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Strategic Changes to Enable Increase in US Wind Energy Production

By

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Abstract

Renewable energy is not new to the United States. To the contrary, the United States has been investing in it for decades. Today, it is often a source of policy legislation and, especially, debate among government leaders. Commentators believe that wind will play an important role in renewable energy development (Hitaj 1, "Renewable Energy Sources," Saidur 1745). The focus of this thesis is to address two questions: 1) how should the United States finance and support wind energy, and 2) what stakeholders are important to incentivize and work with to ensure that wind energy development occurs successfully?

Research shows that although the United States has invested in renewable energy for decades, it has much to learn from other world leaders in renewable energy investment and use. Germany leverages grassroots support through community cooperatives and clear country-wide targets with implementation strategies, such as incentives for utility companies (Shukla and Sawyer 64-71). In another successful example, China utilizes long-term national policies and targets, a strong industrial development base, and implementation incentives to have an unprecedented wind energy growth rate in the 2000s (Shukla and Sawyer 44-49). While Germany and China both make transparent government policies and targets in support of wind energy, the United States shows uncertainty in the market by lacking long term development strategies and incentives (Shukla and Sawyer 134-141).

Thus, although the United States has been investing in wind energy for over three decades, competitive strategies are still necessary in order to continue growth and maintain leadership globally in renewable energy. One of the most pressing components of these strategies is financing and methods of support. In order to stay competitive and support growth, the United States government needs to support financing programs for wind energy in both current forms, such as tax incentives, and new forms, like feed-in tariffs. Secondly, the US must develop a strategy for offshore wind development and extend the supportive financing programs to the strategy. Additionally, the federal government needs to recognize that country-wide and minimum state targets with accountability measures for utility companies are important for the implementation and adaptation of these initiatives. This makes it crucial for government leaders to work in a bi-partisan way to set goals and show support for growth in the wind industry. Lastly, developing creative partnerships with and incentives for businesses, such as with those trying to offset carbon footprints, can unlock support and adoption of wind energy.

CONTENTS

Introduction

In 2011, the United States was the second largest wind energy market in the world (Shukla and Sawyer 134). At the end of 2012, however, amongst the fiscal cliff policy dilemmas, Congress still had not given certainty to investors of policy extensions for wind investment. In legislation passed to avoid the fiscal cliff, Congress did include US tax credit extensions for producers of wind power, providing credit for ten years to wind farms that are under construction by the end of 2013 (Galbraith). But did the legislation come too late, and without enough time to launch plans before the construction deadline expires? It is predicted that 2013 installations of wind systems will decline in the US due to reduced production as a result of the negative financial climate, uncertainty about future government support, and the lateness of the tax credit legislation at the end of 2012. Additionally, wind power developers see potential in focusing on other countries because of the unpredictability of tax credit extensions in the US, credits that again expire at the end of 2013 (Galbraith). This uncertain future for wind energy paints a bleak picture for hopes of growth and innovation in wind energy in the United States.

Commentators believe that wind will play an important role in renewable energy development (Hitaj 1, "Renewable Energy Sources," Saidur 1745). The focus of this thesis is to address two questions: 1) how should the United States finance and support wind energy, and 2) what stakeholders are important to incentivize and work with to ensure that wind energy development occurs successfully?

For the purposes of this thesis, it will be assumed that the United States should support investment in wind energy. With this assumption, although the United States has been investing in wind energy for over three decades (Shukla and Sawyer 135-139), competitive strategies are still necessary in order to continue growth and maintain leadership globally in renewable energy.

One of the most pressing components of these strategies is financing. In order to stay competitive and support growth, the United States government needs to support financing programs for wind energy in both current forms and new forms. Secondly, the US must develop a strategy for offshore wind development and extend the supportive financing programs to the strategy. Additionally, the federal government needs to recognize that country-wide and minimum state targets with accountability measures for utility companies are important for the implementation and adaptation of these initiatives. This makes it crucial for government leaders to work in a bi-partisan way to set goals and show support for growth in the wind industry. Lastly, developing creative partnerships with and incentives for businesses, such as with those trying to offset carbon footprints, can unlock support and adoption of wind energy.

Roadmap

In order to support the assertions above, this thesis will begin with a background of renewable energy and wind energy. This will be followed by three sections describing current and future plans for financing wind energy and factors that can affect its success in 1) the United States, 2) Germany, and 3) China. Next, the current and future states of these three countries will be compared and analyzed, drawing conclusions about why Germany and China are surpassing the United States in financing and motivating people around wind energy. Finally, based on this analysis, the positions on how the US should finance wind energy and what stakeholders are important in making its financing successful will be supported by recommendations on what the United States can do to continue leadership in wind energy.

The issue of renewable energy

In August 2013, the Clean Energy Victory Bond Act of 2012 was introduced to the 112th Congress. The bill's intention was to promote the domestic development and implementation of clean energy technologies required for the 21st century. In the Library of Congress summary of the bill, several key provisions are highlighted: tax credits and grants for investment in renewable energy, including small wind energy property and offshore wind facilities (Filner).

The motivation behind the victory bonds comes from the fact that a major barrier to growth of renewable energy and energy efficiency in the US is upfront capital costs, which comes from technological development and manufacturing. Though government tax incentives and various assistance programs are supporting these efforts, they do not meet the demand potential, leaving potential for growth untapped. The victory bonds were proposed because bonds are low-cost, not needing direct budget allocations, and would create business revenues and increase Federal tax revenues (Filner). In WWII, over $2 trillion in today's dollars was raised through victory bonds ("American Sustainable Business Council" 63-64). Thus, through the Act, victory bonds would raise revenue for energy tax benefits and supporting programs in wind, solar, energy efficiency, and electric vehicles ("Take Action").

Although the bill's motivations - financing renewable energy - are clear, the best method for doing so, by tax credits, bonds, etc., is less clear. The Clean Energy Victory Bond Act of 2012 was referred to committee, where it died, perhaps because of poor timing with the election or because of a lack of clarity on financing (Filner). Although this bill died in committee, the issue of renewable energy and why it is important to the national business environment is very much alive. Further, this issue is crucial to the US because, according to Dr. Sabine Miltner of Deutsche Bank, 1) clean energy financing is growing substantially in Germany; 2) China is

growing in many renewable energy markets; and 3) "the United States is falling behind in renewable energy and energy efficiency" ("Clean Energy Financing: What Works?").

The relationship between energy and the environment ties business and policy. Research shows that the United States is very rich in domestic energy resources, including oil and natural gas (Anonymous). However, the questions around harm to the environment and the sustainability of these resources challenge us to continue exploration and innovation in renewable energy and clean energy technologies. Though rich in natural resources, the US has the opportunity to lead in the development and deployment of renewable energy ("American Sustainable Business Council" 63-64). However, while the US has invented many of the current technologies, China and Germany are ahead in manufacturing and deployment ("US Lags Behind China").

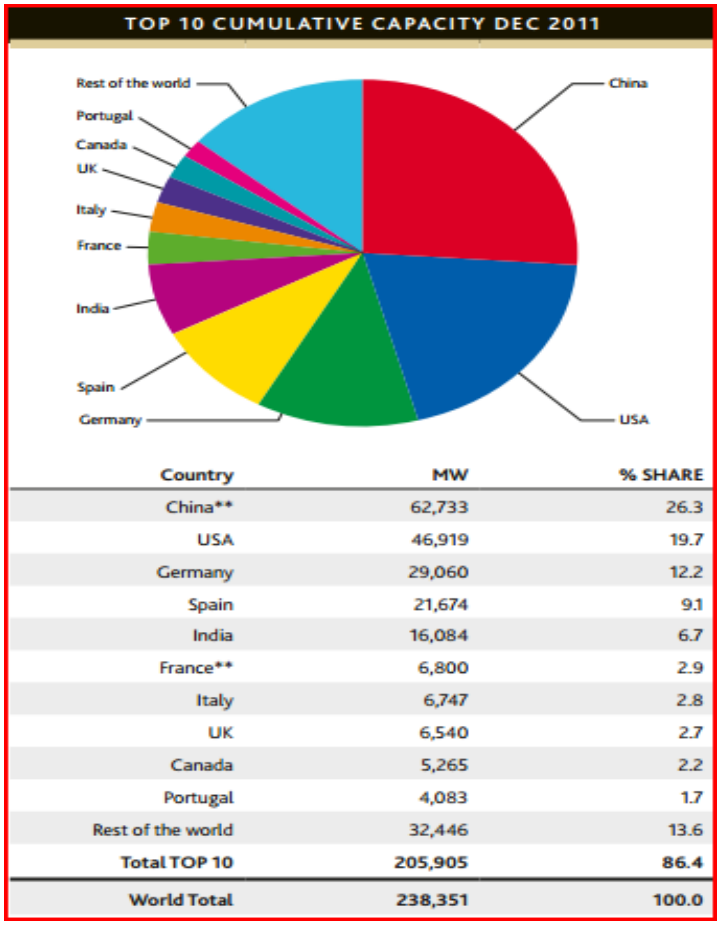
This leads to a call to action for the US: thinking extensively about what the path in renewable energy will look like in the next several decades, a topic which many countries, including China and Germany, are contemplating (Shukla and Sawyer 44-49, 134-141). And this call to action will depend heavily on the ties of business and policy, as, for example, solar and wind are projected to experience decreasing costs, and policy, such as the wind Production Tax Credit (PTC, **Appendix 1**), which was just given a one year renewal at the end of 2012, can influence strategies for development ("Clean Energy Financing: What Works?"). Thus, this discussion on renewable energy suggests that renewable energy is important globally, that strategic policy will be crucial in staying competitive in a global market, and that deciding on financing methods for investments is difficult, and, if not done carefully, can cause uncertainty for investors about the industry's viability compared to other energy sources. In order to better understand the role of wind energy in renewable energy, the next section will give an overview of the global wind power industry and why it is important.

