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THE TRUE COST OF ENERGY: WIND

FINAL REPORT | JULY 2015

THE TRUE COST OF ENERGY: WIND POWER

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EXECUTIVE SUMMARY

WHAT IS THE TRUE COST OF ENERGY?

This report explores the true cost of producing electricity from wind power. Rather than creating a new cost estimate, we analyze the findings of prominent cost studies by experts in the energy field. Each study includes different factors in its estimate of the cost of wind power. We break down each of these factors and explain the significance of each. These factors include: capital costs, operation and maintenance costs, capacity factor, transmission costs, baseload cycling, social and environmental costs, and the cost of government subsidies. Other factors are more difficult to quantify, but nevertheless add to the true cost of wind power. Such factors include: opportunity cost of taxpayer dollars, reduced reliability of the grid, and higher electricity prices. We conclude that, when estimating the true cost of wind power, all of these factors should be included.

What is meant by the term “true cost”? When calculating the cost of any energy source, there are many factors to consider. For example, it goes without saying that the costs of construction, operation, and maintenance of the power plant must be considered. The cost of transmitting the power to the consumer must also be factored in. However, not all costs are so easy to identify. The true cost of an energy source also includes hidden costs such as opportunity cost and other, less-obvious factors.

Proponents of wind energy claim that it is superior to traditional forms of power generation such as coal and natural gas. They claim that wind energy is cheaper to produce and it is renewable. Sometimes, when cursory and incomplete cost accounting is used to calculate wind energy’s costs, these claims appear to be correct and wind energy appears to be not only advantageous to consumers, but also friendly to the environment.

The true cost of wind power, however, is what consumers and society as a whole pay both to purchase wind-generated electricity and also to subsidize the wind energy industry through taxes and government debt. The true cost includes both traditional cost accounting and the seen and unseen costs of policies that seek to artificially bolster renewable energy development and production. When examined more closely, many claims about wind energy are found to be indefensible.

To more closely examine the true cost of wind energy, this report will discuss in detail aspects of wind energy that are often overlooked, aspects which lead to dramatic underestimation of the true costs of producing electricity from wind. These include the cost of massive government subsidies and mandates to incentivize development and production of renewable energy. They also include the costs of building transmission lines to the often-remote locations where wind power is plentiful. As important but more difficult to quantify are the costs of reduced reliability. Wind energy distorts the market and drives more reliable energy sources out. Finally, the true cost of wind must also include opportunity costs paid by taxpayers, whose money could have been spent more productively than subsidizing the wind industry.

By including the cost of government subsidies and other hidden costs of wind power, it is easy to conclude that the true cost of wind energy is much higher than many studies estimate. Before the enactment of more policies and mandates that bolster the no-longer-infant wind industry, the true costs of wind power to American taxpayers should be calculated. This will ensure that future policy decisions are based on comparisons of the actual costs and benefits of wind power.

INTRODUCTION

Since the 1990s, wind power has grown rapidly in the United States. In Texas, for example, almost 10 percent of electricity supplied to the main electrical grid was generated by wind energy in 2013.[1] Other states similarly aspire to move their energy production to wind power and other renewable energy sources in the near future.

The growth of wind energy is not the result of new technology and favorable market forces. Instead, wind energy's rapid emergence is largely a response to generous federal subsidies intended to boost the technology and shift the nation's energy portfolio away from fossil fuels. Governments, from the federal level to the local, have enacted policies to address constituent concerns about the potential negative environmental consequences of burning fossil fuels. The perceived environmental benefits of wind power include increased sustainability, reduced carbon emissions, and reduced potential for catastrophic human-caused climate change. As this report will discuss, however, wind power may not be as environmentally beneficial as many claim. What's more, any environmental benefits must be weighed against the economic costs of wind power borne by electricity consumers and American taxpayers.[2]

In 2012 wind energy represented 43 percent of all new electricity-generating capacity, more than any other type of energy.[3] Environmentalists and wind industry lobbyists tout these numbers as indications of great success and as a path to America's renewable energy future. The growth of wind energy, however, comes at a substantial cost to taxpayers and competitors in the energy marketplace. Government subsidies and state mandates, enacted to help the wind power industry get on its feet, are responsible for the rapid growth in wind installations over the past decade.

