our project. They aimed to compare wind and solar energy to fossil fuels based on their economic and environmental effects and create an energy policy that will promote renewable energy. This group analyzed and critiqued the current energy policy, which was the NEPD policy headed by Vice President Dick Cheney, and then modified it to include the promotion of solar and wind energy. They then discussed how the efficiency of renewable energy must increase in the future and predicted what would happen if no action was taken to promote renewable energy.[93] This project is a decent guide for our research. Current energy policies will be analyzed based on its successes and failures similarly to their project. If suggestions for modifications will be given, then they will be based on the successes of the policies in Germany, Denmark, and Spain, unlike their project's suggestions. Improving the efficiency of renewable energy will also be discussed with new technological advances.

Although many factors were taken into account in the background research when analyzing a country's progress toward clean energy, such as government structure, state of the economy, technological advances, ownership of energy companies, and a few others, there are other uncontrollable factors that may affect a country's progress. For example, the Fukushima nuclear disaster caused Germany to shut down its nuclear reactors and increase its use of fossil fuels for a few years. If something drastic happens, such as the market suddenly crashing, what would happen to investor owned energy companies? Uncontrollable factors may be important to take into account when setting renewable energy goals.

The literature reviews showed that the environmental impact of fossil fuels and renewable energy may be important to look at because renewable energy sources generate less pollution than fossil fuels. This may persuade members of the government as well as the general public to favor the use of renewable energy if they are aware of that fact.

[93] Sikora, Aaron M., Steven T. Ruo, and Jonathan W. Naumowicz. *The Upcoming Energy Crisis. WPI*. WPI, 29 Apr. 2003. Web. 6 Oct. 2015.

Part 2

Introduction

At the beginning of part one, the question was raised; why isn't the United States of America currently a world leader in the renewable energy industry? In order to answer this question, the United States had to be compared to other countries with different levels of success. Germany, with its outstanding solar capacity despite having limited sunlight, Spain, with its thriving wind industry, and the world leader in wind, and Denmark, were all chosen as countries to research. Hawaii was also noted as an outlier in the U.S., have the most progressive clean energy goals in the country. This first step involved researching some of the main differences between the five places. Several factors were chosen to analyze how each country's policies differed.

Part one answered questions about how policy differs in each country. However, the paper brought out a new question; how is policy itself affected? The first steps of part two involved creating a list of factors that affect policy. A conclusion was made that the three main factors that affect policy in a country are public opinion, government, and other uncontrollable factors. Under these headings, more specific factors were chosen. The major factors affecting policies, in no particular order are: historical events and disasters, political leaders, political actors, relative cost of energy, current events, availability of renewable energy resources, and availability of fossil fuels. Some factors affect policies in multiple ways, so they were split into the three main headings accordingly. Historical events and disasters, which includes events such as market crashes, wars, and natural disasters affects all three main headings. Political leaders, or heads of state and political party leaders of a country, political actors such as celebrities and other influential wealthy people, the relative cost of fossil fuels compared to renewable sources, and current events all affect both public opinion as well as government. The availability of renewable energy resources and fossil fuels a country has are factors that neither the public nor the government can control, so it was listed as an uncontrollable factor. These factors were then researched pertaining to which main factor that they applied to.

Public Opinion

The fate of this planet has been and will be decided by the people that live on it. If enough people want something, it will happen. The human race thrives from its strength in numbers. How the public views a certain subject decides how the world acts on that subject. A positive or a negative view on a subject such as climate change can change how the world will be

in the near future. Thus, public opinion strongly influences policies and how important leaders must act on arising public issues, because a government cannot make a decision if the public isn't behind it. On a smaller scale, public opinion affects every aspect of life. Businesses cannot afford to make decisions that people aren't supporting if they do not want to lose money and possibly go bankrupt. In the near future, public opinion will play an important factor in the future of renewable energy as well as Earth.

Many things can cause a shift in public opinion. A war or a disaster could change world opinions in a matter of hours. People in positions of power are ultimately the ones who put policies into action, and they rely on public opinion to attain the position as well as pass laws and policies. On the other hand, they can change the opinions of the public in debates and controversial political battles. The other kinds of people that influence the public's opinion are political actors. Celebrities, billionaires, any person who is popular or has a following can 'inspire' the people in today's society. For better or worse, the opinion of a famous person can become the opinion of many. When most people think of renewable energy, they think of cost. A major factor in determining the popularity of an energy source is the cost compared to other sources of energy. Fortunately, as the technology of anything gets better, its cost decreases, thus making it more popular. Finally, the energy sector is changing every day; any news story has the potential to change opinion. Any current event, technological advancement, or research finding can change how renewable energy is seen.

Historical Events and Disasters

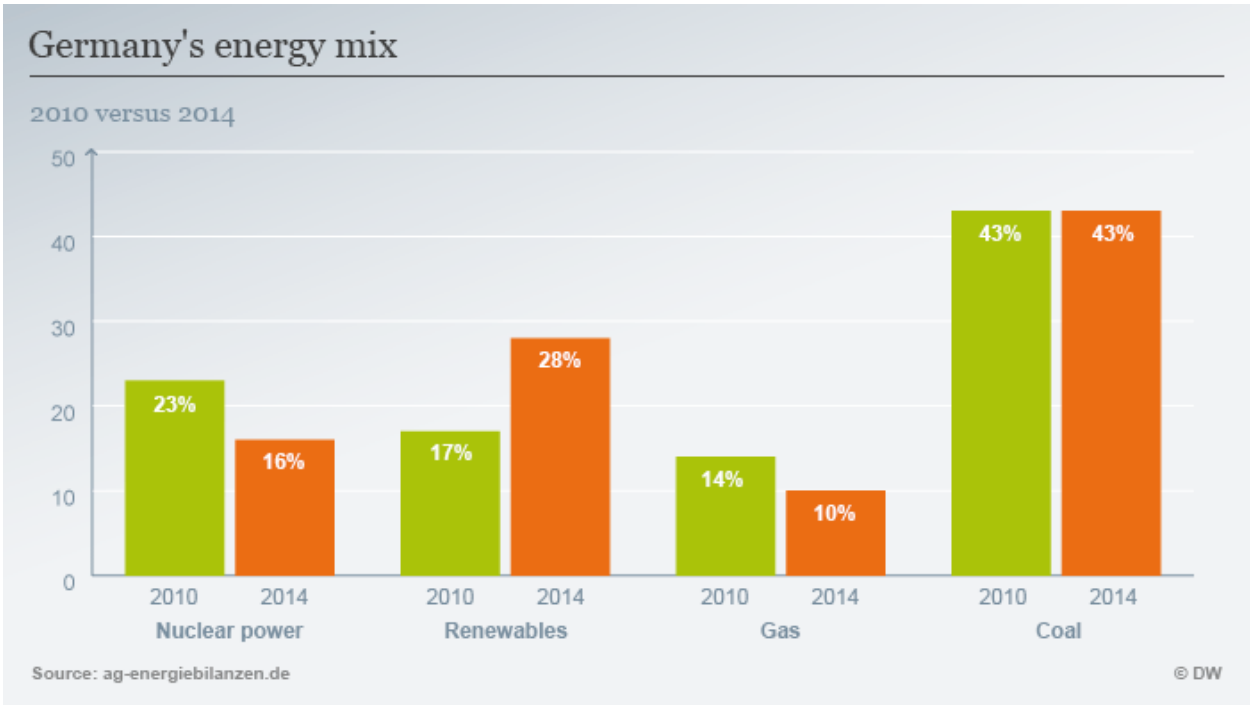
The energy used to power a country is ultimately chosen by the people of that country. That choice, however, can be greatly influenced by the events that happen across the world. For example, nuclear power is extremely popular until a meltdown happens.

A country's opinion on nuclear energy is a good factor in predicting what a country will do in the future. The nuclear disaster in Japan has caused Germany to start a phase-out of nuclear power plants by 2022. In March of 2011, a tsunami caused major damage to a nuclear power plant on the coast of Japan. Three days later, the safety of nuclear energy plants in Germany was under review.[94] At the end of May of the same year, the Reactor Safety Commission (RSK) concluded that "although the risks associated with nuclear energy may not have changed owing to the events in Fukushima, the way these risks are perceived has."[95] The RSK recommended the nuclear phase-out in Germany because public opinion had shifted a great deal in a short amount of time. However, the emphasis on the phase-out has simultaneously slowed the reduction of

[94] Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety. "Overview." *German Developments following Fukushima*. N.p., 03 Oct. 2014. Web. 07 Dec. 2015.
[95] Ibid.

Germany's carbon dioxide emissions. Fig. 1 shows how the use of nuclear power in Germany has decreased, but also how the use of coal has not.

Fig. 1.[96] Change in Germany's energy use from 2010 to 2014



Sometimes, current policies will inhibit the effectiveness of other policies. By using less nuclear energy, Germany has to fill the gaps with whatever energy it can, and a lot of the time, renewable energy would be too expensive. Citizens of Germany are very pro-renewable, but unfortunately, the country will only be able to efficiently enact one policy at a time.

In April 2015, the first radiation from the Fukushima disaster was detected off the coast of California. After the event occurred in 2011, scientists said that the vast size of the Pacific Ocean would dilute the radiation to miniscule amounts. With the radiation finally hitting the west coast, scientists have changed their opinion. They now believe that the ocean has not done a good enough job at diluting, and there may be much thicker pockets of radiation than expected.[97] While the levels of radiation will be well below an amount that can cause harm, the lack of public knowledge on radiation could instill worry on the uneducated populous. Scientists are suggesting that the pacific tuna be monitored for any changes. There is currently no public knowledge of an agency that is monitoring the radiation in the Pacific Ocean,[98] so it is not

[96] Rueter, Gero. "How Far along Is Germany's Nuclear Phase-out?" *DW*. Deutsche Welle, 29 June 2015. Web. 07 Dec. 2015.

[97] ENENews. "Gov't Expert: West Coast Will Soon Be Hit by 800 Trillion Bq of Fukushima Cesium-137." *Energy News*. ENENews, 7 June 2015. Web. 19 Dec. 2015.

[98] White, Greg. "Record Fukushima Radiation Levels Found on Southern California Coast." *Fukushima Watch*. N.p.,

known how bad the radiation will get in the near future. This could potentially be a harmful blow to public opinion of nuclear energy in the United States. If fish are majorly affected by this disaster, more people may look for other sources of energy.

The two oil crises of ‘71 and ‘79 are the reasons that Denmark is the world leader in wind energy. When the price of oil quadrupled in a single day, import-reliant Denmark had to find an alternative means of energy. Public opinion changed rapidly towards wind power and eventually forced the government to get behind it.[99] Surprisingly, Denmark did not switch to nuclear despite being on the forefront of nuclear power research. This can be attributed to the strong anti-nuclear movement that started in Denmark in 1975 by the Organization for Information on Nuclear Power (OOA).[100] Public following of the movement was large enough that, in ‘79, when the oil prices drastically increased again, Denmark did not build nuclear. Later, in ‘85, Denmark vowed that it would not build nuclear power plants. In 2007, a quarter of Denmark was in favor of nuclear energy. Two years later, that percentage had jumped to 54% in favor of nuclear power.[101] This can be attributed to the current climate ‘crisis.’ Countries across the world are focusing more than ever on reducing carbon emissions in any way possible, even if that means going nuclear.

Oil spills and natural gas leaks can have a large effect on public opinion, especially to those living near the accident and are affected by it. Oil spills, such as the Deepwater Horizon oil spill, can be very harmful to the environment and the economy. Animals and plants coated with oil can result in health issues, causing the public to frown upon oil for hurting so many animals and plants. Cleaning up oil spills can take many months and be very costly. About 43% of Americans continued to have an unfavorable view of British Petroleum, the company responsible for the Deepwater Horizon oil spill, after 3 years.[102] This was a devastating oil spill that caused environmental damage, hurt the fishing industry, and damaged beaches. Natural gas leaks can be just as damaging to the environment because methane is released into the atmosphere, which is much worse than emitting carbon dioxide. The California natural gas leak in October 2015 forced residents near the leak to relocate to avoid any potential health effects from breathing in methane. These residents certainly do not have positives opinions of natural gas and many others will be concerned about the environmental impact of this gas leak.

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28 Aug. 2015. Web. 19 Dec. 2015.

[99] Roselund, Christian, and John Bernhardt. "Lessons Learned Along Europe’s Road to Renewables." *IEEE Spectrum*. IEEE, 4 May 2015. Web. 06 Oct. 2015.

[100] SmilingSun. "Smiling Sun, Nuclear Power No Thanks." *Smiling Sun History*. Organisation for Information on Nuclear Power, n.d. Web. 19 Dec. 2015.

[101] NEI Nuclear Notes. "With and Without Nuclear Energy in Denmark." *NEI Nuclear Notes*. N.p., n.d. Web. 19 Dec. 2015.

[102] Swanson, Emily. "Poll Finds BP Public Image Still Tarnished 3 Years After Gulf Spill." *Huffington Post*. Huffington Post, 20 Apr. 2013. Web. 21 Feb. 2016. <http://www.huffingtonpost.com/2013/04/20/bp-poll_n_3111551.html>.

Political Leaders

In many countries across the world, climate change and renewable energy are not deciding factors for voters' decisions on who to elect as their leader. In the United States, for example, people view social issues as more important. This causes many of the presidential debates to not cover climate issues as well as cause renewable energy to not be a top priority for many voters. Also, today's society is extremely polarized. In many countries, especially ones with a two-party system, the only two candidates that have a chance to win are on opposite sides of the spectrum. This can cause public opinion to polarize as well.

In today's society, social media plays a big role in many people's lives. Over the past few years, the Internet has gotten so large that many heads of state in many countries have their own twitter account. People follow those accounts to gain access to important notifications, as well as important announcements that they would miss otherwise. Figure 2 shows the prime minister or president of the respective country and how many followers they have on the popular social media site Twitter.

Fig 2. Table showing twitter users in all the countries and presidential candidates twitter followers

Country	Political Leader	Twitter Followers	% of Population
USA		107.7 million users	33.8% (318.9 million)
	Barack Obama	66.6 million	17.44%
Germany		4 million users	4.96% (80.62 million)
	Angela Merkel	99.4 thousand	0.12%
Denmark		260 thousand users	4.64% (5.61 million)
	Lars Løkke Rasmussen	53.6 thousand	0.096%
Spain		5.7 million users	12.18% (46.77 million)
	Mariano Rajoy	1.05 million	2.25%

[103] [104] [105] [106]

The entertainment-obsessed United States blows the other countries out of the water with the amount of its population that uses Twitter. This data can show insight on important differences in factors such as how many people receive news and how news is interpreted. It can be assumed that in Denmark, few people even know that their prime minister has his own Twitter account and that he posts anything to it. On the other hand, every time Barack Obama posts something, millions of people read it, and thousands go out of their way to share it to their friends and family. Spain and Germany fall in between those two extremes.

The number of parties a political system has can directly affect public opinion. The two main types of political systems are two-party and multi-party systems. In a two-party system, two parties dominate the competition, with one of those two parties being a majority of the legislative branch of government. In a multi-party system, no single party controls the majority of any election or house of government. Usually, a party holds a certain view on a subject. Even if the person voting doesn't agree with the party on that subject, if the person votes for that party, they are effectively agreeing with that view. In a two party system such as the United States,

[103] Twitter. "Number of Monthly Active Twitter Users in The United States from 1st Quarter 2010 to 3rd Quarter 2015 (in Millions)." *Statista - The Statistics Portal*. Statista. 04 Dec 2015. <http://www.statista.com/statistics/274564/monthly-active-twitter-users-in-the-united-states/>

[104] Coleman, Alison. "What Germany Can Teach The Rest Of Europe About Twitter." *Forbes*. N.p., 10 July 2014. Web. 4 Dec. 2015.

[105] The Local. "Snapchat and Instagram Growing Fast in Denmark." *The Local*. N.p., 23 Jan. 2015. Web. 19 Dec. 2015.

[106] Drafting. "Spain Is the Fifth Country in the World with More Social Network Users." *Marketing Actual*. N.p., 22 Sept. 2013. Web. 19 Dec. 2015.

voters can choose whatever party they like, but the Republican and Democratic parties have the best chance of winning. This means that most voters have to side with one opinion or another on most subjects. In a multi-party system like Spain, Denmark, and Germany, there are more parties that could win an election, meaning that there are more variations of opinion that voters can side with.

Political Actors

When talking about people that influence politics and public opinion, or political actors, there are two different kinds that must be looked at. The first kind is famous people. In modern society, there is a thin line between news and entertainment. Some people in many first-world countries care more about the next big celebrity scandal than they do about the next president. This means that celebrities have a very large amount of influence. Their influence only grows when modern technology such as social media is considered. A celebrity can put his opinion out there and millions of people will potentially see it. The second type of political actor is the extremely wealthy group or person that supports and donates to a cause or idea. Money for advertisements and other campaign related items can change public opinion ever so slightly.