Background of wind energy

What is it, and why is it important?

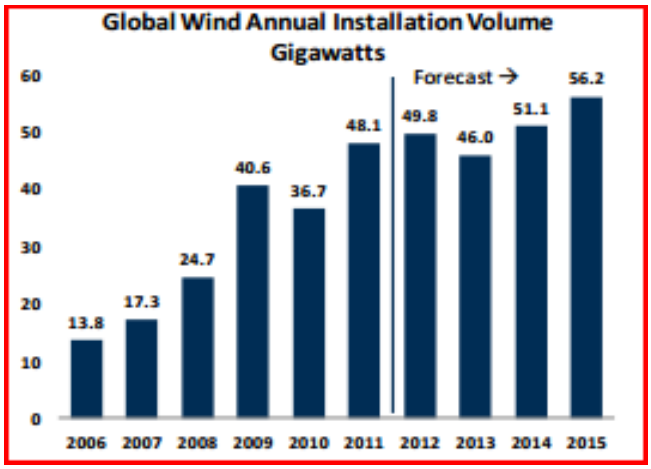
Wind energy is the world's fastest growing renewable energy source. It is a renewable energy in which wind turbines (**Appendix 1**) produce electricity in a cleaner way than coal and natural gas. Europe has used wind energy for centuries and in the last several decades, the rest of the world joined (Saidur 1745). As of 2010, 2% of the world's power consumption came from wind power (*Offshore Wind Power* 2011).

The graph below shows that China, the US, and Germany were leaders in wind energy capacity at the end of 2011. The fact that Germany produces a comparable amount of wind energy but is much smaller in both geographic size and population suggests that the US is not doing all that it can do to utilize wind energy capabilities (Global Wind Statistics 3).



Country	MW	% SHARE
China**	62,733	26.3
USA	46,919	19.7
Germany	29,060	12.2
Spain	21,674	9.1
India	16,084	6.7
France**	6,800	2.9
Italy	6,747	2.8
UK	6,540	2.7
Canada	5,265	2.2
Portugal	4,083	1.7
Rest of the world	32,446	13.6
Total TOP 10	**205,905**	**86.4**
World Total	**238,351**	**100.0**

Looking forward, research shows that electrical energy demand will increase in following decades because of economical and technological advancements, with the greatest increase coming from wind power (Saidur 1746). To illustrate the overall trend of wind energy growth, the graph below shows the global wind installation over time and how it is forecasted to increase through 2015 (Clean Energy Policy 2).



Policy to promote the use of wind energy varies among countries. Common policies include pricing laws, quota requirements, production incentives, tax credits, and more. Two of the most popular methods are feed-in tariffs (FiTs, **Appendix 1)** and renewable purchase specifications standards (RPS, **Appendix 1**, Saidur 1747).

The profitability of wind power is determined by factors such as windiness in an area, reliability, and distance to an electricity transmission grid (**Appendix 1**). Regarding windiness, doubling wind speed causes power generation to increase eight times, making location critical. For reliability, many turbines find a 25-40 percent capacity factor common. Lastly, if new turbine owners bear the cost of connecting to the grid as is the case in the US, then the cost to the new turbine owner increases the further the turbine from the grid (Hitaj 2). However, when speaking costs, it is important to note that wind energy has lower upfront capital costs than solar

energy and can utilize production tax credits in the first few years because of higher pre-tax net income received over the first decade (Fisher 2).

As mentioned previously, this thesis focuses on wind energy investment and financing in the United States, Germany, and China. While the United States invests in wind energy, it is projected to lag behind other renewable energy leaders, such as Germany and China (Clean Energy Policy 2). The next section examines the history, current state, and future of wind power in the United States, Germany, and China, highlighting important policy and financing methods used in each respective country.

Wind energy in three major markets

Part 1: United States

Section 1: Country Background

Below is a table with general information about the United States that can be compared with similar tables for Germany and China later in this thesis ("GDP per Capita (current US$)," "United States").

Characteristic	Description
GDP per capita, 2011	$48,112
Population, 2011	311.6 million
Government System	Federal republic with two legislative houses
Economic System	Market economy
Geographic Area	3,678,190 square miles

United States Wind Industry

The table below shows key statistics of the US wind power industry in 2013 to understand its size (Sherman 3).

Key Statistics	Amount
Revenue	$4.8 Billion
Profit	$1.4 Billion
Annual Growth 2008-2013	14.7%
Annual Expected Growth 2013-2018	9.6%
Wages	$196.9 Million
Number of Businesses	90

Section 2: Financing methods

History of wind energy in the United States

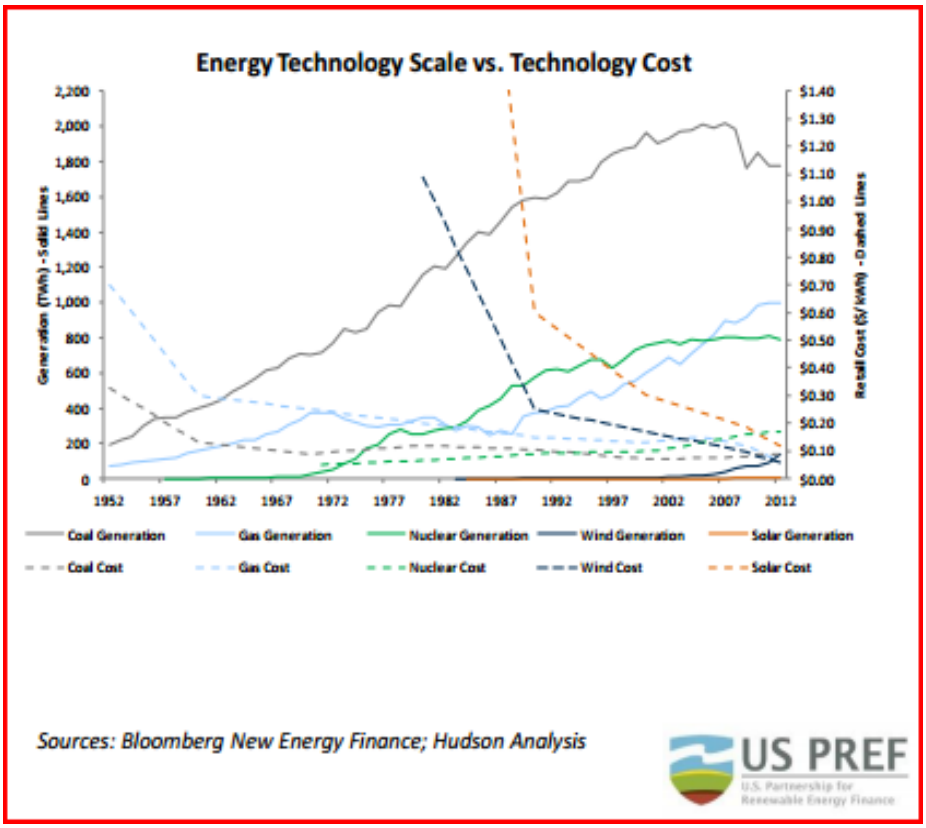
The US was one of the first countries to support wind energy because of a sense of urgency from the oil-shock of the 1970s. However, the legislation to promote development, Public Utility Regulatory Policies Act of 1978, lost support by the mid-1980s, and wind energy did not regain momentum until the late 1990s. But some important legislation was put into place, including the Energy Policy Act of 1992, the policies of which were just extended for one year at the end of 2012. During the early decades, wind installation occurred on a state-by-state basis. For example, California supported installation and in the 1980s, it introduced an investment tax, which, along with tax credits, helped develop the first utility-scale wind farm (**Appendix 1**).

The early 2000s experienced periods of increasing costs for wind installations because of expirations of federal tax credits. In 2005, the Energy Policy Act was extended and expanded tax credits for investment and production. Below is a chart of various pieces of legislation in the 2000s, primarily focused on tax credits, the effectiveness and difficulty of which will be discussed in the section on current financing (Shukla and Sawyer 135-139).

Phase 3: Summary of key legislation passed between 2002 and 2010	
2002	Farm Security and Rural Investment Act of 2002, called the "Farm Bill". The Farm Bill was revised in 2008, and will be in effect till 2012.
2005	Energy Policy Act of 2005, which extended and expanded the coverage of production and investment tax credits.
2008	2008 Bill "Title IX: Energy" established a Rural Energy for America Program under Section 9007.
2009	American Recovery and Reinvestment Act, which included several provisions to support wind energy.
2009	Production tax credit renewal for three years (2010-2012).
2010	Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act. Under this Act, projects (including wind energy) in service or under construction by 2011 became eligible to the U.S. Treasury grant programme.

Investments Benefits

Because of policies in the past two decades that have driven investment, if uncertain, in wind energy in the US, the industry has experienced equipment cost reduction of 40%, and total costs are moving toward grid parity (**Appendix 1**). The below graph indicates that as wind generation has increased over time, costs have decreased. This is consistent with the coal, natural gas, and nuclear power generation industries, as scale was crucial for reaching competitive costs, and even more so in these industries than in wind energy - for each unit of wind generation, costs decrease more than for the aforesaid industries (Clean Energy Policy 2).