Unfortunately, subsidies, tax breaks, and other incentives do not seem to be generating substantial returns in terms of electricity. In fiscal year 2010, for example, wind energy received 42 percent of direct federal subsidies for energy, more than any other type of electricity generation. Despite this, wind produced only 2 percent of the nation's total electricity.[4] In 2013 that number grew to 4 percent, while still receiving 37 percent of direct federal subsidies for

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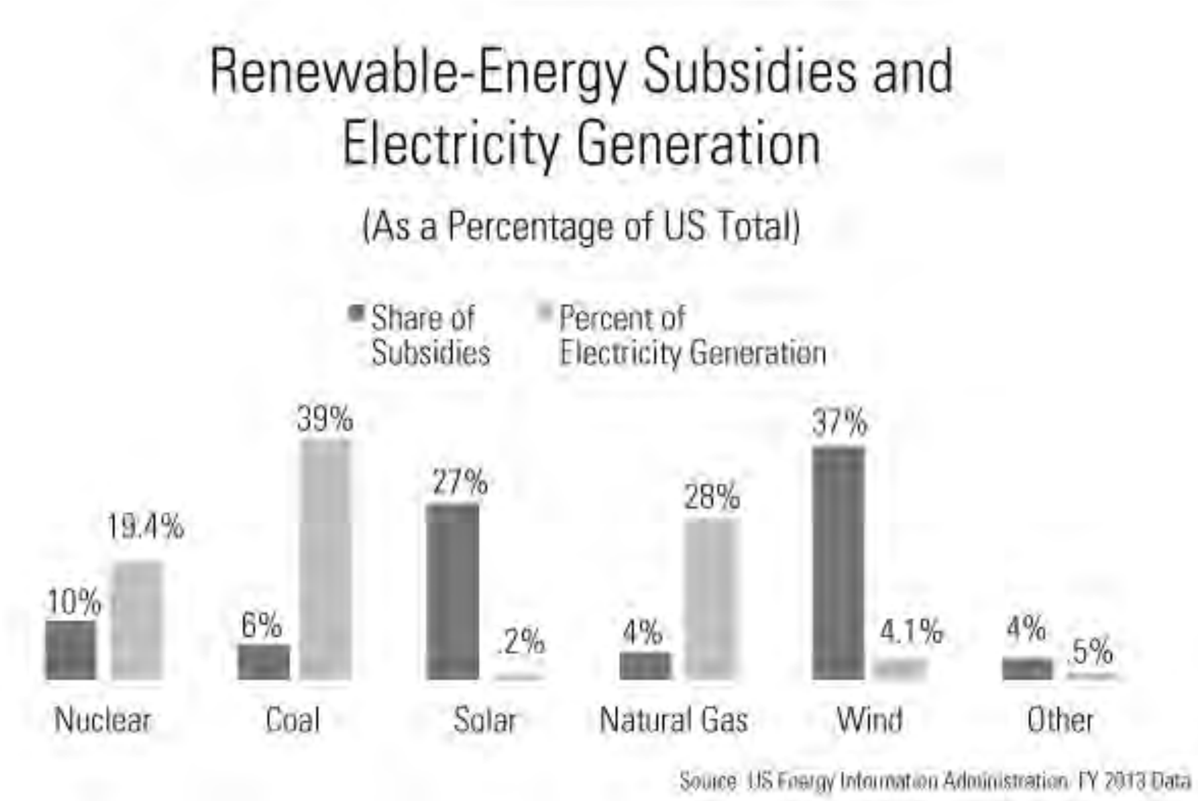
[1] American Wind Energy Association (AWEA). 2014, March 5. "American Wind Power Reaches Major Power Generation Milestones in 2013." Retrieved from: http://www.awea.org/MediaCenter/pressrelease.aspx?ItemNumber=6184
[2] It should be noted that this cost study is meant to be just that—a study of the costs of wind power. It is not intended to provide a complete cost-benefit study of wind power.
[3] Department of Energy (DOE). 2013. "America's Wind Industry Reaches Record Highs." Retrieved from: http://energy.gov/articles/americas-wind-industry-reaches-record-highs
[4] de Rugy, V. 2013, May 21. "Renewable-Energy Subsidies and Electricity Generation." The Mercatus Center at George Mason University. Retrieved from: http://mercatus.org/publication/renewable-energy-subsidies-and-electricity-generation

energy. However, as *Figure 1* shows, generation of electricity from wind remained insignificant compared to generation from coal, nuclear, natural gas, and hydropower.[5]

FIGURE 1: RENEWABLE-ENERGY SUBSIDIES AND ELECTRICAL GENERATION[6]



Government policies enacted to incentivize the development of renewable energy create economic distortions, which drive more reliable sources of electricity generation out of the market. These artificially induced disturbances in the energy marketplace make energy sources less reliable than they would ordinarily be. This reduced reliability is a hidden cost of wind energy, paid for by the American public. In other words, federal wind policies do not lead the United States into a future of renewable energy, but instead create problems in the present energy market, which are paid for by American taxpayers.

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[5] Energy Information Administration. 2015, March 13. "Direct Federal Interventions and Subsidies in Energy in Fiscal Year 2013." Department of Energy. Retrieved from: http://www.eia.gov/analysis/requests/subsidy/

[6] Ibid.