Two economists at the University of Maryland performed a study that shows just how influential celebrities can be. Their research covers the democratic primary of 2008 between Obama and Clinton. Enough evidence is given to suggest that Oprah Winfrey's endorsement of Barack Obama swung enough votes in his favor for him to win the primary.[107] These types of actions can slide an election in either direction. Some extremely famous people, including Leonardo DiCaprio, Brad Pitt, and Al Gore are all active proponents of renewable energy.[108] The Leonardo DiCaprio foundation is dedicated to well-being of the earth and all its inhabitants.[109] It is also funded of The Solutions Project, an organization with a goal of getting the world to 100% renewable energy.[110] Brad Pitt's organization, Make It Right, has a goal of everyone living in environmentally sustainable homes. Make It Right Solar, a subsidiary, has the goal of making solar accessible to the whole world.[111] Al Gore is mostly known nowadays for his dedication to the planet that he lives on. After his stint as vice president under Clinton, he wrote several books about climate change as well as making his own documentaries, and many other famous people use their influence and wealth for a good cause. People that support these celebrities and former politicians tend to also support their causes.

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[107] Garthwaite, Craig, and Tim Moore. "The Role of Celebrity Endorsements in Politics: Oprah, Obama, and the 2008 Democratic Primary." (n.d.): n. pag. University of Maryland, Aug. 2008. Web. 4 Dec. 2015.
[108] CNBC. "15 Green Celebrities." *CNBC*. NBC Universal, 13 Apr. 2012. Web. 20 Dec. 2015.
[109] Leonardo DiCaprio Foundation. "About the Leonardo DiCaprio Foundation." *Leonardo DiCaprio Foundation*. Greenhour, Inc., n.d. Web. 20 Dec. 2015.
[110] The Solutions Project. "The Solutions Project." *The Solutions Project*. N.p., n.d. Web. 20 Dec. 2015.
[111] "Who We Are." *Make It Right Solar*. Make It Right, n.d. Web. 20 Dec. 2015.

The other type of political actor is the one that donates to a cause. Political Action Committees (PACs), and Super PACs, are both extremely important organizations that change the tide of elections and even political decisions. There are hundreds of PACs and Super PACs that support both political parties. However, Republicans, the political party that hasn't made much effort with renewable energy, get most of the support from the two types of organizations. A big part of what these organizations do is advertise for their political candidates. Advertisements have a big role in affecting how people view candidates, especially since many commercials and ads nowadays try to defame opposing politicians.

Relative Cost of Energy

Cost is possibly the single biggest factor in public opinion. It doesn't take long to realize just how much people like their money. Given the opportunity to spend less, a majority of people would, and if told to spend more, many people would not like it. Even though it is a well-known fact that renewable energy would be much cheaper in the long-run, most people nowadays only care about the short-run. "I won't be alive in 100 years so why should I care if the world is ruined," is a response heard very often in today's extremely selfish world.

While it would end up being amazingly cheap in the long-run, switching to renewable energy would be a very costly short-run goal. Switching could possibly increase the public's electricity bills a hefty amount. However, it will not raise the price as much as people think. One of the current misconceptions about some renewable energies, specifically solar, is that they are very expensive to produce and install. Several years ago, they were; however, with ample technological advances, the costs have become competitive with fossil fuels.

Figure 3[112]. Prices of crystalline silicon photovoltaic cells in $/watt over the years

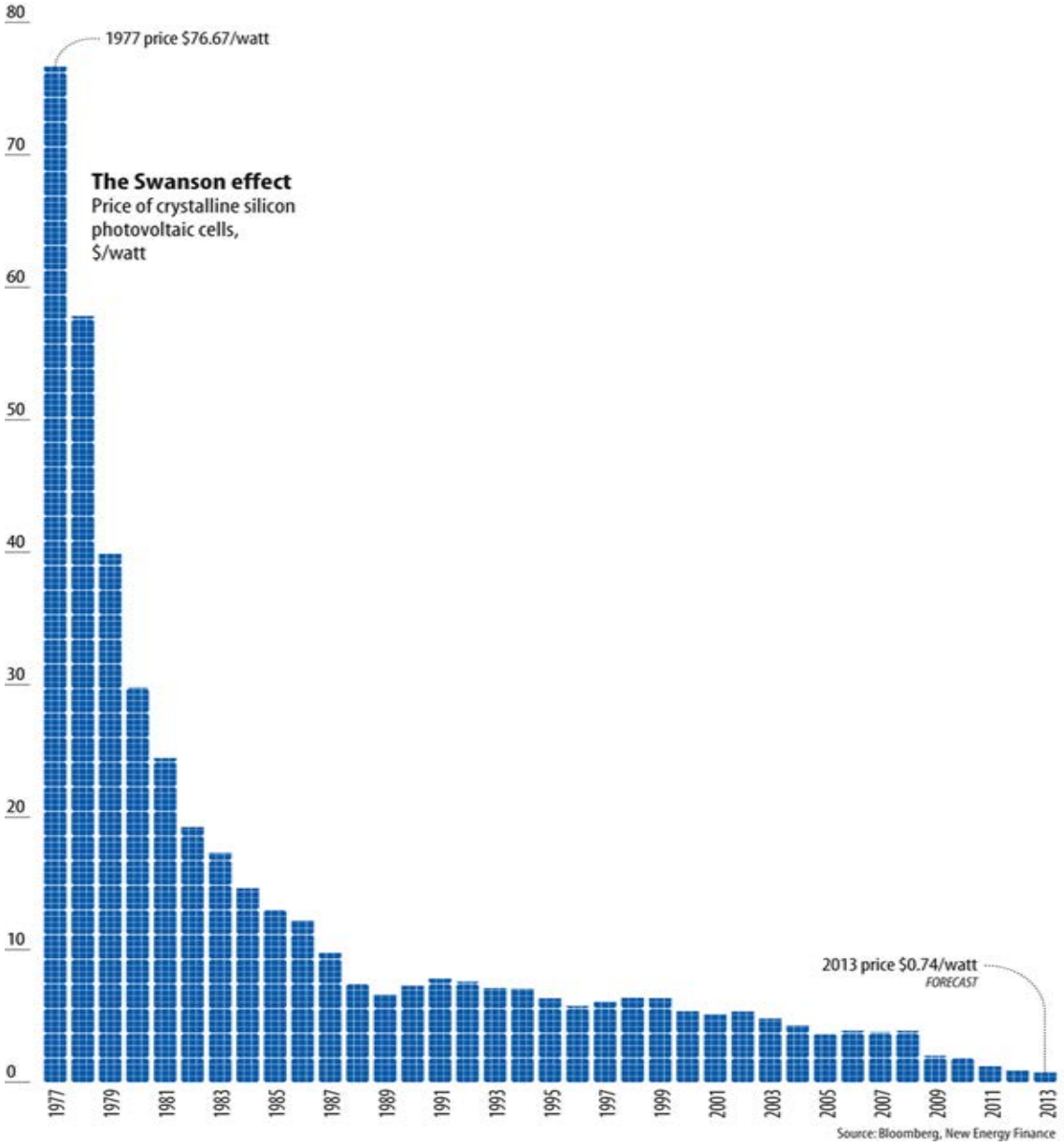


Figure 3 shows just how much the price of solar panels has dropped. Swanson's law, named after the founder of SunPower Richard Swanson, is a phenomenon in which the price of solar cells drops by 20% whenever the world production of solar panels doubles.[113] Production cost isn't the only factor that is dropping fast. A typical roof installation that took two days 5-10 years ago now takes 4 hours, effectively quartering installation costs.[114] Another way citizens are being

[112] *The Swanson Effect*. Digital image. *Bloomberg Business*. Bloomberg New Energy Finance, 28 Dec. 2012. Web. 8 Dec. 2015.

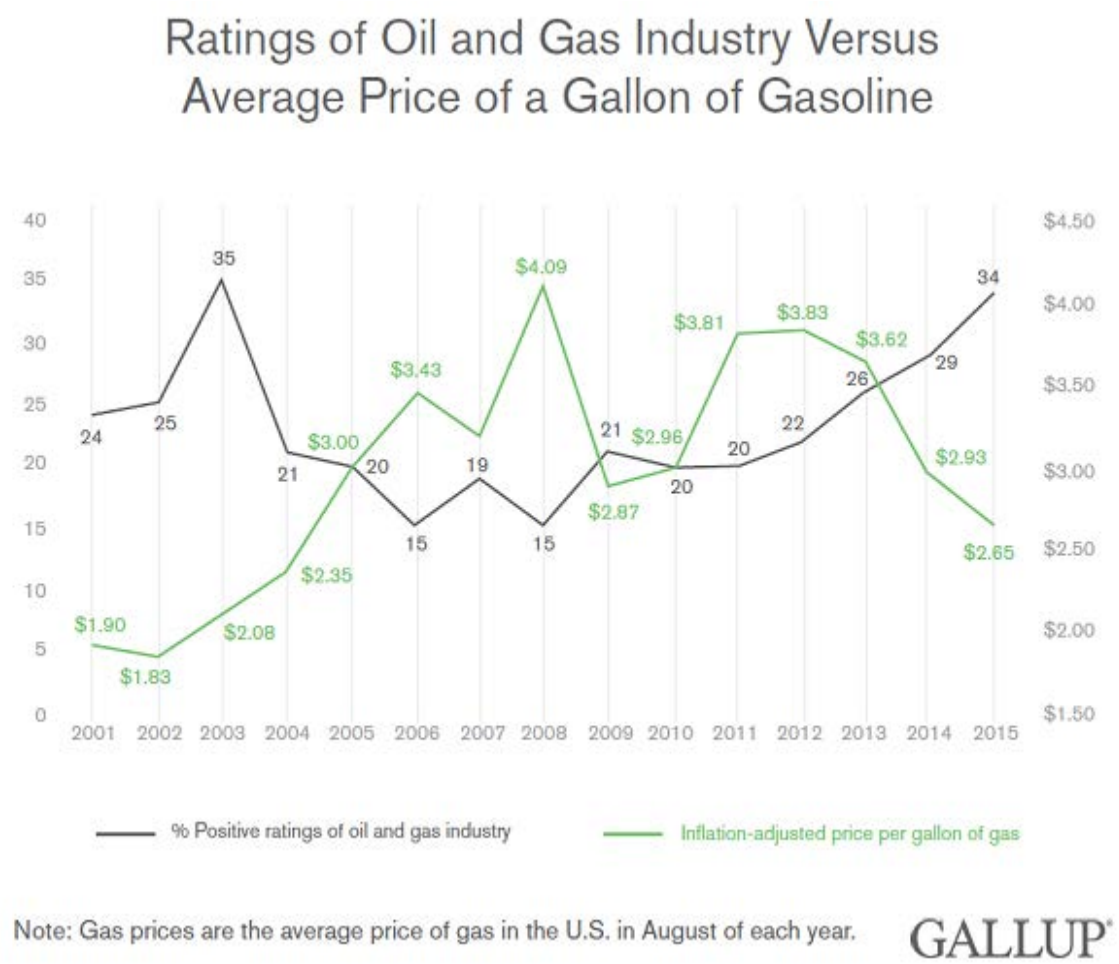
[113] Hunt, Tam. "Swanson's Law and Making US Solar Scale Like Germany." *Gtm*. Green Tech Media, 24 Nov. 2014. Web. 08 Dec. 2015.

[114] Goldstein, Jacob. "How Solar Power Has Gotten So Cheap, So Fast." *NPR*. National Public Radio, 10 Apr. 2015.

compelled to buy solar panels is by not actually buying them. By having the electric companies technically own the panels, they can charge the customer less, and if they spread it out over several years, the customer will barely notice the difference.

Unfortunately, while renewable energy prices are dropping, so are the prices of fossil fuels. Figure 4 shows the correlation between favorability and the price of fossil fuels. While prices are currently dropping as production hits an all-time high, positive ratings are reaching an all-time high.

Figure 4.[115] Fossil Fuel Ratings vs. Prices



Web. 08 Dec. 2015.

[115] Gallup Inc. *Ratings of Oil and Gas Industry Versus Average Price of a Gallon of Gasoline*. Digital image. *Gallup*. N.p., 24 Aug. 2015. Web. 19 Dec. 2015.

However, in earlier years, as prices were higher, people rated fossil fuels much lower. It is widely hypothesized that the world has reached 'peak oil.' Many people say that that last of the world's oil has been discovered and that it's only a matter of time before it runs out.

Figure 5[116]. Prediction of Fossil Fuel Production

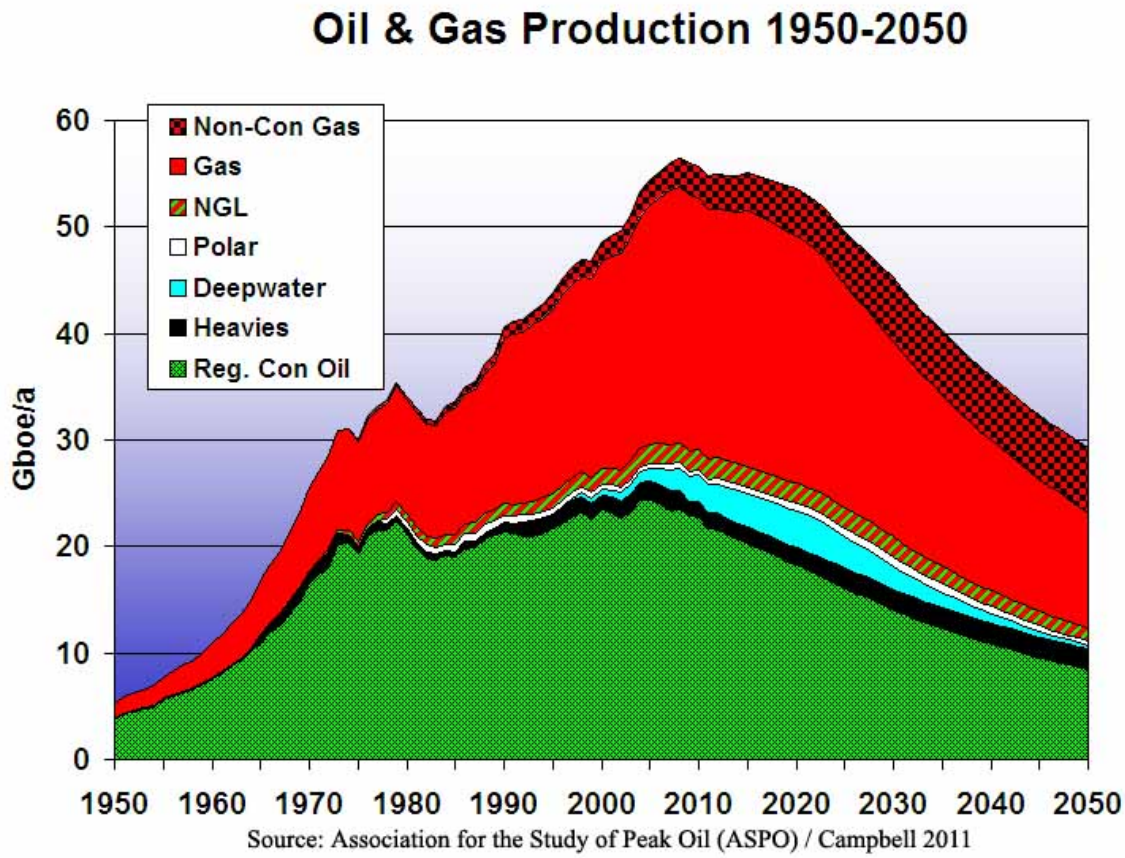


Figure 5 shows one of the many predictions of fossil fuel production in the near future. If oil and gas production decline, prices in the near future will rise and favorability should plummet. This could end up being extremely beneficial to the renewable energy industry.

The price of gas rising has already affected many countries. Germany, Denmark, and Spain, who are all doing better than the U.S. with renewable energy, all have more expensive gas. The price of gas in the U.S. as of September 10th, 2015, was $2.74 per gallon. This amount costs $6.93 in Denmark, $5.52 in Spain, and $6.21 in Germany.[117] The United States pays less than half the three European countries pay for a gallon of gas. While there are many factors that

[116] Association For the Study of Peak Oil. *Oil & Gas Production 1950-2050*. Digital image. *Peak Oil*. ASPO, n.d. Web. 19 Dec. 2015.

[117] Randall, Tom. "Bloomberg Gas Price Ranking." *Bloomberg.com*. Bloomberg, 10 Sept. 2015. Web. 19 Dec. 2015.

contribute to public opinion, these high prices may be one of the driving factors behind what energy a country gets behind.

Current Events

New information regarding renewable energy is published every day. As this paper is being written, the United Nations conference on climate change is under way, policies are changing, and offices are changing hands. Decisions made today will shape the future of energy.

Denmark, the world leader in wind power, is currently making budget cuts that could drastically slow its progress in the renewable energy field. After the recent elections placed more conservative members in Parliament, a financial plan was proposed to cut green energy research from 55 to 18 billion dollars.[118] By only reducing this budget to a third of what it was, progress in renewable energies could slow drastically not only in Denmark, but also in other parts of the world because a majority of new technologies in the wind sector are made by Danish companies. This may also cause a drop in public morale in more than just Denmark. By seeing a successful green country tug on the reins of its progress, the public's hopes may be crushed and they may be dissuaded in backing their own country's endeavors.

The fourth biggest bank in the world, HSBC Holdings, has announced that it will be creating an investment portfolio of green bonds worth one billion dollars.[119] The portfolio will fund projects in the renewable energy and sustainability sector. This policy should encourage more projects and hopefully stimulate faster growth in the industry. As this and similar news starts to come out more frequently, hopefully the public will realize the importance of these decisions and back them.

Elon Musk, CEO of SpaceX and Tesla Motors, expressed his views on the climate issues and articulated his theory on a carbon tax and how it could theoretically stop carbon emissions. He also notes that there is a 5.3 trillion dollar hidden subsidy that benefits carbon-producing companies.[120] In today's society, the actions of the ultra-successful heavily influence the public's ideas; those who follow Elon Musk now have a better chance of being behind the idea of a carbon tax.