Despite the existence of short-term legislation supporting wind energy and investment benefits, the growth of the wind industry in the US has been intermittent because of a lack of long-term policy certainty for investors (Shukla and Sawyer 139).

Current state of wind energy in the United States

In 2011, the United States was the second largest wind energy producer in the world (Shukla and Sawyer 134). Additionally, wind energy provided 2.9% of power generation in the United States. The graph below illustrates the increased growth rate of wind installation since 2008, much of which is attributed to state and local policies (Shukla and Sawyer 134, 144).

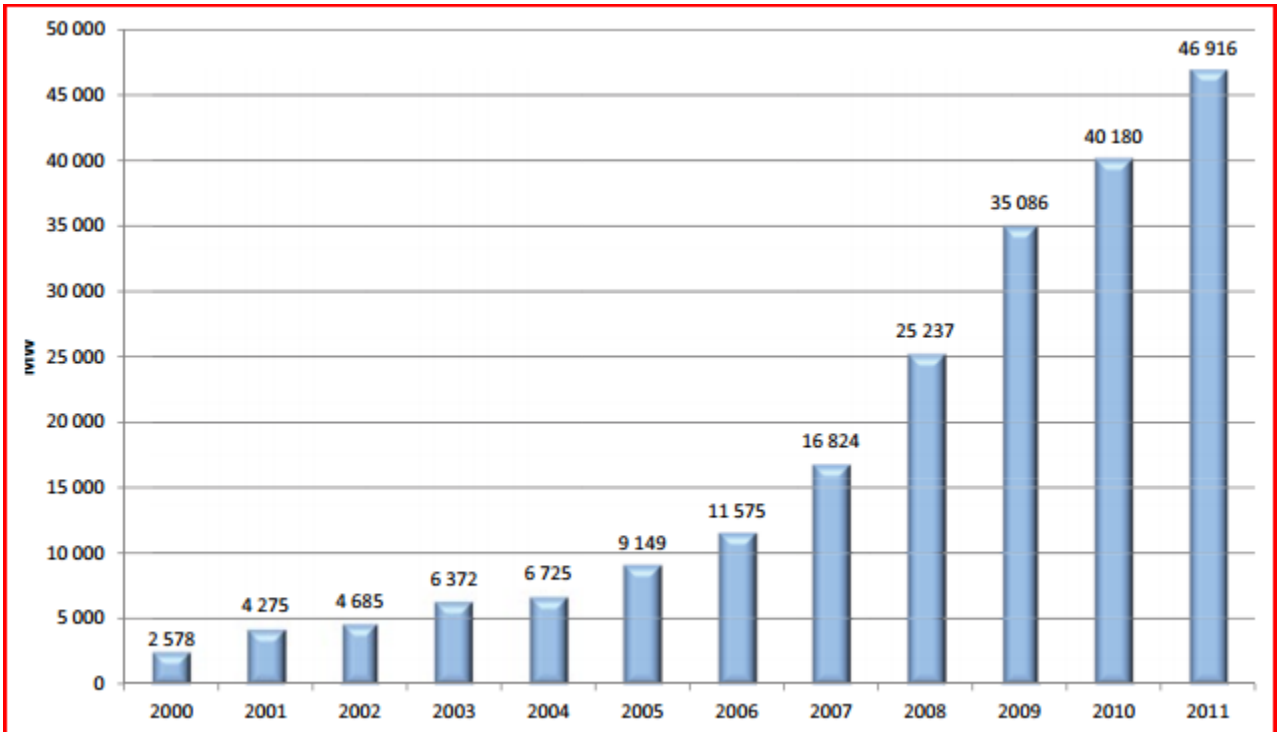


Figure 19: Cumulative Wind Installation (MW) of the USA (GWEC, 2011)

From its current state of being as a large wind producer, it is not evident that there is a problem. However, in the following sections, possibilities for change will reveal how the United States has much more potential in wind energy projects and could reach higher percentages than 2.9% of power generation.

Method of Financing

At the federal level, the United States offers companies 1) tax credits, 2) low-interest loans, and 3) tax-free Clean Renewable Energy Bonds (CREBs) for public colleges and universities (Nelson), rural electric cooperatives, and municipally-owned utilities ("American Sustainable Business Council") to invest in the production of wind energy. Specifically, the wind industry relies heavily on government incentives in the form of tax credits, including the Renewable Energy Production Tax Credit ("Renewable Electricity Production Tax Credit") and the Business Energy Investment Tax Credit ("Business Energy Investment Tax Credit"). The wind production tax credit legislation has expired three times since it was first enacted in the early 1990s. This has caused a start and stop pattern of turbine installations (Wald, "Developers of Wind Farms"). The three occasions in 1999, 2001, and 2003 caused annual installed capacity to fall 93%, 73%, and 77% respectively (*Clean Energy Policy* 5).

More recently, the legislation put in place to avoid the fiscal cliff at the end of 2012 included US tax credit extensions for producers of wind power, providing credit for ten years to wind farms that are under construction by the end of 2013 (Galbraith). However, since the companies eligible for these federal tax incentives need to have substantial and predictable tax liabilities, developers of wind energy often have to enter into intricate financial arrangements with outside investors. This method of financing in which outside investors provide the capital needed and then benefit from tax incentives is called tax-equity financing (**Appendix 1**). What it does is install barriers for investors and companies that want to participate directly in the wind energy market (Sheridan 1), with high professional service transaction fees (Fisher 2). After the 2008 global financial crisis, the US financed wind energy through cash grants (**Appendix 1**) as a

part of the American Recovery and Reinvestment Act, providing approved projects with a Treasury grant for thirty percent of the upfront costs (Sheridan 1).

The breakdown of financing in 2011 included $7.5 billion for renewable energy projects, with tax-equity financing providing $3.6 billion and the remaining $3.9 billion coming from cash grants (Fisher 1). Cash grants were successful in helping to finance projects but expired in 2011, leaving tax credit as primary incentives (Sheridan 1). The chart below shows that cash grants are a more cost effective finance method than tax equity financing (Fisher 3).

Specific Costs of Tax Equity Financing

Category	Cost to Sponsor of Tax Equity	Cost to Sponsor of Cash Grant
Attestation	-	$75k-$150k
Legal Documentation/Tax Opinion	$350k	-
Independent Engineer	$150k	-
Syndication Fees (may or may not be needed)	0.5% of tax equity amount	-
Pre-Tax Cost of capital during construction period	12%-13%	3-5% / year of cash grant amount during construction period[(1)]

(1) Assumes the project sponsor will also issue additional project level debt

Equity partners are hesitant to enter into a capital structure in which debt is part of the financing because the debt holders have the first claim on the project's assets. Equity partners who do enter such a structure often require a 2-3% premium on a pre-tax basis. With cash grants, a new entity citing claims on assets is not introduced, so combining debt financing is easier. Additionally, the cost of capital of projects using a tax-equity method and without cash grants is higher, which is passed on as higher cost of electricity (Fisher 4).

Financing Methods Summary

Because different methods of financing wind energy have different costs and benefits from the perspective of the investor, the inconsistent and last-minute policy endeavors by the federal government leave uncertainty in the US wind power industry. The uncertainty is a significant problem because long-term investment plans, such as in additional wind farms or offshore wind energy which will be discussed next, cannot gain financial support. Evidence comes from a stop and start pattern of wind turbine installation observed in the US when tax credit legislation expired three times (Wald, "Developers of Wind Farms").

Small Steps in Offshore Wind Production in the US

The uncertainty and lagging in the US described above results in the US not having offshore wind farms (**Appendix 1**). Contrarily, in mid 2011, Europe had close to fifty offshore wind farms. In mid-December 2012, the US Department of Energy announced that to spur the offshore wind industry, it will award $28 million in grants to seven projects developing offshore wind power generating technologies, with up to $47 million awarded to three of the seven projects for implementation by 2017 (Hurdle).

Speaking to the possibilities that successful implementation offers, CFO Graeme Walker of Baryonyx, a Texan company wanting to build offshore wind farms, finds that the scale of power production possible from offshore wind farms in the US will eventually bring down the price of the electricity generated (Reed). His thoughts are echoed in an industry report of wind power in the US (Sherman 9). Walker also foresees lower prices for offshore wind turbines, as Chinese and non-Western manufacturers of these turbines expand and European companies must lower prices to remain competitive (Reed). These possibilities suggest small steps for the US wind industry if implemented successfully and with continued support by the government.

Section 3: Projections for the future

Wind Market Uncertainty in the US

It is predicted that 2013 installations of wind systems will decline due to the reduced production in the US because of the negative financial climate in 2012, uncertainty about future government support, and the lateness of the tax credit legislation at the end of 2012. Additionally, wind power developers see potential in focusing on other countries because of the unpredictability about tax credits in the US, credits that again expire at the end of 2013 (Galbraith). The low price of electricity in the US, because of high supply of electricity as a result of the abundance of natural gas from hydraulic fracturing, also leads US wind developers to look elsewhere (Galbraith).

However, researchers find that wind production in the US could be profitable if turbines were taller and able to harness more energy or installed in the most favorable areas where wind is the strongest, like in the Midwest. Taller turbines are inherently more expensive, and the problem with location is twofold. First, many of the favorable locations are saturated with turbines already. Second, other favorable areas are generally in rural regions where transmission is difficult. Therefore, in order to profit without tax credits, an extension of the power grid is needed in order to produce in the Midwest, transmit, and then sell where prices for electricity are higher - generally the on the coasts (Wald, "An Industry's Future")

Potential within the States

In the US since 2010, progress is occurring at the state level as states have constructed their own plans using Renewable Purchase Specifications (RPS, **Appendix 1**), requiring a certain amount of electricity sales to come from renewable energy sources. States like California and Texas lead in wind energy development, and twenty-nine other states have set mandatory targets.