This report begins with an overview of current federal wind policies and an in depth analysis of how those policies increase the true cost of producing electricity from wind power. We then examine state policies meant to boost renewable energy, primarily through mandates called Renewable Portfolio Standards (RPS). Using several state-level case studies, we show that state policies further increase the true cost of wind power. Finally, we carefully review the most commonly cited cost estimates for wind power to create a more complete list of the factors that should be included in estimating the cost of wind.

CURRENT FEDERAL WIND POLICY

PRODUCTION TAX CREDIT (PTC)

Data collected by the U.S. Energy Information Administration show that federal wind energy subsidies have grown by an average of 32 percent each year since 2000, and in 2010 the federal government spent nearly $5 billion on subsidies for wind energy.[7] Of those subsidies, the Production Tax Credit (PTC) is the foremost federal policy supporting wind energy in the United States. The PTC was originally passed in 1992, and provided a subsidy of $15 per megawatt-hour to producers of wind energy.[8]

The American Recovery and Reinvestment Act of 2009, commonly known as the Recovery Act, made small wind producers (those with a generating capacity of 100 kilowatts or less) eligible for refunds of up to 30 percent of total investment cost. Producers can choose to accept this option, known as the Investment Tax Credit, in lieu of the PTC.[9] Finally, the Recovery Act provided $31 billion for clean energy research, development and deployment.[10] In 2013, the U.S. Congress increased the amount of the PTC from $22 per megawatt-hour to $23 per megawatt-hour.[11] According to the Institute for Energy Research, that equates to $38 per megawatt-hour in post-tax subsidy.[12]

The Tax Increase Prevention Act of 2014 extended the PTC further so that any project that began work before January 1, 2015 is eligible for the credit. The Act also allowed these facilities to claim the Investment Tax Credit in place of the PTC through the end of 2014.[13] The extension will not have a significant effect on the wind industry because it was passed only 3 weeks before

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[7] de Rugy, V. 2013, May 21. "Renewable-Energy Subsidies and Electricity Generation." The Mercatus Center at George Mason University. Retrieved from: http://mercatus.org/publication/renewable-energy-subsidies-and-electricity-generation
[8] Database of State Incentives for Renewables and Efficiency (DSIRE). 2015, April 13. "Renewable Electricity Production Tax Credit (PTC)." U.S. Department of Energy. Retrieved from: http://programs.dsireusa.org/system/program/detail/734
[9] Database of State Incentives for Renewables and Efficiency (DSIRE). 2015, March 18. "Business Energy Investment Tax Credit." U.S. Department of Energy. Retrieved from: http://programs.dsireusa.org/system/program/detail/658
[10] Department of Energy (DOE). n.d. "Recovery Act." Retrieved on December 3, 2014 from: http://www.energy.gov/recovery-act
[11] Hanson, C. 2014, September 2. "The IRS Is Giving Away $13 Billion A Year In Wind Energy Subsidies, Without Congressional Authorization." Retrieved from: http://www.forbes.com/sites/realspin/2014/09/02/the-irs-is-giving-away-13-billion-a-year-in-wind-energy-subsidies-without-congressional-authorization/
[12] Institute for Energy Research (IER). 2014, October 8. "Why Are States Reevaluating Wind Energy?" Retrieved from: http://instituteforenergyresearch.org/analysis/states-reevaluate-wind-energy/
[13] Database of State Incentives for Renewables & Efficiency (DSIRE). 2014, December 22. Department of Energy. Retrieved from: http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=US13F

the end of the year. The only investors able to benefit from this most recent expansion would need to begin construction immediately.[14] Some members of Congress are dissatisfied with the extension, and are debating about whether to expand the tax credit for an additional 2 years or to implement it permanently.[15]

The Recovery Act also established the 1603 Treasury Program, which allowed taxpayers who are eligible for either the Production Tax Credit (PTC), a tax benefit for producing energy from certain sources, or the ITC, to receive a payment from the Treasury in lieu of a tax credit. The program is meant to increase liquidity to quickly spur renewable energy development.[16] The 1603 cash grant program applies to wind, geothermal, biomass, and solar among other forms of renewable energy. Through May 8, 2012 the 1603 program provided almost $8.4 billion to wind projects and in total awarded about $11.6 billion to over 37,700 renewable projects.[17]

Figure 2 shows the extent to which the wind energy industry is dependent on subsidies. New wind energy production plummets every time the PTC is set to expire. In 2003, the wind industry added almost 2,000 megawatts of capacity; in 2004, when the PTC expired again, investments in new capacity fell 76 percent. An even more dramatic decline occurred in 2013 when there was a 92 percent drop in installations due to uncertainty regarding the fate of the PTC. If the PTC permanently expires in 2016, it is unlikely there will be any new wind installations.[18] If wind energy were a competitive source of electricity, wind installations would continue without federal subsidies.