Bill Gates, one of the richest men in the world, has announced the creation of the Breakthrough Energy Coalition with more than 20 other billionaires. The sole purpose of this group will be to invest in renewable energy technologies.[121] Its goal is to start a movement in the

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[118] Eddy, Melissa. "Denmark, a Green Energy Leader, Slows Pace of Its Spending." *The New York Times*. The New York Times, 05 Dec. 2015. Web. 11 Dec. 2015.

[119] UNEP. "HSBC Confirms $1bn Green Bonds Portfolio." *Climate Action Programme*. United Nations Environment Programme, 3 Dec. 2015. Web. 11 Dec. 2015.

[120] Korosec, Kirsten. "Elon Musk: Only a Carbon Tax Will Accelerate the World's Exit from Fossil Fuels." Fortune, 02 Dec. 2015. Web. 11 Dec. 2015.

[121] Dolan, Kerry A. "Bill Gates, Mark Zuckerberg & More Than 20 Other Billionaires Launch Coalition To Invest In Clean Energy." Forbes, 29 Nov. 2015. Web. 11 Dec. 2015.

clean energy field that will hopefully make the world carbon-production free. By having such a large group of wealthy and popular individuals pledge to the cause, the public will hopefully follow suit.

A research team at Michigan State University has created a fully transparent solar cell that could revolutionize the solar energy field.[122] With this new technology, laminates for pre-existing windows or new windows could be made that could capture the sun's energy and be indistinguishable from a normal window. A decent portion of people do not like solar because of the way it looks on roofs; hopefully this invention could change that.

Government

One of the major factors affecting policy-making as well as how successful the policies will be is the government. Different governments, whether a monarchy or a democracy, affect the processes of passing laws, how the political parties work, and how decisions are made about the country. The decisions of government officials are crucial when it comes to promoting or enforcing policies for renewable energy use. Politicians have the power to economically support renewable energy by providing incentives to invest in energy with grants, loans, and tax credits. Public opinion is directly related to the government, as it is the people who choose their leader. Providing national energy security by making sure that energy fuels are always available will keep the public safe and happy. Knowing how a country's government runs is essential in knowing the reasons why it makes decisions. The main subparts affecting government are presented below.

Historical Events and Disasters

As mentioned before, the government is directly related to public opinion. That being said, both of them have to do their parts in order to have successful policies. Historical events and disasters include events in the past in general, such as successful policies, wars, market crashes, natural disasters, etc. Successful policies play a key role in the transition towards renewable energy. Countries in Europe, such as Germany, have been achieving certain goals for cleaner energy like reaching 20% of electricity be from renewable energy by 2020. Chancellor Angela Merkel cemented Germany's shift toward an economy powered by renewable energy in 2010 with her "Energiewende" plan. By early 2014 Germany reached 27% of energy consumption from renewable energy, 7% more than it was expected in 6 more years. This happened because the government enforced the policies and followed the plan well. In general

[122] Olewitz, Chloe. "Fully Transparent Solar Cell Could Make Every Window in Your House a Power Source." *Digital Trends*. N.p., 14 Oct. 2015. Web. 11 Dec. 2015.

the success of policies results from how well the government enforces them in order for companies and people to follow. Successful policies affect policy making in a positive way and also give guidance, as well as inspiration, for new policies and behaviors of a country's government.

On the bad side of things, market crashes and wars affect policy making in a very negative way. Market crashes cause renewable energy prices to increase, meaning that it makes it harder for the government to make or enforce renewable energy policies. Another negative effect is that progress towards expanding capacity is slowed down drastically, giving more space for fossil fuel sources to be used. Furthermore wars are one of the biggest tragedies that could happen. Excluding the deaths and destruction it causes a huge disruption inside governments. All types of war hinder any progress made towards a renewable energy environment. Also war brings every country affected in a state of panic and therefore the government doesn't have much power in its hands, meaning that it becomes weaker and less influential. However modern wars are waged with such weapons that require some of the most energy-intensive materials and whose deployment is heavily based on gasoline and electricity both for operation, as well as transportation. Also the most powerful modern war machines are designed for maximum performance and not for minimized energy consumption. Therefore spending towards the energy sector increases dramatically during times of war.[123]

Lastly, natural disasters, just like wars, not only cause many deaths, but also make a big impact on the renewable energy sector. Energy capacity can be damaged or completely destroyed and in some cases, like the Fukushima nuclear station accident caused by a tsunami, can heavily pollute the environment, too. In such cases the government is obliged to spend large amounts of money on damages rather than using it for new technology advancements or renewable energy subsidies. Such events are uncontrollable by man, but can still have a huge negative impact on policy making and the economy as well.

Political Actors

Political actors, such as interest groups, business associations and energy company owners can greatly influence the government. It is a desirable thing to have those three on the side of the country's government, because they can all be of major help for policy making as well as its success.

First of all interest groups, like American Wind Energy Association and Solar Tribune, raise awareness for wind and solar energy respectively. Solar Tribune is a solar news, education, and advocacy website, which offer straightforward reporting that promotes solar interest and awareness. They also help promote solar adoption by providing helpful tools and resources for

[123] Vaclav, Smil. "War and Energy." *Science News* 106.14 (1974): 217. Web. 12 Dec. 2015.

people considering solar power solutions.[124] The mission of the American Wind Energy Association (AWEA) is to promote wind power growth through advocacy, communication, and education. AWEA is a national trade association representing wind power project developers, equipment suppliers, services providers, parts manufacturers, utilities, researchers, and others involved in the wind industry, one of the world's fastest growing energy industries.

Energy company owners are also strong political actors, since they can either make or break policies concerning renewable energy. Company giants such as E.ON in Germany, DONG in Denmark and Iberdrola in Spain have played key roles for the promotion of cleaner energy. EnBW, another German company, aims to double their installed solar output of electricity to over 40% in 2020 and as a result is supporting the Energiewende plan by making a material contribution to providing the infrastructure for the energy system.

Current Events

Current events have a great influence on the government and as a result on renewable energy policies. They are essentially the foundation of future decisions and a good indicator for the evolution of renewable energy policies. One of the best examples for current events is the 2015 Climate Change Conference “COP21”, which took place in Paris, France, and is a crucial conference, because the expected outcome is a new international agreement on climate change, applicable to all, to keep global warming below 2°C. In order to reach a new universal climate agreement that is applicable to all, the delegates of the 195 States Parties to the United Nations Framework Convention on Climate Change (UNFCCC) have held regular meetings to make progress on the text that will be voted on. This year of negotiations was marked by the publication on October 7 of the climate finance report by the OECD and the think tank Climate Policy Initiative. According to this report, $62 billion were raised in 2014 by developed countries to help developing countries cope with climate change. Another important fact is the attempt at a major decrease in global Greenhouse Gases (GHG). The UNFCCC studied 146 national contributions, and as things stand the global GHG emission pathway, based on these published contributions, would mean that by 2030 we would be heading for a rise of around 3°C, that is between 2.7°C and 3.5°C, by the end of the century.[125]

One of the challenges of the Paris agreement will be to establish a periodic review mechanism to raise the ambition of each Party and progressively improve the collective pathway. Such events are very influential for a government’s policy making process. Not only does it alert and pinpoint the problems that are present, but it also sets goals and tries to find solutions that apply for all the Parties. Climate conferences are crucial for the improvement of national and international policies, as well as for the ignition of new ones, which will help eliminate important

[124] "The Voter's Self Defense System." *Project Vote Smart*. N.p., n.d. Web. 21 Dec. 2015.
[125] "What Is COP21?" *COP21*. N.p., n.d. Web. 20 Dec. 2015.

problems. By gathering many government officials from around the world it makes it easier to find more efficient policies in order to tackle bigger environmental and energy problems and also be more successful in general.

Political Leaders

Political leaders play a big role in every country, since they are the most influential people. Prime ministers in particular, who are the most senior ministers of cabinet in the executive branch of government, are considered the leaders of countries. They usually represent a political party, which is the strongest since it is elected by the people. Prime ministers are one of the key players in the energy game because they can allow the growth of the renewable energy sector by making and enforcing policies and energy plans. Below is a table presenting the current political leaders in Germany, Denmark, Spain, and U.S.A., as well as the side that they represent.

Figure 6: Political leaders and their affiliations

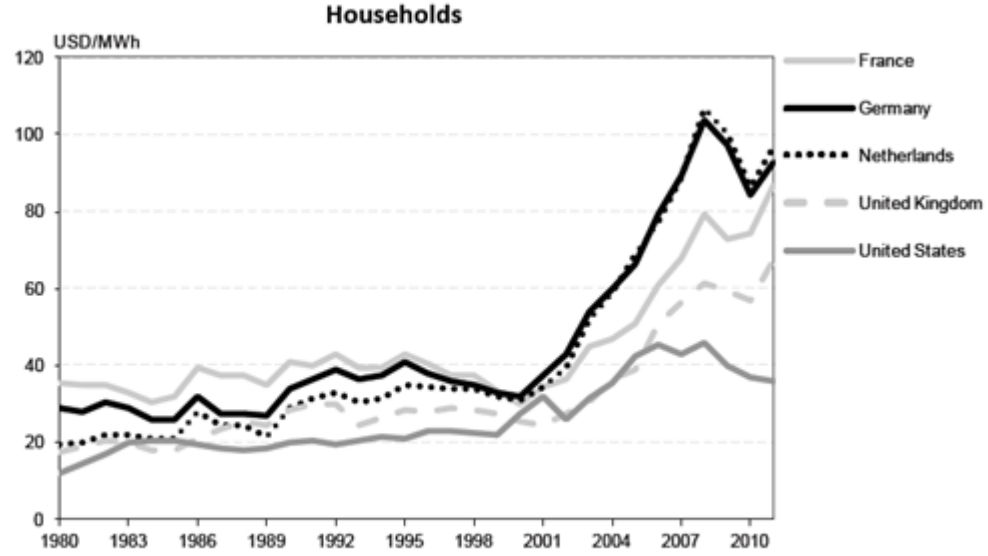
Country	Head of Government	Party	Party Type	US Equivalent
Germany	Angela Merkel	Christian Democratic Union (CDU)	Center right	Liberal
Denmark	Lars Løkke Rasmussen	Venstre	Center right	Moderate
Spain	Mariano Rajoy Brey	People's Party (PP)	Center right	Conservative
United States	Barack Obama	Democratic Party	Liberal	-

Even though these parties dominate their respective country's government branch there are also green parties in almost all 4 countries which support renewable energy usage and work towards making the transition to a cleaner energy environment easier. Two good examples of those green political parties are EQUO and ICV in Spain, which promote green jobs (employment created through the overhaul of the Spanish energy sector, the development of greener transport systems, etc.) and come up with renewable energy models and policies for the short- and long-term future.

Relative Cost of Energies

Germany's wholesale electricity prices keep falling and as a result 2015 marks the first time consumers paid less for electricity in over a decade. Chancellor Angela Merkel cemented Germany's shift toward an economy powered by renewable energy in 2010 with her "Energiewende" plan. The plan is an ambitious policy aiming to move the country's electricity generation away from nuclear and fossil-fuel sources. More specifically it represents the German government's desire to cut carbon emissions by 70% from 1990 levels by 2040, while switching off all of the county's nuclear power plants by 2022.[126] This shift is hurting RWE AG and EON SE, the worst performers on Germany's DAX stock index, as cheaper green power gets priority to the grid. Also the commodity price rout is dragging German power prices lower as oil, natural gas and gas costs slide. Electricity prices have fallen 13% in the past year and one of the main reasons is production and consumption subsidies to fund "Energiewende". These subsidies have pushed consumer bills and production costs down and therefore both households and the industry sector enjoy the low prices. As far as natural gas prices are concerned, big changes have occurred in the past 30 years. More specifically in the last 10 years prices have gone up by a lot in Europe, whereas in the U.S. there wasn't much of a difference. Below is a graph presenting natural gas prices for households from 1980 to 2010.

Figure 7[127]: Natural gas price trend from 1980 to 2010

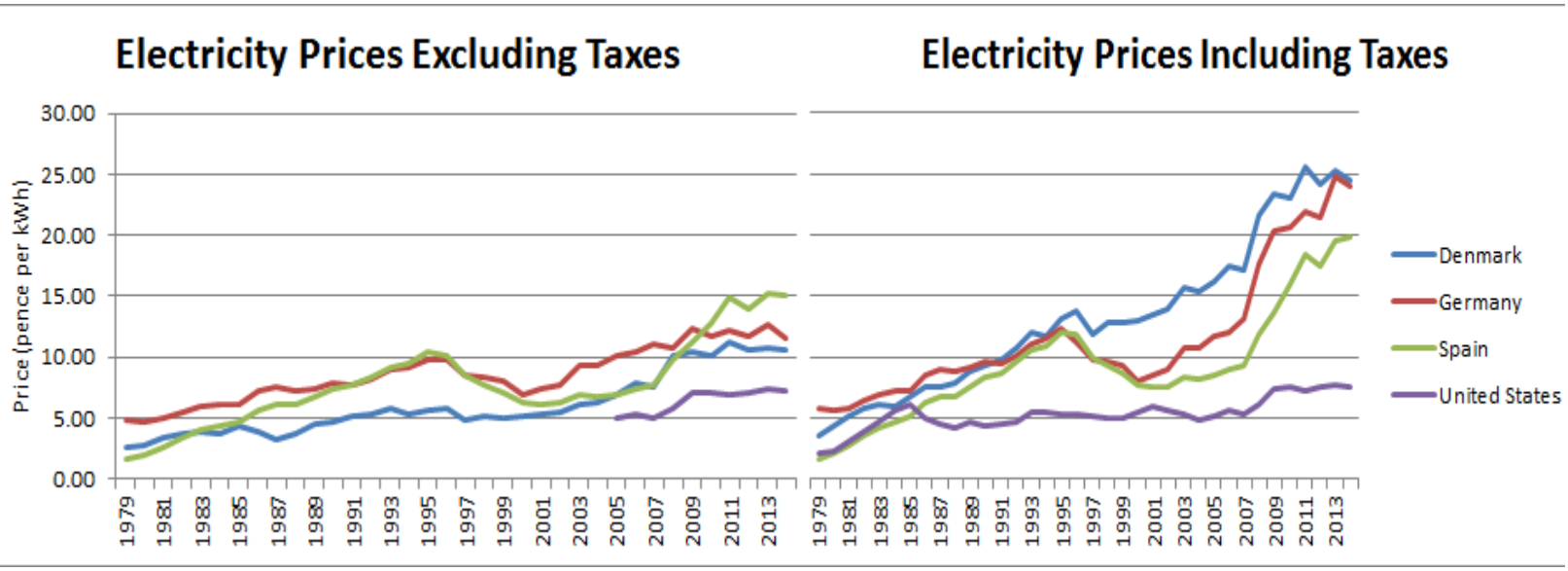


Note: data not available for Germany for 2001.
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2012.

[126] "Getting out of Gas." *The Economist*. The Economist Newspaper, 26 Sept. 2014. Web. 20 Dec. 2015.
[127] Ibid.

As shown on the graph, prices were stable with a couple of fluctuations until 2000. In the next 10 years there was a dramatic increase of approximately $70 per MWh in Europe. Although prices have been mostly stable in the United States up until 2010, they are expected to rise, as demand and supplies gradually begin to come back into balance.

Figure 8[128]: Average Electricity Prices from 1979 to 2014



The graphs above show the average electricity prices from 1979 to 2014 in Denmark, Germany, Spain, and the United States. The first graph shows prices excluding taxes and the second graph shows prices including taxes. Comparing the two graphs, taxes hardly add anything to electricity prices in the United States while taxes make up a significant portion of the electricity price in the three European countries. Unfortunately, data for electricity prices excluding taxes for the United States from 1979 to 2005 was missing from the source, but it is still evident that European electricity prices remain higher than prices in the United States, and in recent years, taxes have been a major reason why this is the case.

Support for the shift to a low-carbon economy is strong because electricity spending, as a share of disposable income, has remained steady for years. Continued relief in retail prices depends on whether power companies pass savings from lower wholesale prices to consumers, and to what extent grid operators raise fees. More than half of the power price for German households and small businesses consists of components determined by the state.

[128] Department of Energy and Climate Change. "International Domestic Energy Prices." *Gov.uk*. N.p., 24 Sept. 2015. Web. 20 Dec. 2015. <https://www.gov.uk/government/statistical-data-sets/international-domestic-energy-prices>.

Uncontrollable Factors

Energy policies are also affected by uncontrollable factors such as historical events and disasters, amount of available renewable resources such as solar and wind energy, and amount of available fossil fuel. These factors are different for each country and therefore have a different impact in each country. With the slight exception of wars and recessions, these factors cannot be influenced by human intervention, but they are still important to take into account for energy policies.

Historical Events and Disasters

Unanticipated events such as recessions, market crashes, war and natural disasters can both help and hinder progress toward installing renewable energy. Although recessions and wars can be slightly controlled through government intervention, they will be considered uncontrollable because these events will inevitably occur again in the future. It is difficult to predict exactly when these events may occur; however, historical trends may show how often they occur and how long they may last.

Recessions and market crashes can be anticipated when prices begin to change and there is a decline in investments. According to the data below, the United States experiences a recession at a median rate of approximately every four years and a median duration of nine months since the Great Depression.