Between 1999 and 2008, 67% of the added wind capacity came from states with these specifications. The image below gives a good illustration of the targets for wind power installations put in by state as of 2011 (Shukla and Sawyer 140-141).

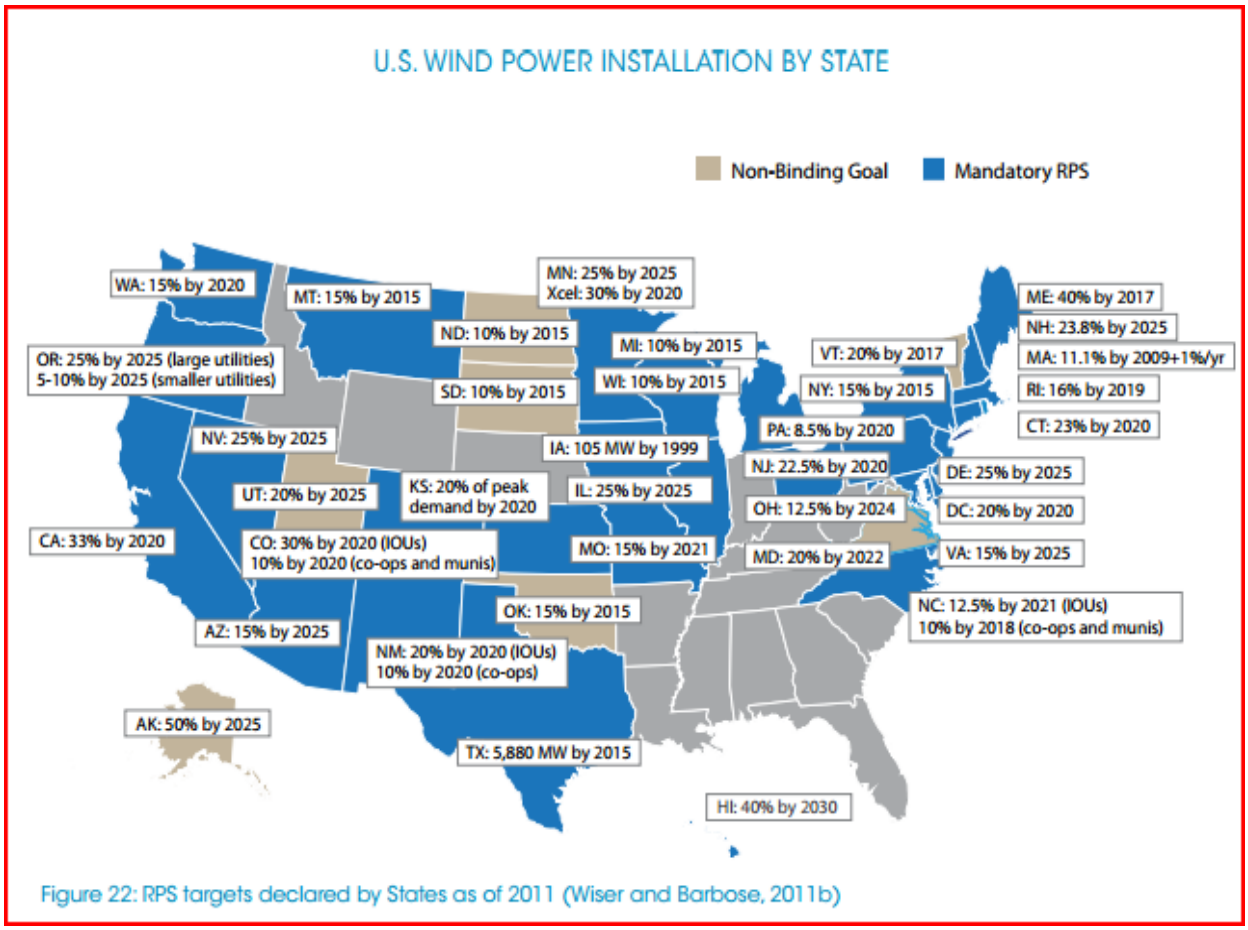


Figure 22: RPS targets declared by States as of 2011 (Wiser and Barbose, 2011b)

The next image below shows installations in mega watts in each state as of 2011. As the image conveys, the top five states by wind capacity are Texas, Iowa, California, Illinois, and Minnesota. Quickly growing states include Ohio, Vermont, Massachusetts, Michigan, and Idaho (Shukla and Sawyer 140-141).

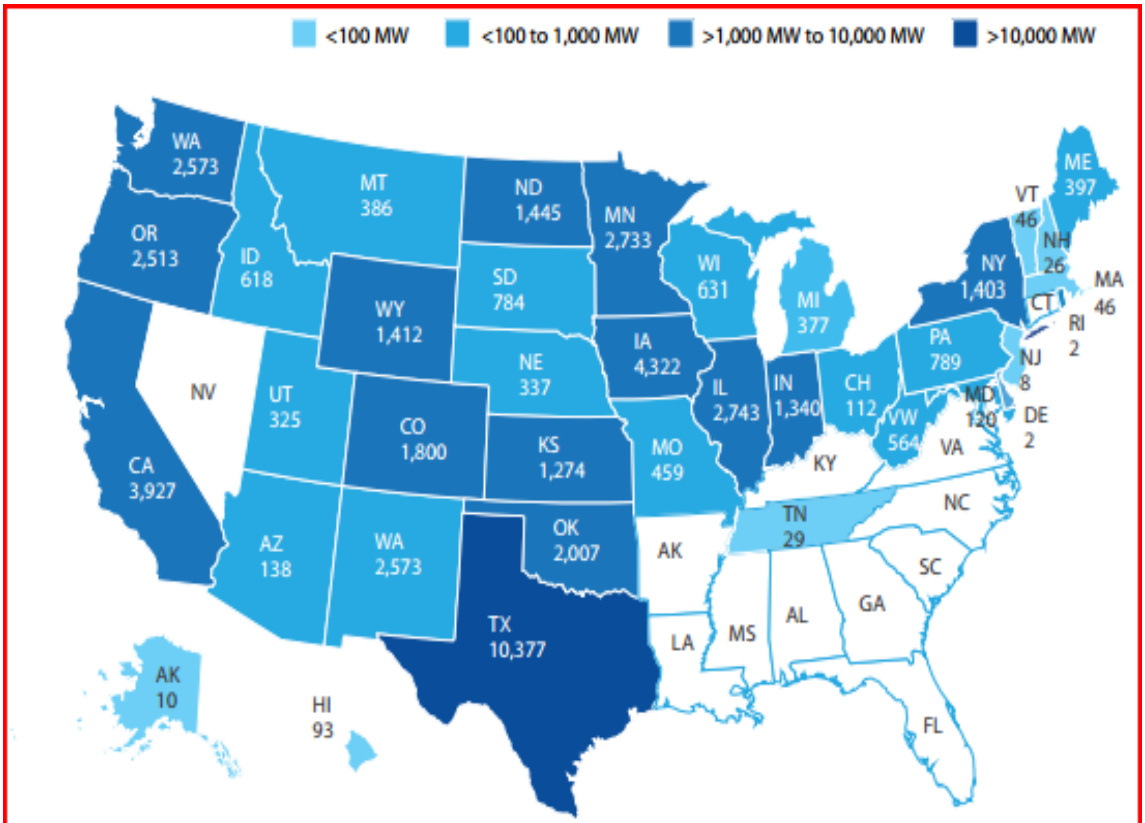


Figure 23: U.S. Wind power installations by State as of December 2011 (AWEA, 2012)

These images convey the role of the states in successfully supporting wind energy use by using Renewable Purchase Specifications and setting targets, which help supplement policy efforts of the federal government.

Part 2: Germany

Section 1: Country Background in the Year 2011

Below is a table with general information about Germany that can be compared with similar tables for the United States and China ("GDP per Capita (current US$)," "Germany").

Characteristic	Description
GDP per capita	$44,060
Population	81.7 million
Government System	Federal multiparty republic with two legislative houses
Economic System	Social market economy
Geographic Size	137,879 square miles

Section 2: Financing Methods

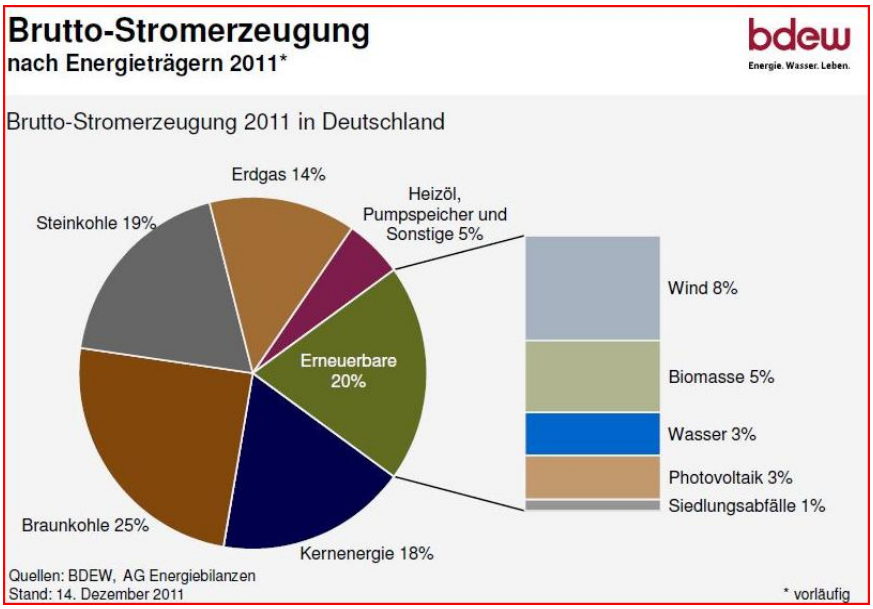
History of wind energy in Germany

Germany established a goal of transforming its energy system in order to have energy independence and security, affordable and sustainable energy, and a clean environment. This energy transformation is termed "energiewende," which means "energy change" or "energy shift" (Davison) and it encourages the development of many renewable energy projects, including offshore wind farms and community heating facilities ("Clean Energy Financing: What Works?").