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[14] Guillen, A. 2014, December 4. "House sends one-year tax extenders to Senate – Wind, efficiency groups unhappy – Hearing for FERC nominee Honorable – Landrieu dings Cantwell on policy." Politico. Retrieved from: http://www.politico.com/morningenergy/1214/morningenergy16330.html

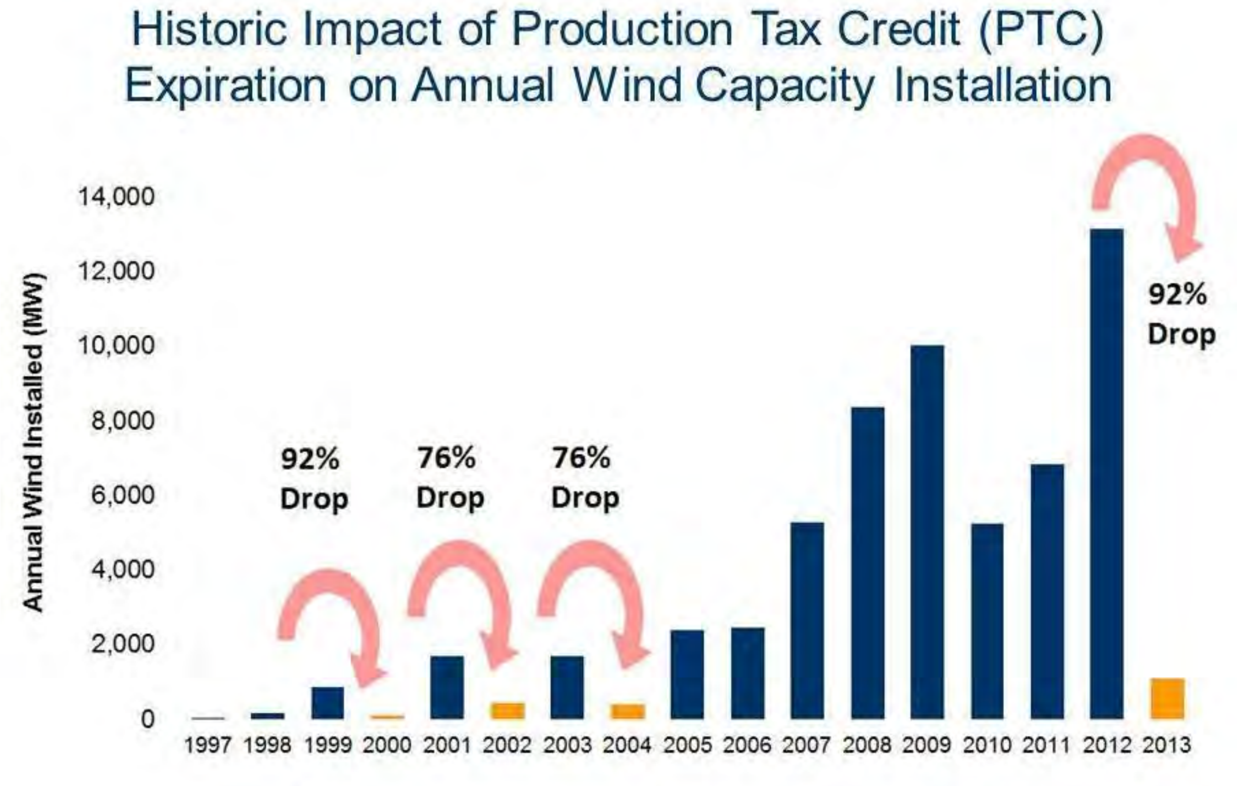
[15] Stokols, E. 2014, December 3. "Bennet blasts House's three-week extension of wind PTC, other tax breaks." KDVR. Retrieved from http://kdvr.com/2014/12/03/bennet-blasts-houses-three-week-extension-of-wind-ptc-other-tax-breaks

[16] Solar Energy Industries Association (SEIA). (n.d.). 1603 Treasury Program. *Solar Energy Industries Association*. Retrieved on May 14, 2015 from http://www.seia.org/policy/finance-tax/1603-treasury-program

[17] Mendelsohn, M., J. Harper. 2012, June. "§1603 Treasury Grant Expiration: Industry Insight on Financing and Market Implications." Pg. 22-23. National Renewable Energy Laboratory (NREL). Retrieved from http://www.nrel.gov/docs/fy12osti/53720.pdf

[18] American Wind Energy Association (AWEA). 2013. "Federal Production Tax Credit for Wind Energy." Retrieved December 5, 2014 from: http://www.awea.org/Advocacy/content.aspx?ItemNumber=797

FIGURE 2: HISTORIC IMPACT OF PRODUCTION TAX CREDIT (PTC) EXPIRATION ON ANNUAL WIND CAPACITY INSTALLATION[19]