Figure 9[129]: List of recessions in the United States since the Great Depression

Recession	GDP Contraction	Duration	Time Until Next Recession
August 1929 - March 1933	-26.7%	3 Years 7 Months	4 Years 2 Months
May 1937 - June 1938	-18.2%	1 Year 1 Month	6 Years 8 Months
February 1945 - October 1945	-12.7%	8 Months	3 Years 1 Months
November 1948 - October 1949	-1.7%	11 Months	3 Years 9 Months
July 1953 - May 1954	-2.6%	10 Months	3 Years 3 Months
August 1957 - April 1958	-3.7%	8 Months	2 Years
April 1960 - February 1961	-1.6%	10 Months	8 Years 10 Months
December 1969 - November 1970	-0.6%	11 Months	3 Years
November 1973 - March 1975	-3.2%	1 Year 4 Months	4 Years 10 Months
January1980 - July 1980	-2.2%	6 Months	1 Year
July 1981 - November 1982	-2.7%	1 Year 4 Months	7 Years 8 Months
July 1990 - March 1991	-1.4%	8 Months	10 Years
March 2001-November 2001	-0.3%	8 Months	6 Years 1 Months
December 2007-June 2009	-4.3%	1 Year 6 Months	???
Median	**-2.7%**	**9 Months**	**4 Years 2 Months**

Source: National Bureau of Economic Research

[129] Carlson, Ben. "When Will The U.S. Have Its Next Recession?" *A Wealth of Common Sense*. N.p., 26 Feb. 2015. Web. 20 Dec. 2015.

The median and average values for the time until the next recession are not too useful because the range of the data is rather large. There was only a one year gap between the recessions in 1980 and 1981, but then it took almost eight years for the next recession to occur. The Great Recession of 2008 is another example of why this trend is not as useful as expected. Economist experts predicted that there was only a 3% chance that the economy would shrink by any margin in 2008 and a 1-in-500 chance that it would shrink by at least 2%.[130] A recession in one country, especially one that heavily relies on imports and exports, can cause recessions in other countries. The Great Recession began in the United States and eventually spread to Germany, Denmark, and Spain. Although recessions may be difficult to predict, it is important to take into account because they cause energy prices to decrease and small energy companies to go out of business. New companies, however, can emerge during recessions and continue to be a very successful company, such as General Electric, which was founded by Thomas Edison during a recession in 1890.[131]

Wars and conflicts are usually easy to predict when tensions between countries or organizations begin to arise. They may happen suddenly due to one person's actions or slowly over time because of security reasons. With so many people having different opinions on everything, conflicts are inevitable.

[130] Ibid.

[131] Dahl, Darren. "Top Companies Started During A Recession." *The Huffington Post*. TheHuffingtonPost.com, 10 May 2010. Web. 20 Dec. 2015.

Figure 10[132]: List of major wars after World War II that selected countries participated in

	Germany	Denmark	Spain	United States
Cold War (1946-1949)				x
Korean War (1950-1953)		x		x
East German Uprising (1953)	x			
Vietnam War (1955-1975)				x
Ifni War (1957-1958)			x	
Basque Conflict (1959-2011)			x	
Invasion of Czechoslovakia (1968)	x			
Cold War (1979-1986)				x
Conflict in Persian Gulf (1987-1988)				x
First Gulf War (1990-1991)		x	x	x
Somali Civil War (1992-1995)	x		x	x
Bosnian intervention (1992-1996)	x	x	x	x
Conflict in Iraq (1992-1996)				x
Kosovo War (1998-1999)	x	x		x
War Afghanistan (2001-?)	x	x	x	x
Iraq War (2003-2011)		x	x (2003-2004)	x

The table above shows that conflicts occur quite often and can last for many years. The United States has been involved in many wars since it was founded in 1776. Out of the 239 years as a nation, the United States has been involved in some sort of major conflict for 222 years, which is approximately 93% of the time. Many of those conflicts have been initiated by the United States.[133] Germany, Denmark, and Spain have been part of fewer conflicts perhaps

[132] "The Wars of Germany." *The History Guy*. N.p., n.d. Web. 20 Dec. 2015.
[133] Washington's Blog. "America Has Been At War 93% of the Time – 222 Out of 239 Years – Since 1776." *Infowars*.N.p., 21 Feb. 2015. Web. 20 Dec. 2015.

because they are wiser to stay out of other countries' businesses. Spain, however, was involved with the Basque conflict, which lasted from 1959 to 2011, so it has also recently spent more time at war than not. Perhaps a better question would be to ask when countries are not at war. Wars could potentially damage the energy market because a viable military strategy includes attacking oil and gas facilities to cut off the supply of the enemy.[134] With the recent and current wars in the Middle East, this action would increase the price of oil because a large supply of the world's oil comes from the Middle East.

Natural disasters, such as earthquakes and hurricanes, are caused by natural activity that cannot be controlled by humans. Along with taking many lives, natural disasters can damage energy facilities and installed solar and wind capacity. Fortunately, disasters of higher magnitude are much less common. Nonetheless, it is important to try to predict natural disasters in order to prepare for it and take the least amount of damage from them as possible. Unfortunately, scientists currently do not know exactly how to predict such disasters, but they can predict where they are more likely to occur. This can lead to construction of sturdier buildings and facilities in areas likely to be hit and prevent loss of energy production.

Earthquakes occur most often on the boundaries of the Earth's tectonic plates, where the plates directly underneath the surface interact and cause violent shaking of the surface. They may happen without warning and cause massive damage if hit in densely populated areas.

Figure 11[135]: Map of Earth's Tectonic Plates

[134] Spano, Kirk. "The Potential Impact of War." *Fundamental Trends*. N.p., 29 Oct. 2015. Web. 20 Dec. 2015.
[135] "Plates & Boundaries." *Annenberg Learner*. Annenberg Foundation, n.d. Web. 20 Dec. 2015.

The map shows that the west coast of the Americas, the southern coast of Europe near and including Italy, the Middle East, the northern border of India, Japan, and the islands in Southeast Asia are more likely to receive earthquakes. Of course, earthquakes can occur anywhere, but the most severe earthquakes are those closer to the plate boundaries. The largest recently recorded earthquakes include the one in Chile in 1960, the one off the coast of Japan in 2011, and the one in Nepal in 2015. Scientists also say that there is a 67% chance that the San Francisco bay area in California will be hit with a major earthquake within the next 30 years.[136] Earthquakes can also occur in the ocean and cause tsunamis. Major recent tsunamis include the ones that hit Indonesia in 2004 and Japan in 2011. Major disasters around the world, not just in the United States or Europe, can impact the four countries being observed, such as the 2011 tsunami in Japan having an impact on German nuclear power.

Most hurricanes form in the ocean in tropical areas near the equator. The Intertropical Convergence Zone is likely a main cause of hurricanes[137], which is the area where the northeast and southeast trade winds converge along with rising air to create storms. This area encircles the Earth around the Equator and shifts throughout the year. It is difficult for scientists to predict when hurricanes will form, but they can track the general route that existing hurricanes are likely to take. There are multiple models used to track hurricanes a few days in advance, but they are still quite inaccurate. As a hurricane approaches closer to land, the error of the models decreases. However, scientists can still be 100 miles off in their prediction just a day before the hurricane hits.[138] Since hurricanes generally travel west[139], the eastern coast of North America, Asia, and Australia, India, and the Southeastern Asian islands are more prone to hurricanes. There are different peak times when storms occur most often for each location. The Atlantic and West Pacific has the most activity in August and September, although storms may occur any time of the year.[140] In 2005, Hurricane Katrina hit New Orleans and caused massive damage, even shutting down total natural gas production of the United States by 4%.[141]

Availability of Renewable Energy Sources

The amount of sunlight and wind energy that a country receives daily, both total and accessible amount, cannot be controlled; they depend on the location of the country. Due to the shape and tilt of the Earth, places closer to the Equator will generally receive more sunlight. The amount of accessible sunlight is also affected by the amount of cloudy days there are. The

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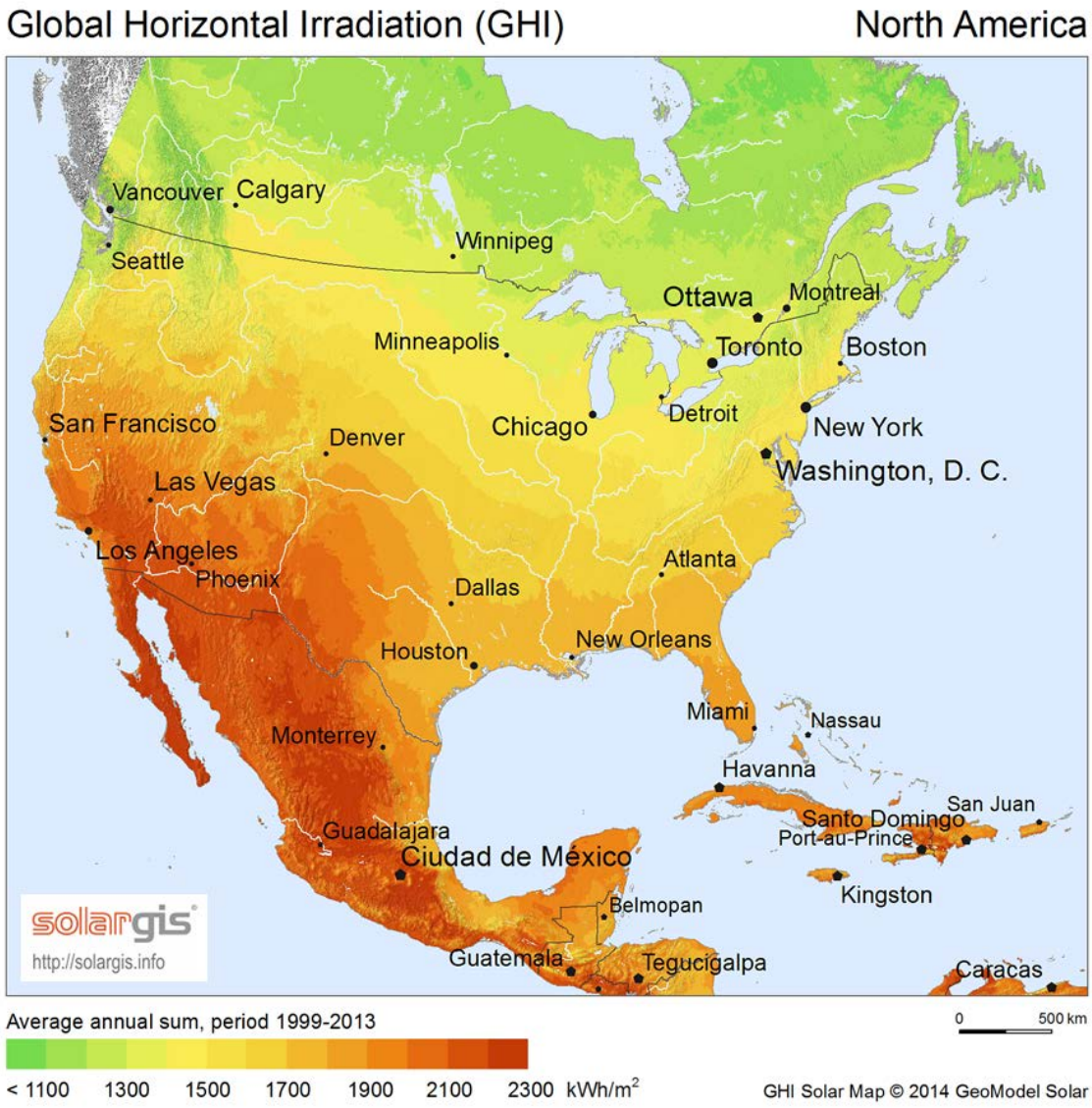
[136] "Can We Predict Earthquakes?" *Planet Science*. Nesta, n.d. Web. 20 Dec. 2015.
[137] "What Is A Hurricane?" *Natural Disasters Association*. N.p., n.d. Web. 20 Dec. 2015.
[138] Samost, Aubrey. "Predicting Hurricanes: A Not So Exact Science." *MIT*. MIT, n.d. Web. 20 Dec. 2015.
[139] "What Is A Hurricane?" *Natural Disasters Association*. N.p., n.d. Web. 20 Dec. 2015.
[140] "When and Where Do Hurricanes Occur?" *AccuWeather*. N.p., 30 Apr. 2010. Web. 20 Dec. 2015. <http://www.accuweather.com/en/weather-blogs/hurricanefacts/when-and-where-do-hurricanes-o/31028'>.
[141] "Factors Affecting Natural Gas Prices."US *Energy Information Administration*. EIA, 28 July 2015. Web. 20 Dec. 2015. <http://www.eia.gov/energyexplained/index.cfm?page=natural_gas_factors_affecting_prices>.

geography of a country affects the amount of accessible onshore wind. Although mountainous areas can be very windy, it is not as easily accessible as plains. Offshore wind capacity can increase if there is a good amount of coastline surrounding the country. Below are maps of North America and Europe showing how much sunlight each place receives annually and average wind speeds for both onshore and offshore areas.

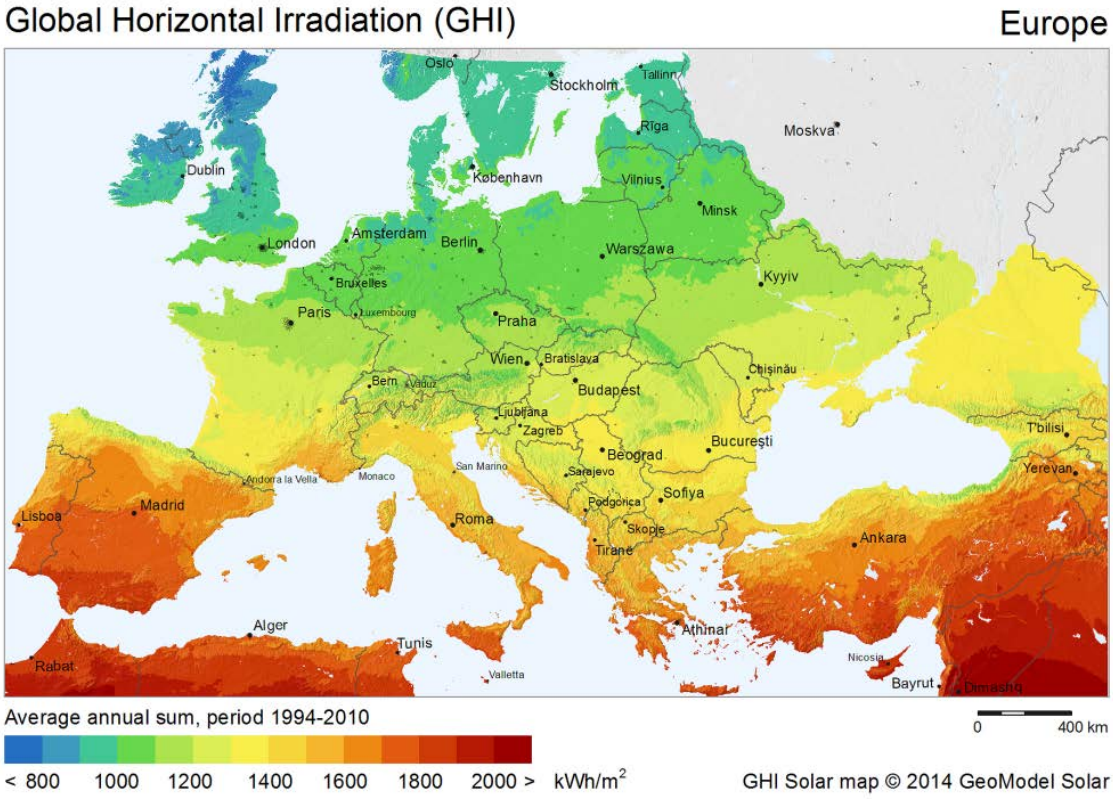
Figure 12[142]: Solar Irradiation in the United States



[142] SolarGIS. "Free Download of Solar Radiation Maps:Global Horizontal Irradiation (GHI)." *SolarGIS*. N.p., 2015. Web. 20 Dec. 2015.

The southwestern states, including Arizona, New Mexico, and Southern California, have the highest amount of annual solar irradiation in the country, reaching up to 2300 kWh/m^2. These areas are not very cloudy and have the highest potential for solar energy. Tucson, Arizona has an average of 193 clear days per year, which include days when clouds cover "up to 30% of the sky during daylight hours."[143] Tucson also has an average of 3806 hours of sunlight annually. Albuquerque, New Mexico has an average of 167 clear days and 3415 hours of annual sunlight while San Diego, California has an average of 146 clear days and 3055 hours of annual sunlight. Including days when clouds cover up to 70% of the sky during daylight hours, Tucson has an average of 284 days of sunlight annually, Albuquerque has 278 days, and San Diego has 263 days.[144] Some of the cloudiest places in the United States are in the northwest and the northeast, where solar irradiation reaches up to only about 1500 kWh/m^2. Seattle, Washington has an average of 226 days with heavy clouds while Buffalo, New York has 208 days.[145] These places are not quite ideal for solar energy, although it can still work in these areas.