Early technology development was spurred by engaging local farmers in producing their own electricity, establishing a basic industry before 1980, and providing a foundation for local communities to be involved in wind power development ("Clean Energy Financing: What Works?"). But even until the end of the 1980s, most of Germany's electricity came from coal

and nuclear power. In 1986, the Chernobyl accident changed public opinion dramatically, urging a reduction of reliance on nuclear power. In 1991, the first feed-in tariff (**Appendix 1**), set at 90% of the average electricity utility rate, was introduced to support wind energy financing. Wind energy's success in Germany by the end of the century can largely be attributed to this new policy of financing. In 2000, the feed-in tariff was altered for each kilowatt-hour produced, motivating higher production of wind energy. Specifically, there was an initial fixed tariff for five years for wind energy, followed by fifteen years where the tariff level was moderated by wind conditions. In 2002, Germany also encouraged turbine manufacturers to reduce production costs and make turbines more efficient (Shukla and Sawyer 64-65).

Also in 2002, Germany began its exploration into offshore wind energy production to meet wind energy targets, which are mandated by the government. For example, Germany wants to reach 30 percent renewable power by 2020 and 80 percent by 2050 (Saidur 1750). Because of laws of coastal regions, Germany was forced to build stronger turbines that could withstand conditions twelve nautical miles off a coast. During this process, the government supported financially R&D for offshore wind. When the Fukushima accident (**Appendix 1**) occurred in 2011, Germany decided to phase-out nuclear power entirely by 2022, making offshore development even more important. In 2011, 108 megawatts (**Appendix** 1) of offshore wind was produced but twenty-four projects that would add 7 gigawatts (**Appendix 1**) of capacity were licensed (Shukla and Sawyer 65-66). The graph below highlights that out of the 20% of electricity that renewable energy composes in Germany in 2011, wind energy makes up 8% of that 20%. Today, that number is even greater, showing that investment over time has led to wind being a largest source of renewable power (Brutto-Stromerzeugung).



Throughout these decades, the government has partnered with and supported projects by industrial firms, academic organizations, and wind turbine manufacturers, providing certainty to the market and direction to the public. Germany also engaged the public in participating, specifically small enterprises and cooperatives (Shukla and Sawyer 67-71). As the next section discusses Germany's current state, it is important to recognize that 65 percent of Germany's renewable energy capacity is currently owned by individuals, cooperatives, and communities (Davidson). This public participation shows that Germany makes wind power development a country-wide effort.

Current state of wind energy in Germany

Germany is ranked number three for wind energy production in the world (Shukla and Sawyer 64). Currently, more than twenty-six percent of Germany's energy comes from renewable energy ("Clean Energy Financing: What Works?"). The country's official targets for renewable energy are 30% by 2020 and 80% by 2050, with a long-term goal of 100% renewable (Saidur 1750).

At the end of 2011, Germany had 29,060 megawatts of installed wind capacity. The graph on the next page demonstrates the steady growth of between 2,000 megawatts and 3,000 megawatts of installed wind capacity added each year in Germany (Shukla and Sawyer 64).

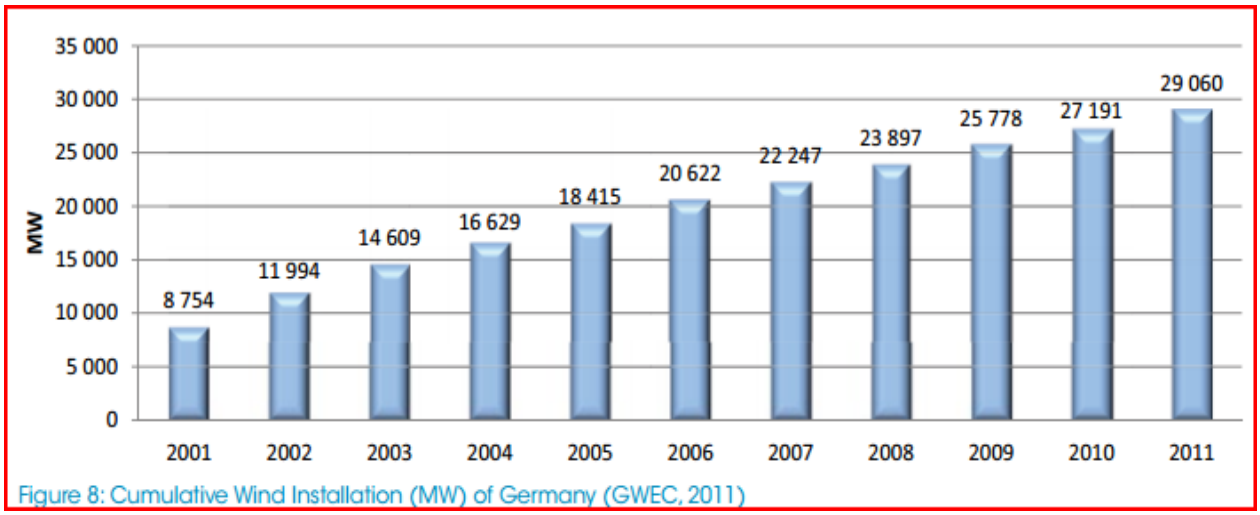


Figure 8: Cumulative Wind Installation (MW) of Germany (GWEC, 2011)

The increasing installation encourages production, increasing economies of scale, leading to cost reduction and the ability for affordable technologies to be spread more globally through export to developing countries ("Clean Energy Financing: What Works?"). The next section discusses how Germany finances this growth in efforts of reaching its targets.

Method of Financing

As discussed above, Germany and its people set goals for moving toward renewable energy, with wind energy making up the largest percentage (Saidur 1750). In 2011, Germany invested 30 billion euros ("Clean Energy Financing: What Works?"), approximately $39 billion ("Euro to Dollar"), in renewable, creating 390,000 jobs for people in the country ("Clean Energy Financing: What Works?"). Very important to financing energiewende is the system of long-term feed-in tariffs (FiT), which guarantees a minimum price over a twenty-year period of surplus electricity from wind energy (**Appendix 1**). FiTs provide certainty to investors by guaranteeing payments and a reasonable return on investment, while also encouraging rapid

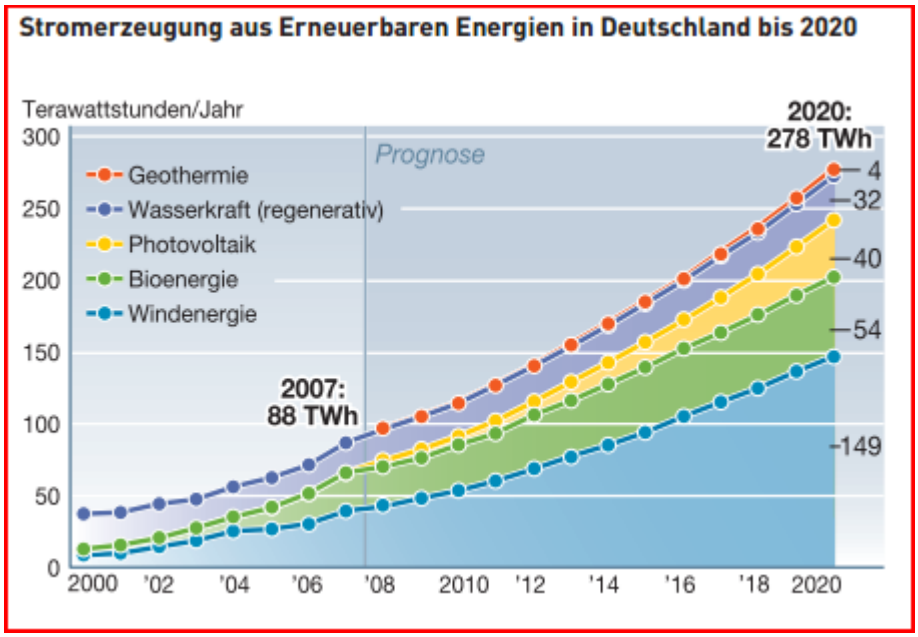
utilization, as payments decrease every year. One of the most beneficial characteristics of German FiTs is that they encourage deployment, not research, supporting entrepreneurs by providing a stable return. And from a government's perspective, the best part about FiTs is that the government sets the FiT amount but does not fund it. Rather, ratepayers pay a surcharge on their monthly utility bills, currently an $11.50 surcharge on an average $108 monthly electricity bill (Davidson). Because of systems like FiTs, wind power financing is growing fast in Germany, becoming a viable option for investors, according to Deutsche Bank's Dr. Sabine Miltner ("Clean Energy Financing: What Works?", Saidur 1750).