Including the PTC, Congress has created 82 initiatives overseen by nine different federal agencies to promote the production of wind energy. *Figure 3* below shows these initiatives broken up by agency. These initiatives support wind energy through research grants and financial support for demonstration, commercialization, and deployment of wind energy technology. Of these initiatives, the PTC represents the largest portion of government spending on wind energy. In 2011 the PTC represented almost 39 percent of the revenue losses for the Treasury's wind-related tax expenditures.[20]

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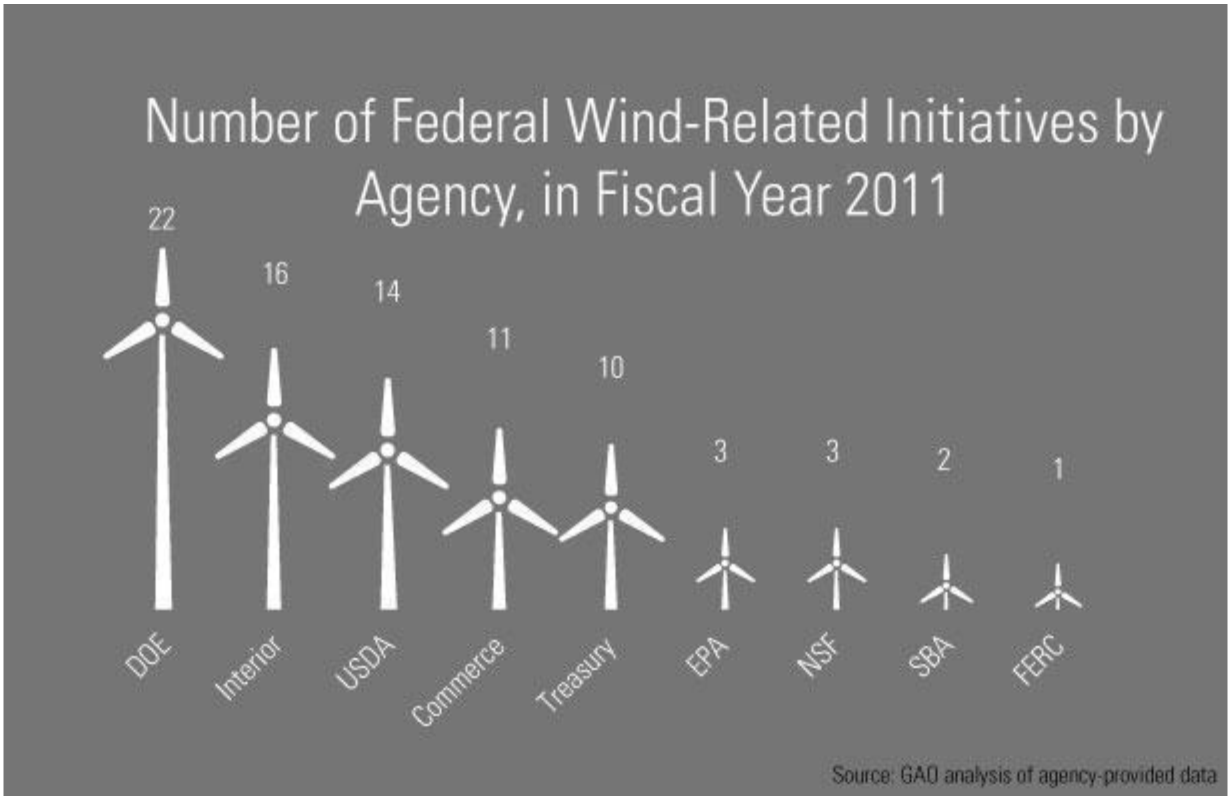
[19] Ibid.

[20] Government Accountability Office (GAO). 2013, March. "Wind Energy: Additional Actions Could Help Ensure Effective Use of Federal Financial Support." Pg. 14-15, 80. U.S. Office of Government Accountability Office. Retrieved from: http://www.gao.gov/assets/660/652957.pdf; Figures are calculated from the numbers available on page 80.

FIGURE 3: NUMBER OF FEDERAL WIND-RELATED INITIATIVES BY AGENCY IN FISCAL YEAR 2011[21]



THE TRUE COST OF THE PTC

Federal policies such as the PTC enable producers to sell wind power at prices well below what the market would otherwise dictate. Even with these incentives in place, wind has been slow to take hold as a viable energy source. By 2013 it accounted only for 4 percent of annual energy consumption.[22] If these policies did not exist at all, wind power would be economically unsustainable—it would be prohibitively expensive to construct wind energy facilities and too expensive for consumers to use the resulting electricity.