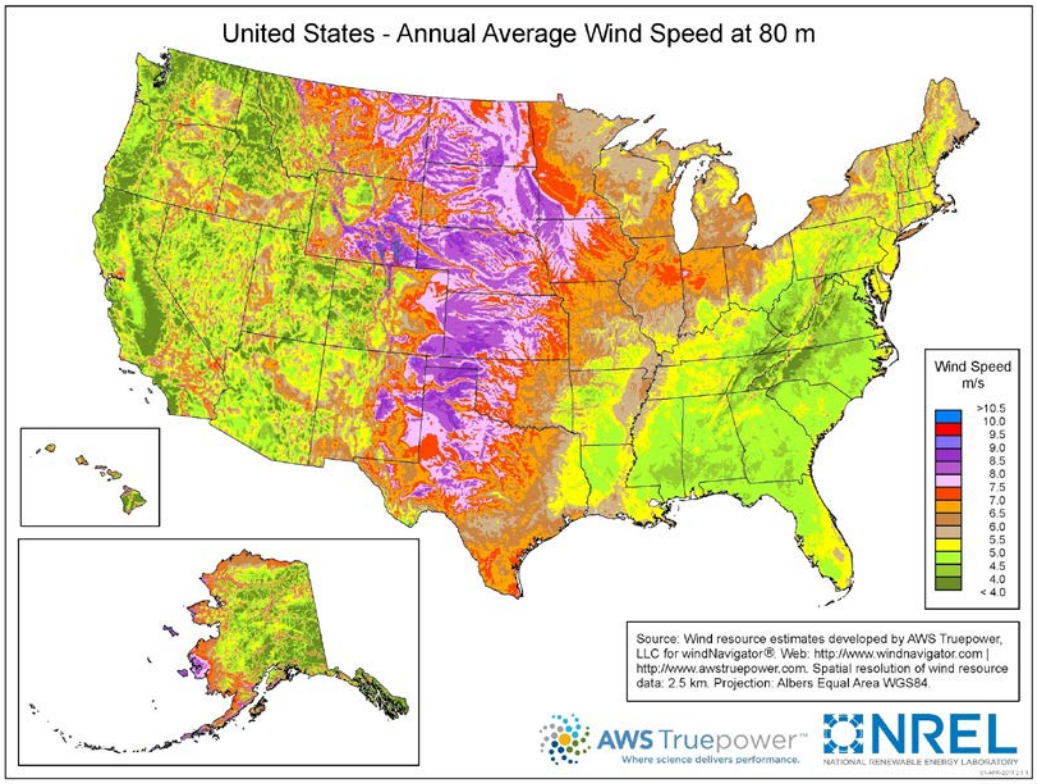
Figure 13[146]: Solar Irradiation in Europe



[143] "Average Annual Sunshine by State." *Current Results*. N.p., n.d. Web. 20 Dec. 2015.
[144] Ibid.
[145] Osborn, Liz. "Cloudiest Cities in America." *Current Results*. N.p., n.d. Web. 20 Dec. 2015.
[146] SolarGIS. "Free Download of Solar Radiation Maps:Global Horizontal Irradiation (GHI)." *SolarGIS*. N.p., 2015. Web. 20 Dec. 2015.

As seen from the map, the northern half of Germany receives 1000 to 1100 kWh/m^2 annually from solar irradiation while the southern half of Germany receives 1200 kWh/m^2 annually. Berlin, located in Northern Germany, receives 1625 hours of sunlight annually while Munich, located in Southern Germany, receives 1709 hours of sunlight annually.[147] Germany certainly does not receive as much sunlight as Southwest United States, but as a world leader in solar energy, it manages to use more of its potential than other countries. Denmark receives even less sunlight, with approximately 900 to 1000 kWh/m^2 annually, which contributes to reasons why Denmark uses more wind energy. Spain receives from 1200 kWh/m^2 annually at the northern border to approximately 1900 kWh/m^2 near the southern border of the country. The city of Pamplona in the northeast region has 2201 hours of sunlight annually while Madrid in the central region has 2769 hours of sunlight.[148] Spain has high potential for solar energy, especially the lower half of the country.

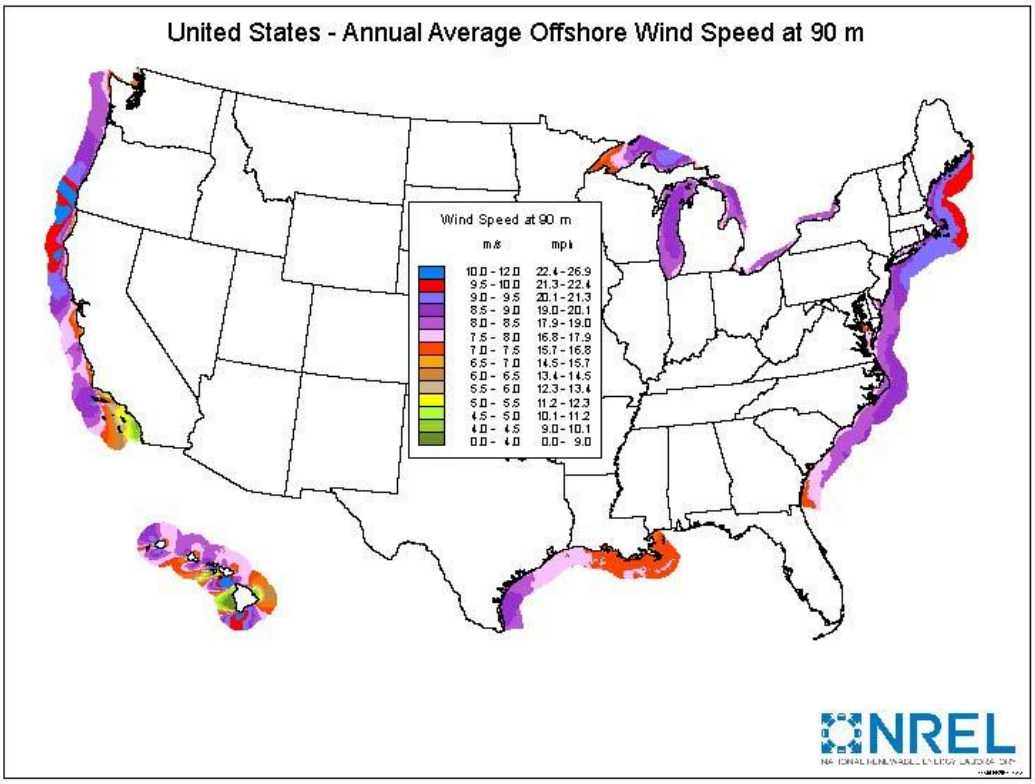
Figure 14[149]: Average Wind Speed at a height of 80 m in the United States



[147] "Average Sunshine a Year in Germany." *Current Results*. N.p., n.d. Web. 20 Dec. 2015.
[148] "Average Sunshine a Year in Spain." *Current Results*. N.p., n.d. Web. 20 Dec. 2015.
[149] "Wind Maps." *NREL*. Alliance for Sustainable Energy, 17 Sept. 2015. Web. 20 Dec. 2015.

The highest potential for wind energy in the United States is in the Midwest, including states from North Dakota down to Texas, where average wind speeds reach up to 9 m/s at a height of 80 meters, which is a common height for wind turbines. Because the Midwest is home to the Great Plains, a large area of flat land, there is a large amount of accessible wind energy. The rest of the United States have average wind speeds that range from 4 m/s to 6 m/s, which can certainly be used for wind energy, but not as much energy can be obtained.

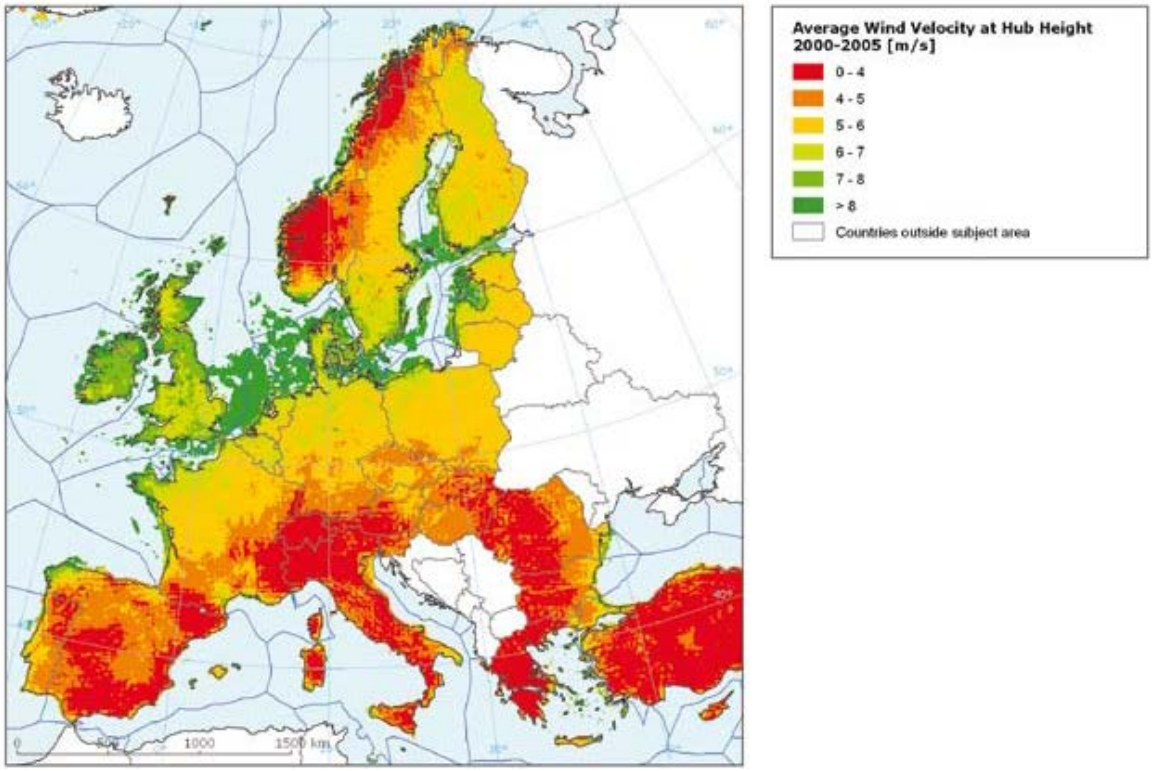
Figure 15[150]: Average Offshore Wind Speed at a height of 90 m in the United States



The United States has a good amount of offshore wind potential with coastlines on the east and west side. Average wind speeds vary quite a bit, but are greater than onshore speeds. Certain areas reach an average of 12 m/s while other areas reach 8 m/s. These high speeds are also present in the Great Lakes. The east coast can certainly use offshore wind effectively because it is not ideal for solar or onshore wind.

[150] Ibid.

Figure 16[151]: Average Wind Speed at heights of 80 m onshore and 120 m offshore in Europe



The map shows that Germany has average onshore wind speeds of 4 m/s to 7 m/s, Denmark has an average wind speed of about 7 m/s, and Spain has varying average wind speeds from less than 4 m/s in the southern half to about 6 m/s near the northern border. Although these speeds are not as high as the United States Midwest, they are still good speeds for wind energy. Out of the three countries, Spain has the lowest average speeds, but manages to be one of the world leaders in wind energy. The offshore area around Denmark and Germany reach average speeds of over 8 m/s, which explains why Denmark emphasizes more on offshore wind energy than onshore wind.

Availability of Local Fossil Fuels and Dependency on Foreign Fuels

Fossil fuels can be found underground all over the world. The amount of fossil fuels available to extract and use varies with geography and location. As consumption of fossil fuels continues to rise each year, the total reserves of fossil fuels will eventually be depleted in the distant future because they are nonrenewable sources of energy. The availability of fossil fuels in each country affects policies regarding where it gets its energy. A limited availability of fossil

[151] European Environment Agency. "Europe's Onshore and Offshore Wind Energy Potential." *European Environment Agency*. EEA, 8 June 2009. Web. 20 Dec. 2015.

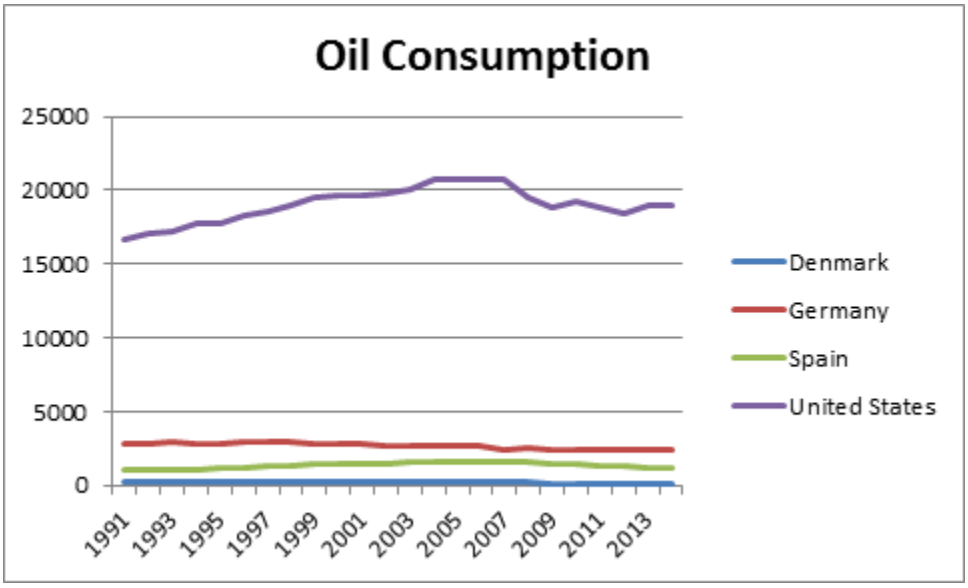
fuels in a country would mean that the energy must come from either renewable sources or from imported fossil fuels. A large supply of fossil fuels in a country would lead to policies that encourage the use of the fossil fuels due to the low cost of extraction and transportation. Below are charts and graphs that show how much Germany, Denmark, Spain, and the United States use oil, natural gas, and coal.

Figure 17[152]: Crude Oil Data in 2011, in thousand barrels per day

	Production	Imports	Exports	Consumption	Reserves*
Germany	161	1827	7.4	2392	0.3
Denmark	226	62	151	164	0.8
Spain	28	1121	0	1385	0.2
United States	10,128	10,406	334	18,882	25

*Reserves data in billion barrels

Figure 18[153]: Oil consumption trend from 1991 to 2014



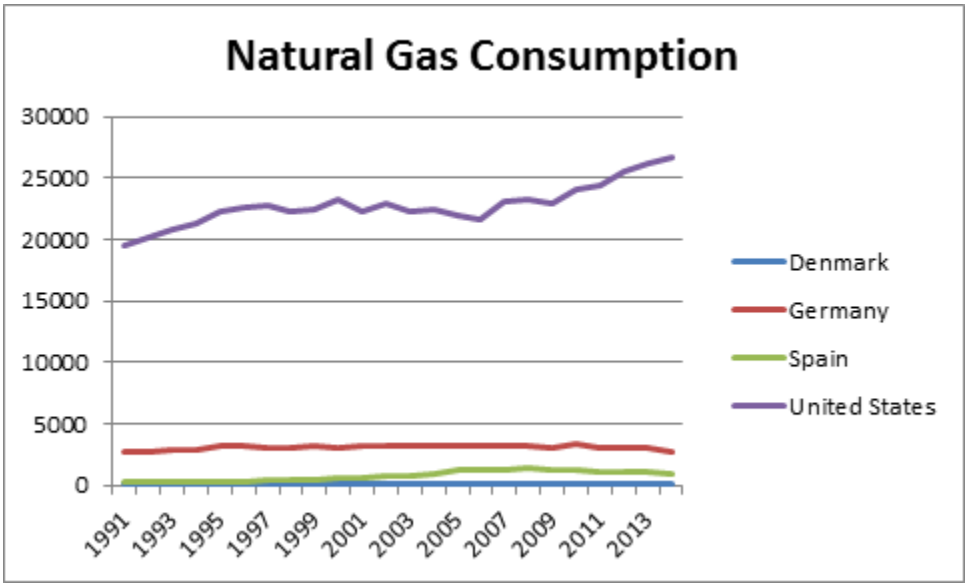
[152] EIA. "International Energy Statistics."U.S. *Energy Information Administration*. EIA, n.d. Web. 20 Dec. 2015.
[153] Ibid.

Figure 19[154]: Natural Gas Data in 2011, in billion cubic feet

	Production	Imports	Exports	Consumption	Reserves*
Germany	524	3166	622	3037	6.2
Denmark	250	13	110	148	2.1
Spain	1.8	1253	60	1175	0
United States	22,902	3469	1506	24,477	305

*Reserves in trillion cubic feet

Figure 20[155]: Natural gas consumption trend from 1991 to 2014



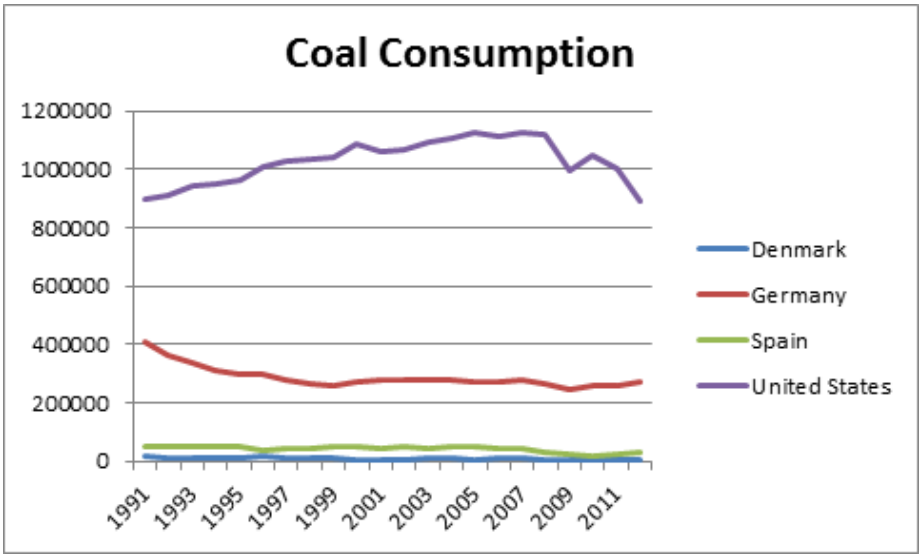
[154] Ibid.
[155] Ibid.