Financing Methods Summary

The key success factors in Germany include (1) strong political commitment through country-wide targets; (2) mobilized participation from the public; (3) priority grid access; and (4) long-term price stability through the feed-in tariff (Shukla and Sawyer 68-71).

Section 3: Projections for the future

Europe aims to use 20 percent renewable energy by 2020 (Galbraith), with Germany at a 30 percent target (Saidur 1750). The graph below shows electricity generation from renewable sources in Germany by 2020. It is clear that wind energy, highlighted in blue, represents more than 50% of the planned renewable energy electricity generation (*Stromversorgung* 2).



Stefan Gsänger, secretary general of the World Wind Energy Association, based in Bonn, Germany, does not expect changes in this German support of wind energy and the phasing out of nuclear power even with the elections occurring this year (Galbraith, Saidur 1750). With the growth trajectory, Germany will need to expand offshore wind development in addition to onshore to achieve its targets. A Bloomberg New Energy analyst Fraser Johnston said that "offshore wind is absolutely fundamental" if Germany is to meet its carbon reduction targets, as Germany does not "have enough space for solar and onshore" (Reed).

Part 3: China

Section 1: Country Background in the Year 2011

Below is a table with general information about China that can be compared with similar tables for the United States and Germany ("GDP per Capita (current US$)," "China").

Characteristic	Description
GDP per capita	$5,445
Population	1.334 billion
Government System	Single-party people's republic with one legislative house
Economic System	Mixed economy
Geographic Size	3,696,100 square miles

Section 2: Financing Methods

History of wind energy in China

The first wind farm in China was built in 1986, and the industry experienced slow growth in the 1990s. Government subsidies provided initial backing and then, with government policy providing security to the market, loans were also issued for wind development. Growth was slow as high costs and policy support became unclear. But in 1997, China established its first wind development target for 2001 and partnered with a German company to develop wind projects, all the while trying to retain local content to bolster domestic manufacturing and jobs (Shukla and Sawyer 45-46).

After 2001, the industry continued moderate growth and, in 2003, the government supported a Concession Policy Program. The program selected wind projects and chose the investor through competitive bidding. The government guaranteed that the price of electricity on

the grid was set through process bidding and that all electricity generated by the project would be purchased (Shukla and Sawyer 45-46). This reduced market risk and provided certainty to investors and developers (Saidur 1754), while also establishing reasonable levels for tariffs (Shukla and Sawyer 45-46).

Since 2005, China's wind capabilities have expanded dramatically thanks to national renewable energy funding policies, doubling installed capacity every year between 2006 and 2009 and becoming the leading market for wind energy in 2010. This means that China installed more wind capacity in a five-year span than the United States or Germany did in over thirty years (Shukla and Sawyer 46-47). One law that helped was the Renewable Energy Law of 2006. It mandated that power grid operators purchase renewable energy from registered producers over other sources of energy (Saidur 1754). Then in 2009, the government required grid operators to purchase a fixed amount of renewable energy, ensuring the utilization of wind power. To support this, the Renewable Energy Fund provided grid companies money to integrate the newer power source. A surcharge on the price of electricity, similar to Germany's feed-in tariffs, financed this fund, as well as feed-in tariffs that have since been implemented in China (Shukla and Sawyer 46-47). As a result of the government funding policies, China experienced massive growth, as shown in the graph on the next page (Shukla and Sawyer 44).

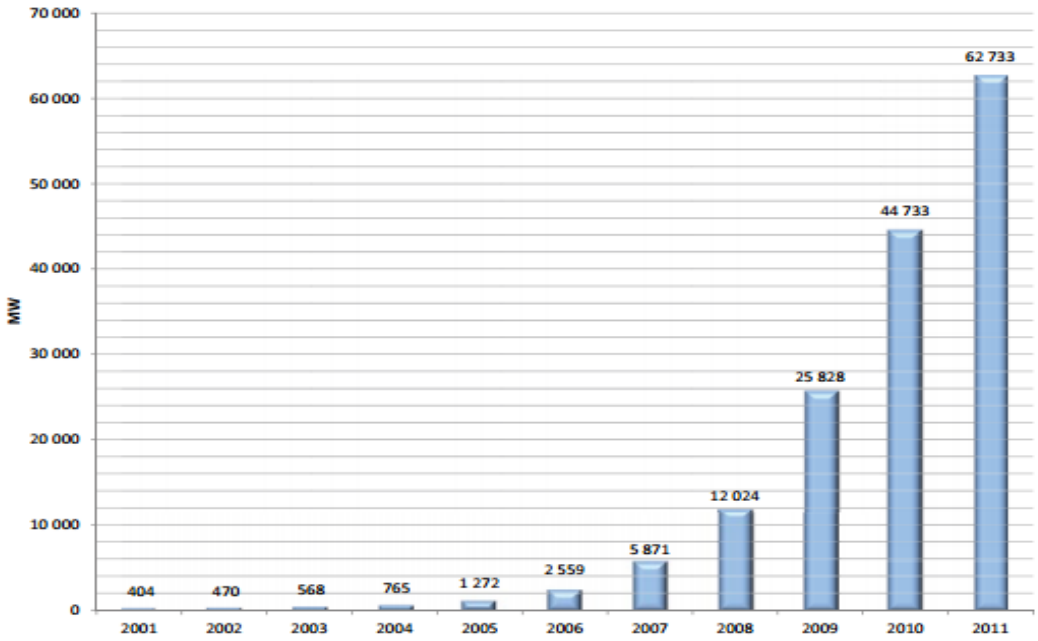


Figure 5: Cumulative Wind Installation (MW) of China (GWEC, 2011)

However, it is important to recognize that there have been difficulties with this explosive expansion of wind capabilities, as many of the installations cannot be utilized, as they are not connected to the grid yet, as will be discussed further (Shukla and Sawyer 49).

The focus after 2008 has shifted toward developing high wind potential regions with targets for 2020 through the Wind Base Programme (**Appendix 1**), introducing the feed-in tariff in 2009 which provided financial stability for investors and offshore wind development, ensuring that utilities purchased all renewable energy production with penalties for a lack of compliance (Shukla and Sawyer 47-49).

Current state of wind energy in China

Matt Guyette, General Electric's strategy and marketing leader for its renewable energy business, said, "Five years ago, almost no one was talking wind in China, and today it's the largest market in the world" (Galbraith). By the end of 2011, China had 62,733 megawatts (**Appendix** 1) of installed wind capacity, enough to power sixty-two medium-sized cities, and making it number one in the world (Shukla and Sawyer 44).

In the China Wind Energy Outlook published by the Chinese Renewable Energy Industry Association, Greenpeace, the Global Wind Energy Council, and the Chinese Wind Energy Association, estimates show that 1.5% of China's electricity in 2011 came from wind energy. It also projects for this number to increase to 8.4% by 2030 because of its global leadership in adding to wind capacity - 2011 being the third year as number one in installations ("China Wind Energy Outlook").

Method of Financing

China uses several financing methods to support its tremendous growth in installation and use of wind power. It uses the feed-in tariff (FiT, **Appendix 1**) method of financing like Germany described previously, with a surcharge to ratepayers with a range of $0.08 to $0.10 per kilowatt-hour on the electricity price (Shukla and Sawyer 47). Additionally, the Renewable Energy Law of 2006 and supporting policy enacted in 2009 ensures that grid operators and electricity suppliers buy renewable energy from the grid, similar to the Renewable Purchase Specifications of the United States (Saidur 1754). The law provided a legal mandate for grid companies to prioritize wind energy over power from coal or other nonrenewable energy sources (Shukla and Saywer 46). Additinally, the Wind Farm Development and Management Interim Rules and Regulations enacted in 2011 improves the approval process, safety standards, and management of wind farm development, improvements which outweigh the approval time added to the process. Projects must go through this approval to be eligible for FiTs and to be added to the grid (Qiao).

Part 3: Projections for the future

China experiences challenges as a result of its massive growth over the past several years. For example, China is unable to use all of the wind power as electricity that it could because of

the lack of connectivity to the grid. The Global Wind Energy Council predicts that power from wind energy will be harnessed after 2015 in China, as the country still has to develop the grid system to transport the power from rural to urban regions (Galbraith).

Another area for consideration is offshore wind development. In 2011, China had 258.4 megawatts (**Appendix** 1) in offshore wind energy, making it third in the world in offshore after the United Kingdom and Denmark, and it has ambitious goals to expand offshore development. Difficulties facing China in the offshore realm include a difficulty coordinating between state administrations and not having an offshore marine utilization plan, but collaboration is increasing in southern China (Qiao).

Even given difficulties ahead with connectivity and offshore wind, China will experience continued growth as a result of its strong support for wind energy use, demonstrated through its policies supporting wind energy financing (Shukla and Sawyer 51).

Country Comparative Analysis

After detailing the histories, current financing and policies, and futures of wind energy in the US, Germany, and China, this section focuses on the key success factors and differences among the three countries. This analysis will enable the identification of opportunities for the United States, which are articulated as recommendations in the next section.

To begin the analysis, the table below highlights initial factors for comparison between the three countries.