By paying for the PTC with their taxes, American citizens subsidize private investments in wind energy development. Wind and solar energy both receive 20 times more federal subsidies than coal or natural gas in terms of average electricity generation.[23] Since it was expanded in 2009, the PTC has cost an average of $5 billion per year. Recent IRS changes expanded the number of

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[21] Ibid.
[22] American Wind Energy Association (AWEA). 2014, March 5. "American Wind Power Reaches Major Power Generation Milestones in 2013." American Wind Energy Association. Retrieved from: http://www.awea.org/MediaCenter/pressrelease.aspx?ItemNumber=6184
[23] Bell, L. 2014, February 9. "Loss of Production Tax Credit brings big wind chill to cooling subsidy-dependent market." Forbes. Retrieved from: http://www.forbes.com/sites/larrybell/2014/02/09/loss-of-production-tax-credits-brings-big-wind-chill-to-cooling-subsidy-dependent-market/

wind producers and the conditions for eligibility so that a one-year extension is expected to cost taxpayers approximately $13 billion over the next decade.[24] These considerations increase the true cost of electricity produced from wind power. While the costs of subsidizing wind power are dispersed across all Americans, the benefits are enjoyed by a select few wind industry favorites.

Without the PTC, many private investors would have no incentive to invest in wind energy because such investments would no longer be profitable. Warren Buffett, who has invested billions in renewable energy, stated, "[W]e get a tax credit if we build a lot of wind farms. That's the only reason to build them. They don't make sense without the tax credit."[25] Thus, when the PTC is allowed to expire, investments in wind energy plummet.[26]

NEGATIVE PRICING AND REDUCED RELIABILITY

Federal subsidies for wind power lead to an economic phenomenon called "negative pricing," which is when the seller pays the buyer to receive the product. In the case of wind energy, negative pricing works this way: demand for electricity is lowest at night, which is when wind blows most powerfully in most geographic regions.[27] This means high levels of wind power are being produced when demand for electricity is lowest.[28] Electricity produced from wind cannot easily be stored, and if more is produced than is being demanded, the only way wind energy producers can get rid of the excess electricity is to pay utilities to accept it.

The PTC pays wind producers $23 for every megawatt-hour of electricity produced, regardless of market factors like supply and demand. Wind producers can then pay utilities (up to $23 per megawatt-hour) to take their power while still making a profit or at least breaking even. Subsidies, and the negative pricing they cause, distort the market for electricity and flood it with subsidized wind power. In some cases, this drives more conventional producers of electricity, such as nuclear plants, out of the market.[29]

Conventional energy sources are also more reliable. When they are forced from the market by subsidized competition, the overall reliability of the supply of electricity is threatened. When the supply of any commodity is threatened, its price increases. Here is another hidden cost of wind energy—consumers may pay higher prices for energy because of government policies they are required to fund with their taxes.

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[24] Hanson, C. 2014, September 2. "The IRS Is Giving Away $13 Billion A Year In Wind Energy Subsidies, Without Congressional Authorization." Forbes. Retrieved from: http://www.forbes.com/sites/realspin/2014/09/02/the-irs-is-giving-away-13-billion-a-year-in-wind-energy-subsidies-without-congressional-authorization/

[25] Pompeo, M. December 2, 2014. "Congressman's response to Sierra Club and union's call to extend wind PTC." The Hill. Retrieved from: http://thehill.com/blogs/congress-blog/energy-environment/225619-congressmans-response-to-sierra-club-and-unions-call

[26] American Wind Energy Association (AWEA). 2013. "Federal Production Tax Credit for Wind Energy." Retrieved December 5, 2014 from: http://www.awea.org/Advocacy/content.aspx?ItemNumber=797

[27] Fisher, T. 2014, April 23 April. "AWEA's Bold Push for More Wind Welfare." Institute for Energy Research. Retrieved from: http://instituteforenergyresearch.org/analysis/aweas-bold-push-for-more-wind-welfare/

[28] Ibid.

[29] Fisher, T. 2014, April 23 April. "AWEA's Bold Push for More Wind Welfare." Institute for Energy Research. Retrieved from: http://instituteforenergyresearch.org/analysis/aweas-bold-push-for-more-wind-welfare/

OPPORTUNITY COST

Another hidden cost of these policies is opportunity cost—the cost of opportunities that could have been paid for by taxpayer money that was instead spent on policies such as the PTC. While it is easy to quantify the billions of dollars taxpayers have spent on wind energy subsidies, it is more difficult to predict how that money would have been spent without the subsidies.

If large federal subsidies for wind power did not exist, taxpayer money could have been spent more productively. In a free energy market, consumers would be free to make decisions about energy consumption based on preferences about price, environmental impact, and other factors such as reliability. In such a market, prices would ensure that resources flow to their most highly valued use.