Figure 21[156] [157]: Coal Data in 2011, in thousand short tons

	Production	Imports	Exports	Consumption	Estimated Availability*
Germany	207,853	56,493	425	262245	44697
Denmark	0	6765	0	6021	0
Spain	7298	17,822	1312	25,773	584
United States	1,095,628	13,088	107,259	1,002,948	258,619

*Availability in million short tons

Figure 22[158]: Coal consumption trend from 1991 to 2012



[156] Ibid.
[157] "How Much Coal Is Left."U.S. *Energy Information Administration*. EIA, 16 Apr. 2015. Web. 20 Dec. 2015.
[158] EIA. "International Energy Statistics."U.S. *Energy Information Administration*. EIA, n.d. Web. 20 Dec. 2015.

Figure 23[159]: Electricity Data in 2011, in billion kWh

	Production	Imports	Exports	Consumption	Capacity
Germany	572	51	55	544	0.168
Denmark	34	12	10	33	0.014
Spain	278	7.9	14	246	0.101
United States	4100	52	15	3883	1.051

The data shows that the United States produces and consumes far more fossil fuels and electricity than the European countries due to the much larger population and economy. To meet the overwhelming energy needs of the country, it must use fossil fuels as a cheap source of energy. The United States has a large supply of all forms of fossil fuel, but must still rely on imported oil for about half of its consumption. The imported oil comes from about 75 different countries, but most of the oil comes from Canada, Saudi Arabia, Mexico, Venezuela, and Iraq.[160]

Germany began using a larger amount of coal in 2011 to replace the nuclear phase-out because it has a lot of coal available and coal is cheap. If Germany wants to limit the use of coal because of its environmental effects, then it must rely on importing natural gas from Russia. Companies in Germany have mixed opinions on this. Vattenfall wants to stop expanding its coal mines while RWE will continue to use coal.[161] Germany does not want to rely on Russia for natural gas because of security reasons with the Russia and Ukraine gas dispute, which encourages more promotion of renewable energy. Natural gas is used to provide the energy that solar cannot during peak hours, so if solar capacity increases, then Germany does not have to rely as much on Russian natural gas. The drop in solar prices has helped reduce natural gas reliance a lot.[162] Germany also heavily relies on Russia and Poland for its oil imports and on Norway and the Netherlands for the natural gas imports that does not come from Russia.[163]

During the 1973 oil crisis, Denmark imported over 90% of its oil.[164] Because of the carbon tax on oil, importing it is expensive. This situation led to the desire to be self-sustainable through renewable energy sources. Currently, Denmark has little to no coal available, so it must

[159] Ibid.
[160] "How Much Petroleum Does the United States Import and from Where?" U.S. *Energy Information Administration*. EIA, 14 Sept. 2015. Web. 20 Dec. 2015.
[161] Nicole, Stefan, Tino Andresen, and Brian Parkin. "Germany's Turn Against Coal Risks More Reliance on Russia." *Bloomberg.com*. Bloomberg, 3 Nov. 2014. Web. 20 Dec. 2015.
[162] "Germany's Reliance on Russian Gas Is Falling." *The Economist*. The Economist Newspaper, 26 Sept. 2014. Web. 20 Dec. 2015.
[163] EIA. "Germany."U.S. *Energy Information Administration*. EIA, Aug. 2015. Web. 20 Dec. 2015.
[164] "Denmark." *Think Global Green*. N.p., 2008. Web. 20 Dec. 2015.

rely on imports for its coal, mostly from Russia. It hopes to phase out coal by 2025,[165] which seems possible because a large percentage of its electricity has been from wind energy and all of its coal is imported.

Spain produces very little natural gas and relies on imports for natural gas. Unlike much of Europe, Spain does not need to rely on Russia for natural gas. Instead, it imports about half of the natural gas supply from Algeria and the rest from many other countries as liquefied natural gas. If pipelines are built from Spain to the rest of Europe to transport liquefied natural gas, then Europe does not have to depend as much on Russia for natural gas.[166]

[165] Doyle, Alister. "Denmark Considers Phasing out Coal by 2025 in Big Green Shift." *Reuters*. Thomson Reuters, 01 Nov. 2014. Web. 20 Dec. 2015.

[166] "Spanish MIDCAT Pipeline to Replace 10% of Russian Gas Imports." *EurActiv*. EurActiv, 28 Mar. 2014. Web. 20 Dec. 2015.

Conclusion

Energy policies in each country vary because of the differences in public opinion, government, and uncontrollable factors of each country. These three main factors also impact each other. Public opinion can greatly influence political leaders' actions. If the majority of the public approves or demands certain actions, such as going to war or implementing a carbon tax, then the leaders would be safe to execute the desired action with public support. Public opinion can also pressure leaders into unwanted situations because if they go against the public, then approval ratings would drop and they would most likely not be re-elected back into office. Likewise, the government can influence public opinion through political actors and social media. Presidential candidates have been appearing in popular talk shows to promote themselves by appearing more relatable to the public. This publicity can be used to persuade viewers to support future policies. Of course, political leaders have the final say in policies, but support of the public allows easy enforcement of the policies.

Uncontrollable factors have an effect on public opinion and government. News of unanticipated events such as war and natural disasters spread very quickly through social media and can increase awareness on the energy crisis, with the help of political actors. This can lead to public support and donations toward building new energy facilities and rebuilding old ones. With the public wanting to help those who are affected by the unanticipated events, political leaders must show that they support the cause as well. The availability of fossil fuels and renewable energy resources affects the cost of energy and the public's support for the use of certain types of energy. A large supply of fossil fuels lowers the price of energy, which encourages people to use more fossil fuels. A large supply of renewable energy also decreases the prices and allows renewable energy to be as competitive as fossil fuels. Policies are dictated by the prices of energy and which types of energy that the public is willing to use.

Part 3

Introduction

In order for the United States to succeed in the renewable energy industry, there must be multiple factors taken into account. In the two previous parts, data was gathered on countries which lead the renewable energy industry and also factors that affect policy making. By looking at countries like Germany, Spain and Denmark, and analyzing how they achieved their success in combination with background research done on them, can prove useful. In this way, solutions are able to be formed that suit the United States and help the country evolve its renewable energy sector.

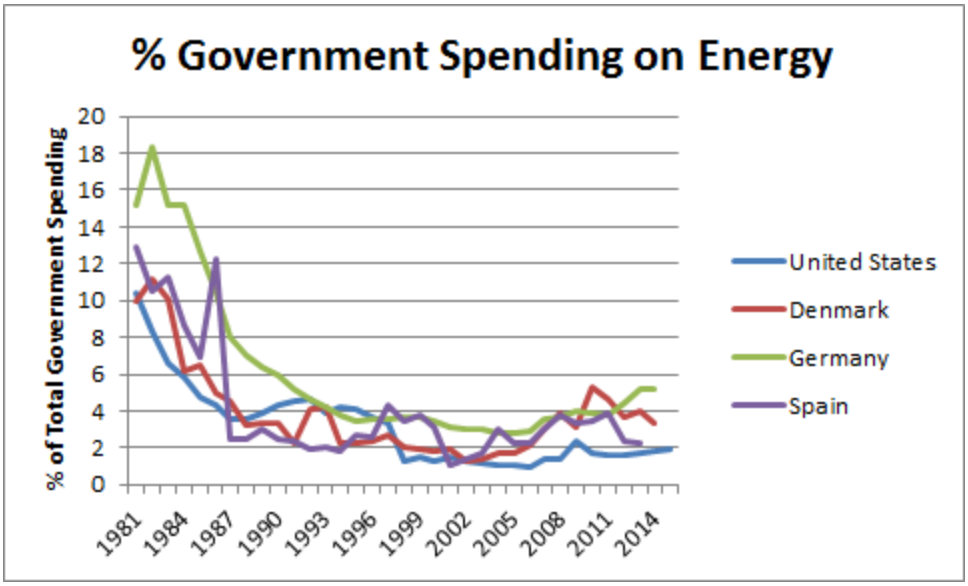
The list of solutions that would be most feasible for the United States includes a technological leap, change in energy prices, policy mechanisms/incentives, federal mandate, restructure of political parties, one-sided government, climate change, bandwagoning and phasing out of energies. All of the nine solutions were derived from understanding the European renewable giants' success and applying it to the United States, by taking into account the country's standards. In this paper there is also the assessment of the proposed solutions and a selection of the most plausible ones. Considering that there are many differences between Europe and the United States, most of them being cultural, it is difficult to evaluate the feasibility of the solutions presented. Even so, all factors were taken into account in order to produce a complete list which would prove vital for the success of renewable energy in the United States.

Technological Leap

New renewable energy technologies that have greater efficiencies will help the renewable energy market in the long term. In the United States, the best photovoltaic panels in the market currently reach up to about 20% to 25% efficiency while photovoltaic panels in the lab reach over 40% efficiency.[167] The more efficient panels made in the lab are very expensive and not economically viable yet. As the technology becomes more efficient, there is a smaller amount of installation required to obtain the necessary amount of energy. One way to speed up technological growth is to have the government invest more money into the energy sector, especially into research and development.

[167] Shahan, Zachary. "Which Solar Panels Are Most Efficient?" *CleanTechnica*. Sustainable Enterprises, Inc., 02 Feb. 2014. Web. 19 Feb. 2016.

Figure 24[168]: % of Government Spending on the Energy Sector



The graph shows that the United States has usually been using a slightly smaller percentage of the total government spending in the energy sector than the European countries since around 1998. In 2013, Denmark spent over double the percentage of spending than the United States while Germany spent just about triple the percentage. This means that the European countries are more dedicated to funding the energy sector than the United States. It is also important to note that a decent percentage of U.S. spending on energy goes into fossil fuels rather than renewable energy because of how reliant the U.S. is on fossil fuels. As time goes by and the supply of more efficient technologies rise, prices of renewables will slowly decrease until they become competitive with the cheapest fuels. It may be many years before more efficient technologies are in the market, but it is important to invest into research to make better technologies possible.

Along with efficiency, the appearance of the technology is important to consider because some people do not like the current appearance of solar panels or wind turbines. People will certainly be less likely to install photovoltaic panels on their roofs if they think it looks ugly. The large size of wind turbines can be annoying for some people as turbines can obstruct the beautiful view of nature from their windows. The noise pollution of wind turbines is also unappealing to many and will hopefully be reduced as technology continues to advance.

Having a smarter grid and better storage systems is important because solar and wind energy are unreliable at times. The ability to store excess solar energy during very sunny days or excess wind energy during very windy days in batteries, fuel cells, or similar technologies is very useful and important. It allows electricity to be constantly available, even during a cloudy night

[168] "Government Budget Appropriations or Outlays for RD." *Organisation for Economic Co-operation and Development*. OECD, 19 Feb. 2016. Web. 19 Feb. 2016. <http://stats.oecd.org/Index.aspx?DataSetCode=GBAORD_NABS2007>.

without wind. Having multiple sources of electricity readily available, which may include nuclear, hydropower, and geothermal, will provide energy security to the country.

Storage systems are currently expensive and require further research for better materials that are cheaper, more efficient, and longer-lasting. Homeowners with solar panels installed on their rooftops would greatly appreciate a cheap storage system so they can stay off the grid, even on cloudy days. It will, however, take time and investments for batteries and fuel cells to be viable. Until then, excess solar and wind energy generated will continue to be lost.

Transporting the electricity generated from solar and wind farms through transmission lines has the disadvantage of losing power over long distances. Electricity generated in places with very high solar potential, such as California and Arizona, cannot be used in New England, where there is much less solar potential because the power would all be lost before it would reach New England. Fully charged batteries can be used to transport electricity across the country, but it may not be practical if the batteries do not carry much electricity.

Advancements in technology are vital for the future of renewable energy because it can affect public opinion. Increased efficiencies and better appearances would make renewable technology more appealing to buy. A storage system allowing people to go off the grid would also encourage people to switch to renewables, especially if power outages occur often. An easy and efficient way to transport electricity would allow places that do not have much wind or solar potential to receive and use renewable energy. In order for these technologies to advance, it requires government investments and time to develop.

Change in Energy Prices

Fossil fuel prices in the European countries are generally higher than the prices in the United States. Because the fossil fuel resources in the European countries are rather low, a large amount of fossil fuels must be imported. Denmark in particular has little to no oil production so it must pay expensive import costs for its energy. In order to avoid paying unnecessary costs for energy, Denmark had to find a way to be self-sustaining without fossil fuels. Realizing that there was a good supply of wind in the country and in the country's shores, Denmark invested in wind technology. This caused Denmark to currently be one of the most successful countries in wind energy. Germany imports a large portion of its natural gas, most of it coming from Russia. Germany wants to avoid importing natural gas mostly because importing from Russia does not give its citizens energy security. Refusing to increase its use of coal, Germany's use of solar energy has increased to reduce the amount of imports needed. As seen from the successful European countries, renewable energy is able to compete with fossil fuels because of higher fossil fuel prices and the desire to be self-sustaining. The United States, on the other hand,

produces a great portion of its fossil fuels, keeping prices rather low. There is no reason to switch to renewable energy as long as more fossil fuel is being discovered and prices stay low.

The best way to promote the widespread use of renewable energy in the United States would be to manipulate energy prices so the cost of renewable energy will be cheaper than fossil fuels and then inform the public that switching to renewable energy would be cheaper. There are multiple options and scenarios where this situation may occur. Fossil fuel prices are controlled by supply and demand, so manipulating the supply of an energy source can increase the price of an energy source and force the country to find an alternative energy source or decrease the price of an energy source to promote the use of that energy source. This can be dangerous because the global economy can be influenced by energy prices as well, especially oil prices. Nevertheless, one possible method to promote renewable energy in the United States would be to set limits and regulations on the production of fossil fuels. The amount of fossil fuels that energy companies burn can be reduced through limits on carbon dioxide emissions or limits on the amount of fossil fuels burned. Another option is to phase out fracking to lower the amount of available oil and gas. States such as New York and Vermont have banned fracking because of its environmental impact. Without access to its own natural gas, these states must either implement renewable energy as an alternative or pay more to import natural gas from other states. Banning fracking in New York had little impact because there is not much natural gas supply in the state.[169] If a national phase out of fracking is initiated, then there will be more impact on the oil and gas supply. A lower supply would increase prices and help the renewable energy industry.

Oil supply can be disturbed if political conflicts occur in the Middle East because the United States relies on Middle Eastern countries for most of its imported oil. If these countries decide to stop exporting oil to the United States, then oil prices would increase and the United States would have to find alternative sources of fuel. Following the European countries, if the United States wants to stop relying on importing oil from foreign countries, then it must begin to invest in renewable energy to be more self-sustaining. The problem with this is that the United States still has a massive amount of fossil fuels available within the country. Waiting until all of the fossil fuel resources in the country run out is a last-resort option that can dramatically increase fossil fuel prices and eventually force the use of renewable energy.

Along with increasing fossil fuel prices, prices of renewable energy must be reduced. This can be achieved if the government invests in renewable energy technologies and companies. As new technologies are introduced, the materials required will become cheaper and more efficient. Renewable energy prices will be able to compete with fossil fuel prices and encourage more people to switch to renewable energy. This requires massive advertisements through the media because the public is mostly unaware of the prices of renewable energy. With the high

[169] Esch, Mary. "New York Fracking Ban Seen As Having Little Impact On Supply." *The Huffington Post*. TheHuffingtonPost.com, 10 Jan. 2015. Web. 19 Feb. 2016.

upfront costs of renewable energy, many people will have misconceptions on how they pay for energy.

All of these potential methods and situations will affect the public opinion of each energy source. Because people dislike paying high prices for electricity, there would be a lower favorability of fossil fuels if fossil fuel prices increase and stay at high prices. When renewable energy costs become low enough to compete with fossil fuel costs, public support for renewable energy will increase, providing more support to install solar and wind technologies at greater rates.