Point of Comparison	United States	Germany	China
Rank in world wind power production	2	3	1
% of electricity comprised of wind	2.9%	8.0%	1.5%
Installed wind power capacity (in MW)	46,919	29,060	62,733
Installed wind power capacity (in MW) per capita	.000150574	.000355692	.000047026
Offshore wind production (in MW)	0	108	258.4

Sources: Brutto-Stromerzeugung; "China"; "China Wind Energy Outlook"; "Germany"; Global Wind Statistics 2; Shukla and Sawyer; "United States"

As the table shows, each of the three countries has strengths in wind energy, but there are also gaps. China has the most installed wind capacity and is ranked number one in wind power production. But because of its large population, it has the smallest installed wind power capacity per capita. This translates to a lower percent of electricity made up of wind because more wind is spread over so many people's electricity use. However, China's use of wind energy is growing quickly, and it uses the most offshore wind production out of the three countries.

According to the table above, Germany is ranked third in wind power production, but its population is smaller than the US and China, leading to its wind power being spread over a

smaller number of people's energy use. Thus, it has the highest percent of its electricity comprised of wind power and the highest installed wind power capacity per capita. Moreover, Germany also uses offshore wind energy production.

The table above also shows that the United States comes to the middle of the group in terms of installed wind energy capacity, rank in wind production, installed wind power capacity per capita, and percent of electricity comprised of wind power. The US falls short in production of offshore wind, as it produces no offshore wind energy. Thus, whereas China and Germany have points of comparison in which they lead, the United States has no factor in which it leads. Moreover, it is the only country of the three that does not produce offshore wind power.

The next table below summarizes the financing policies that exist, or do not exist, from the section on descriptions of wind energy in the United States, Germany, and China.

Financing Method	China	Germany	U.S.
Feed-in Tariffs	x	x	
Premium or Adder system		x	
Auctuion or Tendering system	x		
Tax based (electricity) production incentives			x
Spot market trading		x	
Investment subsidy or tax credit			x
Tradable green certification (e.g. REC/ROC)			x
Concessionary finance through government supported agencies	x	x	x
Concession on imort duty	x		

Source: Shukla and Sawyer

The most striking observation from the chart above is that China and Germany both use feed-in tariffs, but the United States does not. Additionally, the United States relies largely on tax credits and tax based production incentives, but this method is not largely used in either China or Germany.

The final table on the next page demonstrates the leadership of the governments of the United States, Germany, and China in setting targets for renewable energy use in the future.

Renewable Energy Targets	1st Upcoming Target	2nd Upcoming Target
United States	None	None
Germany	30% by 2020	80% by 2050
China	15% by 2020	None

Sources: Martinot, Saidur 1750, Zacharia

As the chart shows, Germany does a good job of setting long-term, country-wide goals for renewable energy use, and from the evidence on Germany's policy, it also promotes these goals through financing support. China also sets country-wide goals for renewable use, and from the evidence on China's policy, it promotes these goals through strong government mandates and financing support. In contrast to Germany and China, the United States does not have long-term, country-wide goals for renewable energy use. One can argue that the United States is not taking the necessary target pledge that will help spur action toward the use of renewable energy.

Although these targets are for renewable energy, they naturally translate to wind energy, as wind energy will be important to the growth of renewable energy use in each of the three countries (Hitaj 1, "Renewable Energy Sources," Saidur 1745).

Summary of Country Comparative Analysis

The country comparative analysis suggests that there is room for improvement in the United States. Part of this improvement can come from policy, as the United States has no long-term policy framework (Shukla and Sawyer 145). Additionally, the United States can consider investing in the production of offshore wind energy. To support both the effectiveness of policy and investment decisions, the United States can also aim to increase the percent of electricity comprised of wind power. Lastly, the United States needs to consider the effectiveness of tax credits compared to feed-in tariffs because the latter has been successful in many cases.

Recommendations for US Financing Wind Energy

Part 1: Insights from country comparative analysis

Implement Feed-in Tariff System

One of the most apparent gaps in policy choices is feed-in tariffs. Both China and Germany have them. Specifically, Germany has used the feed-in tariff for over two decades, revising it as needed, to provide certainty for investors of wind energy (Shukla and Sawyer 70-71). From the large variety of methods for financing wind energy, transparency with the private and public sectors, longevity to ensure sustainability, and certainty are necessary to make financing successful and viable for investors ("Clean Energy Financing: What Works?"). Feed-in tariffs satisfy these three requirements, as demonstrated by the German example.

The United States does not have feed-in tariffs, but rather offers tax credit incentives that do not give long-term certainty to investors of price support mechanisms (Shukla and Sawyer 145). Speaking about Germany, writer Osha Gray Davidson assesses that "without the FiT, only the deepest green eco-warriors would probably go to the trouble of installing" renewable energy systems, but with them, "…even the most buttoned-down, tofu-hating conservatives have joined the renewable revolution." An additional benefit of using feed-in tariffs is the ability of engaging the public and small enterprises, which can bring a more positive perception of wind energy and its benefits (Shukla and Sawyer 70-71). In any public policy issue, the attitude of the public and government can make a difference in a policy's success.

A FiT advantage over cash grants and tax credits is that it gives investors security by having 20-year guarantees for prices on electricity generation, in the case of Germany for example (Davidson). Additionally, paying investors for the energy they produce yields a

decentralized wind production market that rewards participation by the public, farms, communities, and small enterprises.

Therefore, the United States needs to consider implementing feed-in tariffs to engage the country in the effort toward growing wind energy.

Implement Country-wide Targets and Standards

The United States has no federally mandated renewable energy targets in legislation (Zacharia). But there are many existing state and federal incentives that would benefit from long-term federal targets, especially in terms of certainty for investors (Shukla and Sawyer 145). In the case of both Germany and China, a key success factor was the long-term commitments that the governments made to drive development of wind energy use (Shukla and Sawyer 52, 70-71). The current administration in the United States recognizes the importance of country-wide targets, as the Obama-Biden New Energy for American Plan contained a short-term target of 10% renewable by 2012 (Saidur 1748). However, continued targets, both short-term and long-term are essential for continued investment and use of wind energy.

On the state-level the importance of targets and standards is recognized. Twenty-eight states have RPS policies, but no national level exists. The RPS (**Appendix 1**) occurring within states provides a predictable, competitive market, within which renewable generators compete with each other to lower prices, but the lack of a national level impedes what the possibilities of the nation as a whole (Saidur 1748).

Give penalties for curtailing wind use on the grid

Currently in the United States, there are penalties on grid operators for choosing to prioritize nonrenewable sources of electricity (Shukla and Sawyer 145). In both Germany and China, however, it is clear to utility companies that grid operators face penalties for not prioritizing renewable energy (Shukla and Sawyer 70-71). The United States can follow the

successful example set by several states, Germany, and China and implement renewable purchase specifications with penalties for curtailing the requirement of grid companies to prioritize wind energy (Shukla and Sawyer 145).

Install offshore wind turbines

The United States has no offshore wind installation capacity but has a lot of potential (Hurdle). Thus, the United States needs to continue its recently announced support of offshore wind power production, especially from the financing side. Feed-in tariffs can be used to help spur development in offshore wind production in the United States. Along with financing, the United States needs to plan strategically for grid connectivity to utilize offshore wind production most efficiently.

Part 2: Additional ideas for wind power investment

The purpose of this part on additional ideas is to present more options for the United States to explore when forming the United States' strategy for wind energy.

Create partnerships with and incentives for businesses

Deutsche Bank's Dr. Sabine Miltner commented that "there is a need for collaboration and cooperation across the private and public sectors. Policy and business must work together for progress" ("Clean Energy Financing: What Works?"). There are cases in which businesses are leaders in embracing wind energy use. For example, in 2006, Whole Foods Market Inc. declared that it would use wind power for all of its electricity needs, making it the largest business user of wind energy, and renewable energy for that matter, in the United States. In 2006, 2007, 2008, 2009, 2010, 2011, and 2012, Whole Foods purchased the megawatt-hours of wind energy credits needed to make sure that its energy consumption is placed on the grid as wind energy. Another corporate leader in using wind energy is Johnson & Johnson ("Green Mission," "Whole Foods

Switching to Wind Power"). If the US can bring attention to these leaders, reward them, partner with them, and prevent barriers from obstructing their goals of purchasing wind energy credits for their electricity use, then businesses can make a major contribution to the implementation of wind energy.