The U.S. energy market, however, is not a free market. Large federal subsidies like the PTC lock Americans into paying for wind power, no matter how high the cost. Because policymakers have limited information, they cannot predict what the future of energy will look like. Subsidizing wind power gives the industry an advantage over other energy sources, effectively picking wind as the energy winner. This limits competition from new and potentially better energy technologies that might develop in a free market.

STATE-LEVEL WIND POLICY

Voters in many states favor renewable energy because they believe it will lead to environmental benefits. Policymakers have responded to their constituents by enacting state-level policies to spur the growth of wind and solar. As states put these policies into place, they have learned that the reality of wind power is much more complex. States have had to confront unintended consequences that come along with incentivizing wind power. These include the large burden placed on taxpayers, the rising price of electricity, and the need for a costly expansion of transmission capability.

The Database of State Incentives for Renewables and Efficiency (DSIRE) categorizes state policies that promote renewable energy as either financial incentives or rules and regulations. The DSIRE then sorts these into roughly 30 other specific types of incentives and policies.[30] State rules and regulations regarding wind energy include solar and wind access policies that establish a right to install and operate solar and wind energy systems at homes or other facilities. Financial incentives comprise policies like grant and loan programs that finance renewable energy expansion and performance-based incentives that provide cash payments based on the amount of energy generated by renewable energy systems.[31]

States also offer rebates for the installation of new renewable energy systems and equipment. Thirty-eight states have at least one rebate program for renewable energy. Seventeen of those

[30] Database of State Incentives for Renewables and Efficiency (DSIRE). 2014. "Glossary." U.S. Department of Energy. Retrieved December 20, 2014 from: http://www.dsireusa.org/glossary/
[31] Ibid.

states have rebates that support wind power.[32] The American Wind Energy Association (AWEA) argues that the rebate program is a major driver of the small wind market in California. New Jersey and Oregon have rebate programs similar to California's. These programs, however, have failed to stimulate notable market growth.[33]

The primary renewable energy policies states most commonly pursue include the following: Renewable Portfolio Standards (RPS), tax credits, and transmission improvements. Each of these is reviewed in the following sections.

RENEWABLE PORTFOLIO STANDARDS (RPS)

Renewable Portfolio Standards (RPS) are state policies intended to increase the percentage of a state's electricity that is generated from renewable sources.[34] For example, an RPS may require utilities to supply 15–25 percent of a state's total electricity from renewables by 2020 or 2025.[35] Because federal subsidies make wind profitable for investors, wind power is often used to meet RPS requirements.

Figure 4 shows that, as of March 2015, Washington DC, two territories, and 29 states have binding RPS requirements. There are nine other states and two territories with renewable portfolio goals.[36] Goals are not enforceable or mandatory.[37] California's RPS is one of the most aggressive, requiring the state to consume 33 percent of its energy from renewables by 2020.[38]

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[32] Lantz, E. and E. Doris. 2009, March. "State Clean Energy Practices: Renewable Energy Rebates." Pg. 1-3. National Renewable Energy Laboratory (NREL). Retrieved from: http://www.nrel.gov/docs/fy09osti/45039.pdf

[33] Lantz, E. and E. Doris. 2009, March. "State Clean Energy Practices: Renewable Energy Rebates." pg. 9-10. National Renewable Energy Laboratory (NREL). Retrieved from: http://www.nrel.gov/docs/fy09osti/45039.pdf

[34] Char, C. and S. Abramson. 2006, March 13. "Renewable Portfolio Standards in Energy Policy: A Policy Analysis for the State of New Hampshire." pg. 4. Rockefeller Center at Dartmouth College. Retrieved from: http://rockefeller.dartmouth.edu/library/RPS_NH.pdf