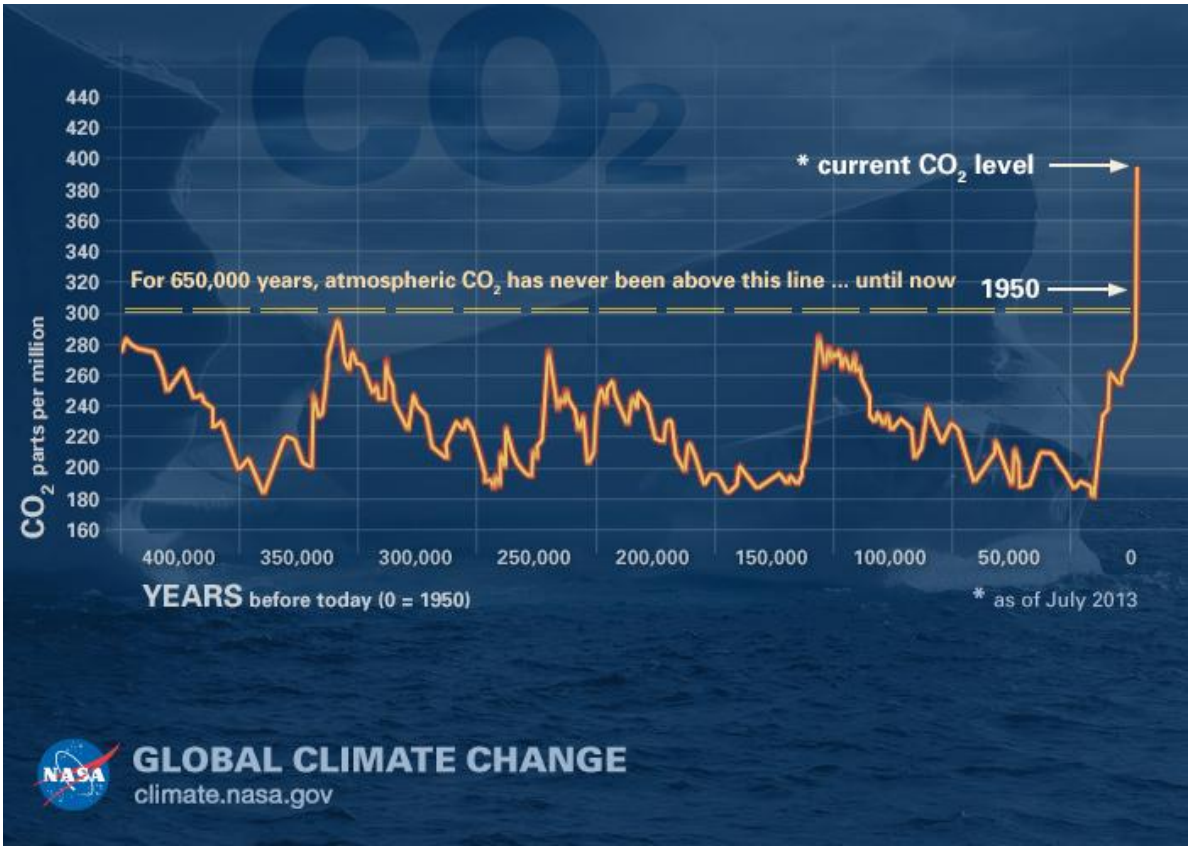
Change in Climate

Evidence of climate change can convince the public that the use of fossil fuels is damaging to the environment. Giving fossil fuels a bad image will decrease the support of fossil fuel use, which will promote renewable energy as an alternative energy source because renewable energy has minimal damage to the environment. Although 79% of people in the United States are aware that climate change is happening, about 50% are worried about it. The other 50% are not worried too much about climate change because they believe that it will only affect other species.[170] Even if people are aware of climate change, it is tough to convince them that they can make a difference by switching to renewable energy because it is nearly impossible to visually see the differences in the atmosphere. Each person's contributions seem insignificant out of millions and the climate is changing too slowly for people to care.

Showing the correlation between the carbon dioxide emissions from fossil fuels and the climate changes around the globe will help convince the public that climate change is an issue to worry about. The graph below shows that carbon dioxide levels have been in a stable cycle for the past 650,000 years and have only recently risen to high levels, shortly after the beginning of fossil fuel use during the industrial revolution.

[170] "American Opinions on Global Warming: A Yale/Gallup/Clearvision Poll." *Yale*. Yale University, n.d. Web. 19 Feb. 2016. <http://environment.yale.edu/climate-communication/article/american-opinions-on-global-warming-a-yale-gallup-clearvision-poll>.

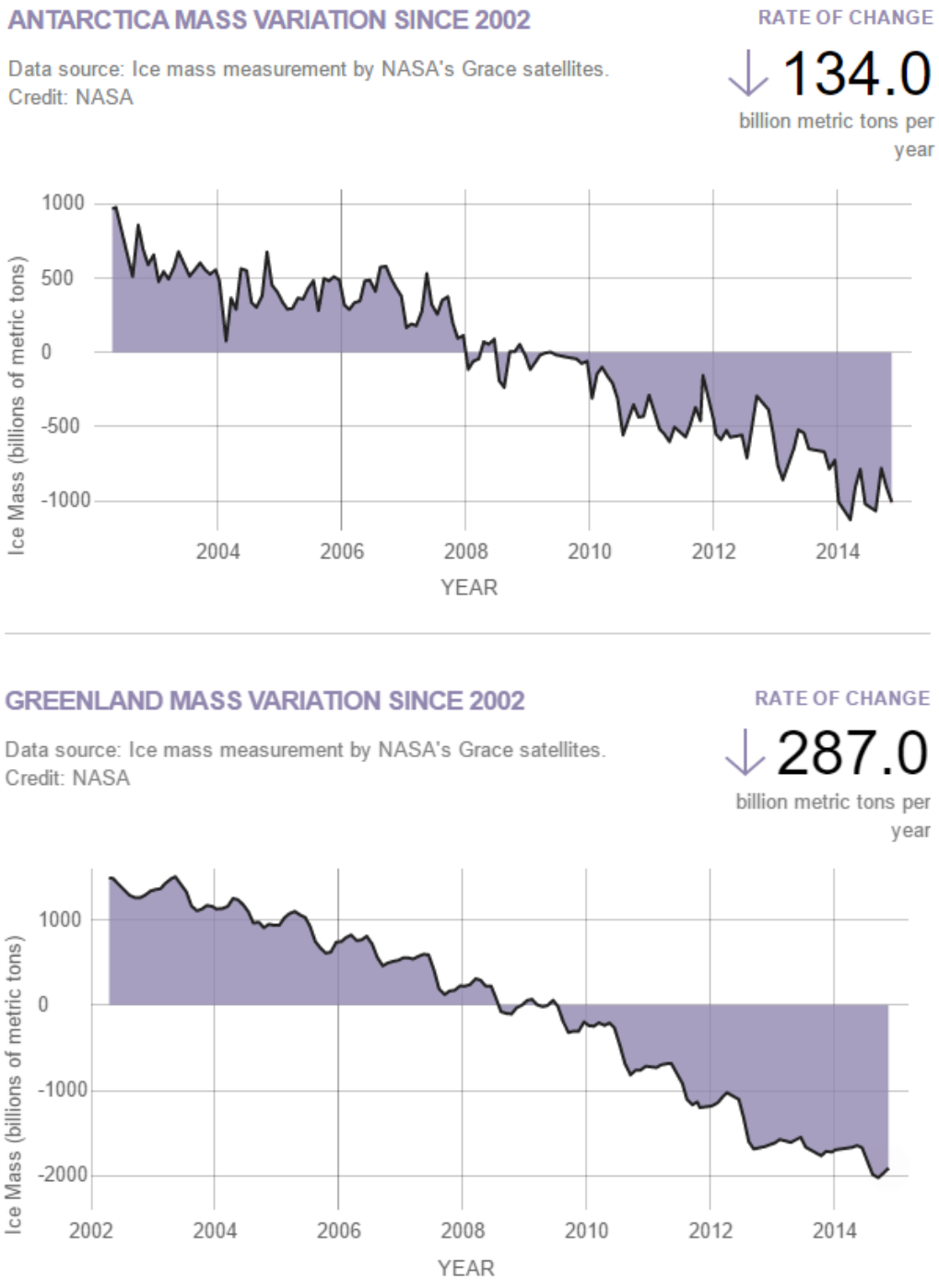
Figure 25[171]: Carbon dioxide concentration in the past 400,000 years



Studies have shown that the average global temperature has risen about 0.8°C since 1880. Most of the increase began in the late 1970s.[172] Land ice in Antarctica and Greenland has been losing mass at rates of 134 billion metric tons per year and 287 billion metric tons per year, respectively.

[171] "Climate Change: Vital Signs of the Planet." *NASA*. NASA, n.d. Web. 19 Feb. 2016.
[172] Ibid.

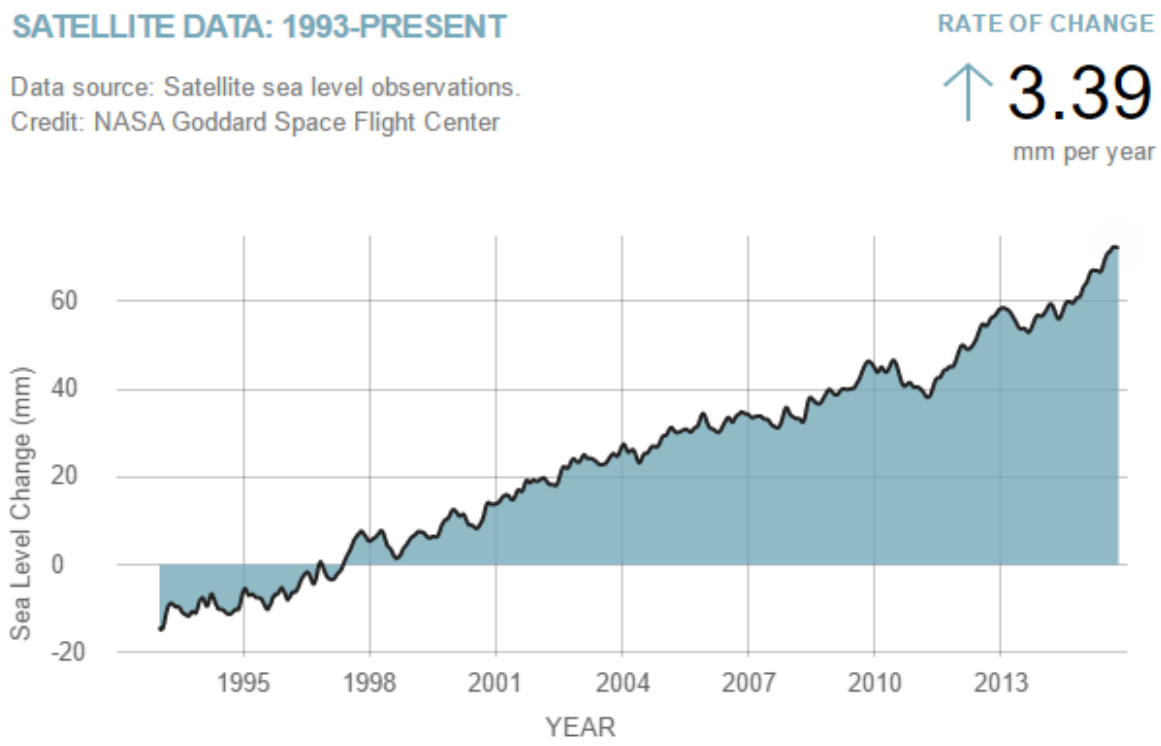
Figure 26[173]: Rate of melting ice mass in Antarctica and Greenland since 2002



The melting of the ice has contributed to the rising sea levels, which is increasing by about 3.4 millimeters every year. Although a few millimeters of extra water sounds insignificant, it accumulates quickly over time and coastal land is constantly being lost.

[173] Ibid.

Figure 27[174]: Change of sea level since 1993



There are many more climate effects from carbon dioxide emissions, such as more acidic oceans, more droughts, and stronger storms.

Portraying climate change as a major issue to worry about is important because awareness of the effects of fossil fuel usage will get more people to be against fossil fuels and be in support of renewable energy. The best way to inform the public would be to use mass media to show the correlations between rising carbon dioxide levels and the climate change trends. Proposing that renewable energy is the best alternative to fossil fuels and can eventually reverse the environmental damage through the lack of carbon dioxide emissions can be a good selling point. Television ads and social media sites are excellent ways to reach out to the public. One event on YouTube, which was called "#OursToLose," was a climate change awareness event held right before the 2015 Paris Climate Conference. YouTube promoted many informative videos on climate change on millions of users' homepages.

Storms have become about 10% stronger since 30 years ago.[175] Devastating storms can both help and hinder progress toward renewable energy. If storms are strong enough and hit the right places, they can damage coal, oil, and natural gas facilities, although it is becoming less

[174] Ibid.
[175] Rasmusssen, Carol. "Global Is the New Local: Pollution Changes Clouds, Climate Downstream." *NASA*. NASA, 26 Jan. 2015. Web. 19 Feb. 2016.

likely as these facilities are designed to resist severe weather. Power lines and renewable energy facilities can also be hit and slow the progress of renewable energy. Installed solar panels on buildings can also be lost in the storm. Storms, however, can also raise awareness on energy issues and lead to the rise of organizations dedicated to funding renewable energy projects, such as Brad Pitt's Make It Right Foundation emerging after Hurricane Katrina.

Increasing public awareness on climate change will slowly change the public opinion to more favorability of renewable energy because it will reduce the carbon dioxide levels and reduce the severity of future storms. Increased support for renewable energy will allow policies promoting renewable energy to be more effective. People will be more proactive and attempt to use more renewable energy for electricity.

Restructure of Parties

One of the biggest differences between the United States and the European countries that are being looked at is the party system that each respective country uses. Most countries utilize a multi-party system, while the U.S. is one of the very few countries that uses a two-party system. While there are many gripes with the two-party system, one of the main problems is that one party will always have majority in one or more parts of the government. When a party has majority, it can control much of the legislation that is being passed. If different branches of the government are controlled by different parties, the government will take much longer to make decisions. In Denmark, a single party has not held the majority of parliament in almost 107 years. The diverse number of parties that the political system of Denmark contains allows the denizens of the country to vote for the party that aligns with their views the most. In the United States, there are only two parties that are popular enough to vote for. That means that there are fewer platforms to choose from when picking candidates that support certain views. With only two different views, compared to the double digit numbers that other countries have, the two sides become extremely polarized. This is the current situation in the US, with the two separate parties almost coming to blows frequently, and decisions in Congress being argued about for ages. In Europe, where a multi-party system is widely used, multiple parties have to join together to form a coalition in order to attain majority. By coalescing, the parties have to make compromises with their most polarized views, actually depolarizing the government as a whole. A restructure of the party system to match this kind could change the way that the United States makes laws and progresses towards renewable energy.

It has been widely theorized that that U.S. is close to having its entire party system scrambled up and changed. In the next few years, one of the major two political parties could disappear entirely and one or more new parties could surface to take the reins. The Republican Party and their conservative views have been splitting recently, and has become less united. If

current trends persist, the party could lose any traction it currently has in presidential elections. If this were to happen, the Democratic Party would likely take control of the executive branch until a new party, or a couple new parties, rose up to challenge their views. The best possible outcome is for several new parties to arise that have green ideals. It's unfortunate that a majority of the country supports renewable energy but the polarization of the parties doesn't allow for much progress to be made to fix it[176]. Even if a new party doesn't inherently have green views, more than two parties will allow for a wider range of views, as well as reducing the amount of polarization present in the current administration. While a lot of Americans are stuck in their ways, if enough of the population started voting for third parties, a lot could change for the better.

One-Sided Government

In a country such as Denmark, the Parliament is the main law-making entity of the legislative branch. In these parliamentary countries, the party or coalition with majority elects the prime minister. In most cases, the executive and legislative branches are controlled by the same party or coalition of parties. This makes lawmaking in these countries a breeze compared to the U.S., with very limited opposition from parties with differing views. In the United States, things are a lot more difficult. While the Republican Party may have trouble winning future presidential elections, on a state-by-state basis, they are still the more popular party, currently owning a majority of seats in the Senate as well as the House. On the other hand, the Democratic Party currently holds the position of president and has a very good chance of winning the next presidential election as well. Having the executive and legislative branches controlled by two different parties makes law-making and other important processes much harder. If one branch wants to make a law, it has to go through the other branch first. That is why that many laws or acts that the House and Senate tried to make were vetoed by the president over the last couple of years. The opposite is also done, with the House and the Senate shutting down much of the president's legislation. A day of voting that resulting in both branches being led by the same party could change the U.S. for the better.

Compared to the United States, most of Europe is much more liberal. The three countries that were researched are all led by more liberal governments compared to the U.S. and all have many more green views. The prime minister and parliament of all three countries currently support renewable energy heavily enough to pass laws and acts supporting it and encouraging progress on it. The government of the United States is currently split between the Republican

[176] PennWell Corporation. "Poll: Americans Overwhelmingly Support Renewable Energy Incentives." *PennEnergy*. PennWell Corporation, 7 Apr. 2015. Web. 11 Feb. 2016.

Party, the more conservative one, and the Democratic Party, the liberal one. The government is very polarized and important bills are being killed over and over again. With elections approaching, there are two possible outcomes that could really change how the country works as a whole, as well as two outcomes that would keep the country in the impeded state that it's already in. If the Republican Party wins the presidential election and keeps control of the House and Senate, the country will definitely start making progress, just maybe not in the right direction. In this case the government would probably first focusing on fixing the economy. This would probably take several years, but after enough money is freed up, there is enough evidence to show that renewable energy is important enough for the Republican Party to at least look in the right direction. The problem with this outcome is that it will likely delay any progress in the right direction for several years, which could prove fatal to the environment. A better outcome for renewable energy would be if the Democratic Party wins the presidential ballot and takes over the House and Senate. Since the more liberal party entertains the idea of renewable energy much more, the issue would be leagues higher on the government's to-do list than if it were controlled by the Republicans. While it is not the first issue that the Democrats care about, it will get done years, if not decades, earlier than any other outcome. The last two outcomes are the worst options. If the government stays how it is, or even if it flops to the opposite parties controlling each branch, there will be trouble in passing any form of legislation. In those cases, the only possible solution would be for something to happen in the world that would actually change the views of both parties to make renewable energy an agreed upon, important topic.