Expand Regional Transmission Organizations

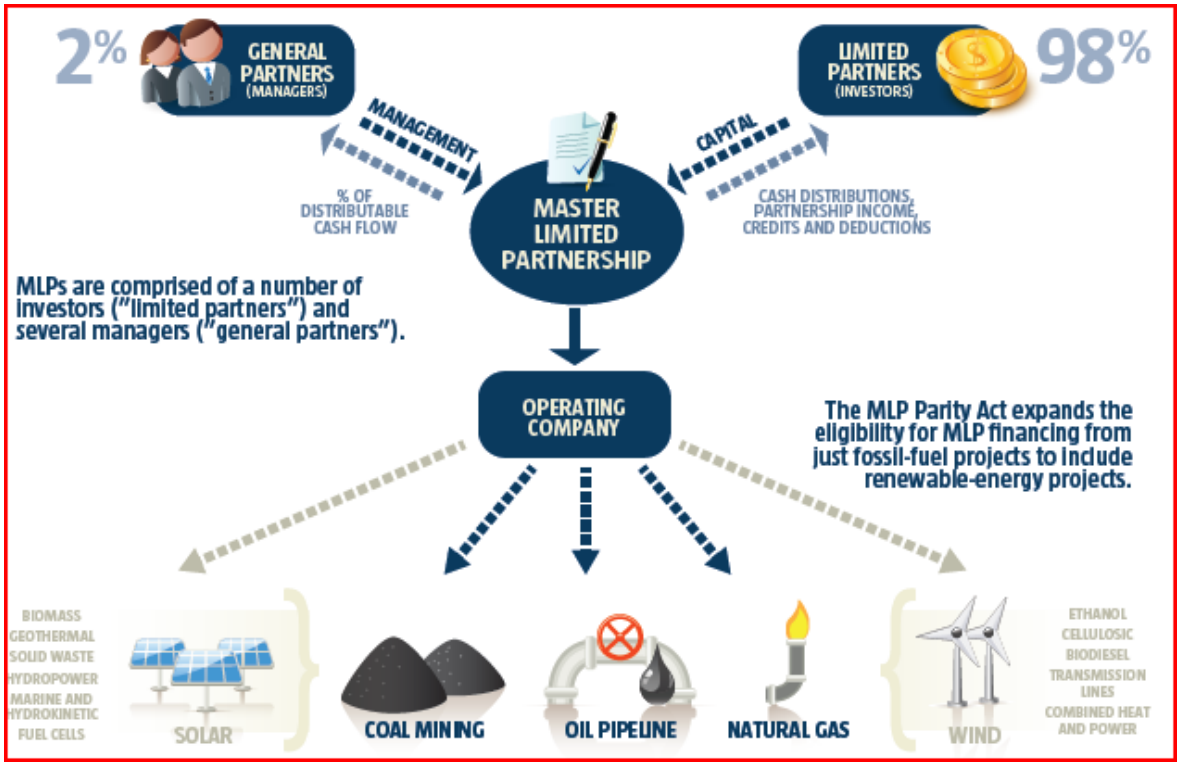
According to a study in 2011, one of the most cost effective ways to increase wind power investment is through expanding regional transmission organizations (RTO) or increasing their coverage. The goal of RTOs is to reduce operating inefficiencies by coordinating transmission and interconnection procedures at a regional level. Increasing coverage increases additions to wind power capacity (Hitaj 2). Grids regulated by RTOs, by county, expect a 20 percent increase in annual additions to wind capacity (Hitaj 13-14).

Utilize Master Limited Partnerships

One structural way to raise capital is through Master Limited Partnerships (MLPs) in the Internal Revenue Code. MLPs give small investors the opportunity to invest in companies benefiting from tax incentives - an opportunity currently open only to fossil-fuel based projects. MLPs are taxed only at the shareholder level as partnerships and, thus, avoid the double taxation of C-corporations (**Appendix** 1) but at the same time are traded on the stock exchange and can pass income on to shareholders. MLPs also allow for individual's investments, making more capital available. Because eighty-three percent of MLPs are made up of energy investments, they have proven to be successful in energy, and as a whole had a market capitalization of $350 billion as of 2012 (Sheridan 2).

In June 2012, Senator Chris Coons, democrat from Delaware, proposed a bill named The Master Limited Partnerships Parity Act, seeking to include renewable energy as eligible for

MLPs, but the bill did not pass committee. The bill would have allowed MLPs to finance and own wind energy projects, providing investors with a sense of security and certainty and reducing the cost of capital of renewable energy generation, as rewritten tax code is permanent unlike the current tax credits under continued debate about renewal. Since the bill did not pass committee, however, MLPs are not currently an option for wind energy developers or owner-operators (Sheridan 2). Below is a diagram of what it would look like to include renewable energies in the MLPs structure (Coons).



Allow wind energy to qualify for Real Estate Investment Trusts

Often traded as liquid securities on major exchanges, Real Estate Investment Trusts (REITs) are "companies that own, and often manage, income-producing properties" (Sheridan 2). Permitted by legislation enacted in 1960, REITs give investors the ability to pool assets in order to interact in the real estate market and pass income on to investors, and similar to MLPs, are only taxed at the shareholder level. As the legislation stands, wind energy projects, in

general, do not meet the criteria of obtaining seventy-five percent of revenue from real estate rent. However, if payment for electricity could be established as qualifying by the Internal Revenue Service, then wind energy could use the REIT structure of financing. This would reduce the cost of capital for renewable energy generation, a method which at the end of 2011 had a market capitalization of $450 billion (Sheridan 2-3).

Summary of additional ideas

The United States needs to consider additional strategies for supporting wind power investment. For example, rewarding and partnering with businesses that purchase wind energy credits can tap into a large potential influence for the adoption of wind energy use. Additionally, expanding regional transmission organizations or their coverage can help improve grid connectivity effectiveness and efficiency. Finally, Master Limited Partnerships and Real Estate Investment Trusts can unlock capital for implementation of wind energy projects.

Conclusion

As the discussions and analysis of the three countries shows, while Germany and China leverage policy, business, and resources, the United States uses "timidity as its guide" (Davidson). In 2011, IPCC scientists said that, "close to 80 percent of the world's energy supply could be met by renewables," by 2050 (Davidson). Countries like Germany and China strive toward this possibility while the United States allows tax credit policies to expire and avoids a proven method for financing wind energy through feed-in tariffs.

Thus, the United States should finance wind energy by providing long term policies that give certainty to investors. First, tax credit policies should not be allowed to expire, nor have short extension dates. Additionally, feed-in tariffs can be implemented to give investors and the industry long-term assuredness of the development of wind energy in the United States. Second, wind energy growth can also be supported by installing offshore wind capacity and also providing long-term certainty to investors for its electricity use through feed-in tariffs. Third, the United States needs to pass legislation targets, with penalties for non-compliance for renewable energy and wind energy to spur production of electricity through these sources. Lastly, the United States can unlock additional support and capital through creative ideas, such as partnerships with businesses and Master Limited Partnerships. Through these methods, the United States can incentivize the wind industry, government, business, and the public to utilize policy, innovation, and business to grow wind energy.

Appendix 1

Wind Industry Terminology (listed alphabetically)

- **Cash grants:** sponsorship or treasury grant for a percentage of upfront costs (Sheridan 1)
- **C Corporation:** "a separate legal structure that shields personal assets from judgments against the company…profits are taxed when earned and taxed again when distributed as shareholders' dividends, what's known as 'double taxation'" ("C Corporation")
- **Concession Policy Program**: the program selects wind projects and chooses the investor through competitive bidding; the government guarantees that the price of electricity on the grid is set through process bidding and that all electricity generated by the project will be purchased; this reduces market risk and provides certainty to investors and developers (Saidur 1754)
- **CREBS**: tax-free Clean Renewable Energy Bonds for public colleges and universities (Nelson), rural electric cooperatives, and municipally-owned utilities ("American Sustainable Business Council") to invest in the production of wind energy
- **Electricity transmission grid:** "network of power lines, transformers, and associated equipment employed in distributing electricity over a geographical area" ("Power grid")
- **Feed-in Tariff (FiT):** "an incentive program that stimulates the renewable energy sector through government legislation; it requires electricity utilities to buy renewable energy at above market rates (set by the government) from anyone who wishes to produce renewable electricity; this has been shown to be one of the most effective ways to jump-start renewable energy production and adoption by rewarding small and medium scale producers as well as industrial scale producers of green power" (Saidur 1748)

- **Fukushima incident:** accident in 2011 at the Fukushima Daiichi – "Number one" – plant in northern Japan, the second worst nuclear accident in the history of nuclear power generation ("Fukushima accident")
- **Grid parity:** occurs when the cost of renewable energy is equal to the price of electricity that is distributed on the transmission grid (Clean Energy Policy 2)
- **GW: "**gigawatt is a unit of electric power equal to one billion (10^9) watts, one thousand megawatts, or 1.34 million horsepower enough to supply a medium size city" ("Gigawatt")
- **MW**: megawatt, in which 1000 MW make a gigawatt, and 1 GW can power a medium size city ("Gigawatt")
- **Offshore wind farm:** "Offshore wind energy has the attraction that it has minimal environmental effects and, broadly speaking, the best resources are reasonably well located relative to the centers of electricity demand; moreover, higher wind speeds at sea mean an increased energy production, as energy output is a function of the cube of the wind speed" ("Offshore wind energy")
- **Production Tax Credit (PTC):** a tax credit; in 2011, it was 2.1 cents per kilowatt-hour; first instituted with the enactment of the Energy Policy Act of 1992; it expired in 2001 and twice more following and was extended 7 times for 1-2 years, with the most recent extension at the end of 2012 (Hitaj 3)
- **Renewable Electricity Standard (RES):** "… a regulation that requires the increased production of energy from renewable energy sources, such as wind, solar, biomass, and geothermal; another common name for the same concept is renewable purchase specification" (Saidur 1747)

- **Renewable Purchase Specifications (RPS):** "…a regulation that requires the increased production of energy from renewable energy sources, such as wind, solar, biomass, and geothermal; another common name for the same concept is renewable electricity standard" (Saidur 1747); the RPS has a target and an implementation year, such as 20 percent by 2025 (Hitaj 8, Shukla and Sawyer 140-141)
- **Tax-equity financing:** method of financing in which investors provide the capital needed to fund a project and then benefit from claiming the tax credits (Sheridan 1)
- **Wind Base Programme:** the focus after 2008 has shifted toward developing high wind potential regions with targets for 2020, using feed-in tariffs for financing (Shukla and Sawyer 47-49)
- **Wind farm:** a cluster of wind turbine, as many as several hundred, built in areas with nearly steady wind, such as areas near mountain passes ("Wind farm")
- **Wind Turbine:** propeller-like set of blades that extract energy from the wind, mostly for electricity generation, by driving a generator through appropriate shafts and gears ("Wind turbine")

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