Federal Mandate

Germany, Denmark, and Spain all have one huge factor in common when talking about renewable energy. They all have aggressive renewable energy federal mandates. All three countries have rules about renewable energy that are enforced to some degree and have helped the countries prosper in the clean energy field. In the United States, there is no federal mandate. A scattering of states have their own mandates, but not all of them are nearly as strict as they should be, and very few of them have good enough punishments, let alone enforce them.

One of the first steps toward becoming self-sustainable would be to create a federal mandate. Alone, however, a mandate won't do much. The punishments and how those punishments are enforced are mainly what cause companies and cities to follow the rules. The punishments have to be strict enough to cause organizations to switch to renewables, but not strict enough where they would be too harmful to companies or not be enforced. The same is true for the goals of the mandate. The goal is for the country to eventually be self-sustainable, but such an endeavor takes time. Some of the reasons that the country does not already have a mandate could be due to its size. The sheer size of the country makes making a uniform mandate

a nightmare. While one side of the country will have insane amounts of one resource, like wind or sunlight, the other side of the country might not have any of the same. It would be way too hard to make a mandate that was possible for every state to accomplish. A solution to this problem would be to have an overall federal mandate, but tailored to specific state circumstances. The mandate could require states that are using a lot of coal to slowly phase it out and switch to a cleaner fuel like natural gas and require states that are already using the cleaner alternative to switch even further to renewables. States with many more resources can focus on the switch to renewables, while states with few renewable resources can focus more on areas of conservation and energy efficiency.

A federal mandate can also be very difficult to implement because each state relies on different fuel sources for energy. States such as Texas generating wind energy would support a reasonable national goal if it is similar to the goal already implemented in the state. Other states, such as Wyoming, produce a massive amount of fossil fuels and would not be happy with an aggressive national goal to switch to renewable energy. Reducing fossil fuel consumption would put many people out of their jobs and smaller fossil fuel companies would shut down.

During the Obama administration, an environmental policy known as the Clean Power Plan was proposed. This set a national goal to reduce carbon emissions by 32% from 2005 levels by 2030.[177] Many states and some energy companies opposed the policy because of how much damage it will cause to the fossil fuel industry. They filed a lawsuit against the EPA claiming that they were attempting to take over state power plants.[178] The Supreme Court temporarily blocked the policy from taking effect.[179] This is just one of the myriad of examples of why there is no current federal mandate in the United States.

Policy Mechanisms and Incentives

One of the most feasible and effective solutions for the United States would be policy mechanisms and incentives. The European countries that are being looked at, like Germany and Denmark, have used such “techniques” in order to promote the use and production of renewable energy by enforcing energy policies as well as appealing to public opinion, by giving the customers benefits. Examples of such incentives and mechanisms would be a carbon tax, a tax credit and also a feed-in tariff.

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[177] "Climate Change and President Obama's Action Plan." *The White House*. The White House, n.d. Web. 19 Feb. 2016. <https://www.whitehouse.gov/climate-change>.

[178] Bentsen, Lloyd. "Clean Power Plan Opposition Grows." *NCPA*. NCPA, 28 Oct. 2015. Web. 19 Feb. 2016.

[179] Liptak, Adam, and Coral Davenport. "Supreme Court Deals Blow to Obama’s Efforts to Regulate Coal Emissions." *The New York Times*. The New York Times, 09 Feb. 2016. Web. 19 Feb. 2016. <http://www.nytimes.com/2016/02/10/us/politics/supreme-court-blocks-obama-epa-coal-emissions-regulations.html?_r=1>.

A carbon tax is an “upstream” tax on the carbon contents of fossil fuels (coal, oil and natural gas) and biofuels. A U.S. carbon tax will transform energy investment, re-shape consumption, and sharply reduce the carbon emissions that are driving global warming. It would be the most efficient means to instill crucial price signals that spur carbon-reducing investment. Other than that, carbon taxing will raise fossil fuel prices and act also act as an antidote to rigged corporate energy pricing. The impact of higher prices on households can be softened through dividends (revenue distributions) reducing other taxes that discourage hiring and investing (tax-shifting).[180] It is believed that by returning at least 70% of carbon tax revenues to consumers as dividends would be a smart move. The return could be increased, as long as the consumer is involved more with the renewable energy sources, such as installing solar panels for electricity. The major setback of this solution is that the United States hasn’t had a national carbon tax, because there is opposition from certain states. Also Republicans are generally opposed to new or increased taxes, therefore it would make it quite difficult to kick start the whole process. Despite the disadvantages, this solution is worth the effort. Germany and Denmark have been using carbon taxes for at least 15 years now and are currently leading the renewable energy industry, so there is a lot of potential in this solution.

Another crucial incentive is tax credit. This is technically a tax incentive which allows certain taxpayers to subtract the amount of the credit from the total that they owe to the state. More specifically this could be applied to taxpayers who are more involved with renewable energy (e.g. home production) in order to promote alternative sources of energy. Most tax credits are nonrefundable, meaning that the credits can only be used to decrease the tax total to zero. However some of them are refundable, allowing the taxpayer to receive the excess amount of credit in money, or in future taxes. In this way the taxpayer would want to produce as much renewable energy as possible, in order to reduce, or even eliminate, the total taxes owed to the state.[181]

Moreover feed-in tariffs have been successful in Europe as an incentive to generate more renewable energy. This policy allows renewable energy companies to sell the power generated for a set price. The additional upfront costs of renewable energy were distributed to all customers through increased electricity bills instead of just those who consumed renewable energy. The feed-in tariff rate decreases over time to encourage technological advancements and cost reduction. However, people are becoming unhappy with the decreasing rates because it is not helping technological advancements and the electricity bills are become too steep. In 1978, the United States passed a similar policy called the Public Utility Regulatory Policy Act (PURPA) to reduce dependency on foreign oil because of the expected rise in oil prices. PURPA required

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[180] "Carbon Tax Center." Carbon Tax Center. N.p., n.d. Web. 15 Feb. 2016. <http://www.carbontax.org/>.

[181] "Tax Credit." *Wikipedia*. Wikimedia Foundation, 5 Mar. 2014. Web. 02 Mar. 2016. <https://en.wikipedia.org/wiki/Tax_credit>.

utilities to buy power from small power-generating companies that could produce power cheaper than what it would have cost the utilities to generate the power. This promoted renewable energy for a while, but eventually became ineffective for renewable energy when oil prices began to drop and natural gas supply increased to the point where it became much cheaper to buy than renewable energy.[182][183] Because of the initial success of PURPA, a new and better policy similar to PURPA and feed-in tariffs may be the necessary incentive to greatly promote renewable energy.

Bandwagoning

When OPEC decided to make an oil embargo in the 70's, the entire continent of Europe, along with the rest of the world, was devastated by the rise of oil prices. Places such as Denmark, that imported most of their fuel, had to adapt quickly. When citizens decided to take the issue into their own hands and started building their own wind turbines, the government saw the possibilities and joined in. The second oil crisis was inflating prices when the world discovered the devastating effects of acid rain and what they were doing to cause it. West Germany commissioned its first wind farm and decided to combat the destructive nature of fossil fuels with renewable energy. Sometimes it only takes one success to change the tide of an era.

In the United States, there hasn't been that one big success that the government and the public could latch on to. While there have been small advances here and there in the renewable energy field, there hasn't been anything major that could prove to the country how effective the switch would be. Several big projects have been very close to happening, but have failed. In the northeast, where wind and coastline are both prevalent entities, a giant wind farm, on the shore or off of it, could prove extremely beneficial to the culture of renewable energy in the country. In recent years a project called Cape Wind was created to try and create a massive offshore wind farm off of Cape Cod. The project was approved, but unfortunately, as one of the contracts expired, the major electric companies pulled out, effectively killing the project. The project is in the process of trying to be revived, so it may see success in the near future. One can only hope that a project like this happens. The success of such a project will motivate others to follow suit, jumping on the proverbial bandwagon. When one business experiences major success, business interest grows in other places. Even though Cape Wind necessarily failed, the infrastructure that had to be built in order to accommodate the giant project has already been built and paid for. In order to build a giant offshore wind farm, the city of New Bedford had to renovate its entire

[182] "Public Utility Regulatory Policy Act (PURPA)." *Union of Concerned Scientists*. N.p., n.d. Web. 19 Feb. 2016.
[183] Beck, Fredric, and Eric Martinot. "Renewable Energy Policies and Barriers." (n.d.): n. pag. Web. 19 Feb. 2016. <http://www.martinot.info/Beck_Martinot_AP.pdf>.

port[184]. Even though the project is no longer happening, the port with wind energy capability still exists. For future projects, this giant infrastructure cost is already paid for. It should be much easier for another company to attempt to make another offshore wind farm. Hopefully, once the wagon gets rolling, it won't stop until the country is self-sustaining.

Ownership of Companies

As far as company ownership is concerned there is a major difference between the United States and the European countries. In Europe the majority of renewable energy companies are state-owned whereas in the United States they are privately-owned. Even though there are some advantages when it comes to the privatization of such companies, they are not enough to overshadow the disadvantages. One of the reasons why renewable energy companies perform better in countries like Germany, Spain and Denmark is because they are state-owned and they enjoy all the advantages that come with that.

State-owned companies provide essential services to the people at cheaper and affordable rates. In contrast with private enterprises, making profit is not the sole aim and therefore consumers avoid paying a great deal of money for these services. Also they help the government to control certain strategic sectors of the economy, such as the renewable energy sector, and therefore boost the country's output. One of the reasons why the "Energiewende" plan in Germany was such a success was because the government owned and controlled most companies. As a result it was easier for them to meet the renewable energy goals and even surpass expectations faster than the deadline. In the case of state-owned enterprises more jobs are created, too.[185]

One of the main disadvantages of privately owned enterprises is that investment is perceived risky and basically its business growth depends on the ability to find private backers to invest money. The transparency and accessibility of public companies makes the decision to invest easier. Moreover when it comes to renewable energy, the profit motive isn't the primary objective of firms and the industry in general. Being a private energy company means that greater priority is given to profit rather than help make the transition to renewable energy easier. The consequence is loss of public interest, which is one of the most important factors affecting renewable energy policy success.[186]

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[184] Moore, Kirk. "Massachusetts Wind Port Gets First Delivery." *WorkBoat*. Diversified Communications, 7 July 2015. Web. 11 Feb. 2016.

[185] "Advantages and Disadvantages Of State Owned Enterprises - Hosbeg.com." *Hosbegcom*. N.p., 08 Dec. 2013. Web. 02 Mar. 2016. <http://hosbeg.com/advantages-and-disadvantages-of-state-owned-enterprises/>.

[186] Roberts, Stacey. "The Disadvantages of a Privately Held Company." *The Disadvantages of a Privately Held Company*. Demand Media, n.d. Web. 02 Mar. 2016. <http://smallbusiness.chron.com/disadvantages-

It is in the interest of the United States to change the ownership of energy companies in order to be able to evolve the industry. State-owned enterprises clearly have the upper hand in the renewable energy sector compared to private ones. Companies in Europe like DONG, which operate under state ownership, are advancing and their success aids the expansion of the renewable energy sector. The U.S. could take a lesson from this and switch to state-owned instead of private firms in order to improve in the energy sector.

Phasing Out

Germany until March 2011 obtained 25% of its electricity from nuclear energy, using 17 reactors. The figure is now about 16% from 8 reactors. The government had the phasing out of nuclear energy as a feature of its energy policies since 1998 and that helped shut down a lot of reactors. Public opinion remains broadly opposed to nuclear power with virtually no support for building new nuclear plants.[187] Therefore the number of reactors can only decrease. The phase-out of nuclear energy in Germany is giving room for alternative energy sources, like solar and wind energy, to become more popular. Policies were adopted to promote renewable sources and as a result nowadays Germany has the one of the largest solar and wind capacities in Europe. The United States could learn from this "move" and also follow a nuclear phase-out. It would definitely support solar and wind, as well as other sources of energy, and make the public happy, since the majority, if not everybody, "fears" the dangers of nuclear reactors.

There are many reasons why a nuclear phase-out would be beneficial to any country. One of them is that even though renewable resources generate less energy than nuclear power plants, renewable technologies offer more jobs. Specifically in Germany they offer almost five times more and as the renewables become bigger players in energy production the number of jobs created increases respectively. Another reason why a nuclear phase-out is desirable is the fact that it allows countries, like Germany, Spain and Denmark, to become leaders in alternative technologies. This innovative attitude in Europe has opened many opportunities on the world market. In general the phasing out of nuclear energy is cost effective as well, since there is less competition between the energy sectors and saves money for the government (less subsidies) as well as consumers (part of the cost of nuclear electricity is paid with regular tax).[188]

Although a nuclear phase-out would give many opportunities to alternative energies, like renewables, the same applies for energy sources like coal. Coal has been a major player in the energy source business and if countries were to take it out of the game, as well as nuclear, then

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privately-held-company-22597.html>.

[187] *Nuclear Power in Germany*. N.p., 30 Nov. 2015. Web. 02 Mar. 2016. <http://www.world-nuclear.org/information-library/country-profiles/countries-g-n/germany.aspx>.

[188] "Time for Change." *Nuclear Power Phase-out Pros and Cons*. N.p., n.d. Web. 02 Mar. 2016. <http://timeforchange.org/nuclear-power-phase-out-pros-and-cons>.

renewable energy consumption would increase even more. Already coal consumption is dropping quite fast in the United States, so this could be an opportunity to proceed with the phase-out.

Conclusion

Countries in Europe such as Germany, Spain and Denmark are the current leaders in solar and wind energy production. Such countries have made great progress in the renewable energy sector and they make a good example for the United States to follow. In order to become a big player in renewables, the United States could learn a lot from the methods and techniques practiced in these European countries. This would allow a more frequent use of renewable energy sources and a smoother transition towards a renewable energy-dependent society. It is of great importance to switch to electricity produced by renewables, since it offers many advantages, and it is of greater importance to reduce fossil fuel consumption and stop damaging the environment in general.

Even though Germany doesn't get a lot of sun annually, it still excels in solar energy production and has one of the largest solar capacities in the world. This shows that not only the government through policies, but other factors, too, made a difference in achieving success in the renewable energy sector. By taking the most important factors into account, these solutions were created, accustomed to the needs of the United States, in order to provide methods for successful policy making. This list of nine solutions includes the phasing out of certain energy sources (like nuclear or coal), a technological breakthrough (introduction of new, more efficient technology), climate failure or drastic change, and bandwagoning. The rest of the list contains solutions that concern the government and the economy of the United States a bit more, like introducing a federal mandate, changing the ownership of companies, using policy mechanisms and incentives, restructuring political parties and last but not least having a one-sided government.

While all of these situations are plausible, some are more plausible than others considering current circumstances in the United States. By far the most plausible option is a giant bound in renewable energy technology. In fact, new ways of looking at renewable energy are being discovered every day; it is only a matter of time before there is a big breakthrough. Another very likely situation is bandwagoning. Like the famous gold rush, a company 'hitting pay dirt' in the renewable energy industry could cause the market to grow at an astounding rate. The third very plausible situation is the creation or improvement of policy incentives that will motivate companies to make a switch to a renewable energy, whether it be from making those energies cheaper, or taxing fossil fuels. On the other end of the spectrum, there are situations that may never happen in the current climate of the country. A restructure of the political parties, for example, is not likely to happen in the next few years. The population's current tendency to stay very polarized and not vote for third parties will persist for many years. The ownership of

companies is also not very likely to change unless huge incentives provoked companies to do so. A phasing out of an energy source, as Germany is phasing out nuclear power, will eventually have to happen as resources dwindle, but the likeliness of the U.S. doing it before that is less than likely. It would take a major world event to make the public and government abhor a specific energy. In the middle of the spectrum are the scenarios that very well could happen, although some might happen in the wrong way and potentially hurt the country more than help it. A federal mandate has a very good chance of happening in the near future, but whether or not it will be enforced correctly, or if it will be aggressive enough to make progress is another question. A government controlled by one party actually has a very good chance of happening, but with the current progress of the country, it may be the wrong party that obtains power and little progress will be made towards renewable energy. Finally, although prices of renewable energies will continue to drop, so will the prices of fossil fuels over the next couple years. Until fuel production starts to slow across the world, prices will likely stay competitive with many alternative forms of energy.

Where the country will be in the next couple decades, no one can accurately predict. Based on current trends, a prediction has been made to where the country will be by the year 2050. At first, the United States will transition to renewable energy rather slowly because there are conflicting views on the energy issue in the government. Attempts made by the president to pass a renewable energy policy usually do not go through the Congress with Republican majority. Progress will also be hindered because of a lack of a federal mandate. In 2014, renewable energy accounted for about 13% of the electricity generated and 10% of total energy in the United States[189]. It is possible that this number can reach up to about 25% of electricity generated by 2030 and 60% by 2050, assuming there will be continued support of renewable energy in the next few decades. These goals can be even higher if the United States makes changes based on the suggestions given above. A hopeful goal would be to have at least 80% of electricity come from renewable energy by 2050.

[189] "How Much U.S. Energy Consumption and Electricity Generation Comes from Renewable Sources?" *US Energy Information Administration*. EIA, 31 Mar. 2015. Web. 19 Feb. 2016. <http://www.eia.gov/tools/faqs/faq.cfm?id=92&t=4>.