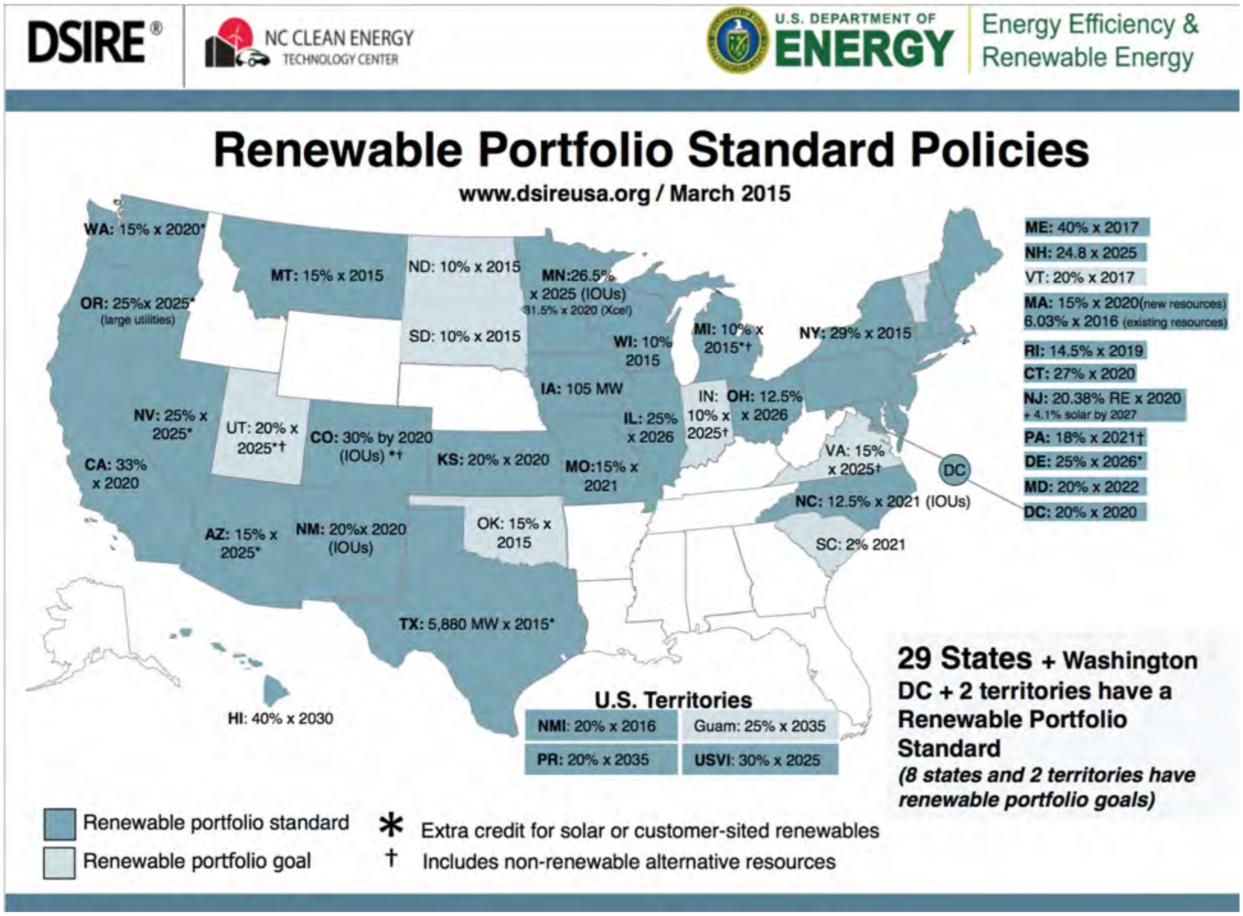
[35] Center for Climate and Energy Solutions. 2009. "State RPS and AEPS Details." pg. 1-3. Retrieved December 21, 2014 from: http://www.c2es.org/docUploads/state-rps-aeps-details.pdf

[36] Database of State Incentives for Renewables and Efficiency (DSIRE). 2015, March. "Renewable Portfolio Standard Policies." U.S. Department of Energy. Retrieved from: http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2014/11/Renewable-Portfolio-Standards.pdf

[37] Solar Energy Industries Association (SEIA). n.d. "Renewable Energy Standards." Retrieved December 14, 2014 from: http://www.seia.org/policy/renewable-energy-deployment/renewable-energy-standards

[38] Database of State Incentives for Renewables and Efficiency (DSIRE). 2015, March. "Renewable Portfolio Standard Policies." U.S. Department of Energy. Retrieved from: http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2014/11/Renewable-Portfolio-Standards.pdf

FIGURE 4: RENEWABLE PORTFOLIO STANDARD POLICIES[39]



Some states also have requirements for specific forms of energy they wish to promote. For example, North Carolina uniquely requires that, by 2018, 0.2 percent of its electricity is generated from swine waste.[40]

Because producing electricity from renewable sources is more expensive than producing it from conventional ones, RPS entail costs that fall to electricity consumers.[41] When RPS require a certain percentage of electricity come from renewable sources, energy prices increase. In other words, in markets where subsidized energy sources are mandated, energy prices will be generally higher. The Institute for Energy Research found that states with RPS legislation have electricity rates 38 percent higher, on average, than states without RPS.[42]

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[39] Ibid.

[40] Database of State Incentives for Renewables and Efficiency (DSIRE). 2015, February 3. "Renewable Energy and Energy Efficiency Portfolio Standard." U.S. Department of Energy. Retrieved from: http://programs.dsireusa.org/system/program/detail/2660

[41] Institute for Energy Research (IER). n.d. "The Status of Renewable Electricity Mandates in the States." Pg. 1. Retrieved December 11, 2014 from: http://instituteforenergyresearch.org/wp-content/uploads/2011/01/IER-RPS-Study-Final.pdf

[42] Institute for Energy Research (IER). n.d. "The Status of Renewable Electricity Mandates in the States." Pg. 5. Retrieved

Jonathan Cook, in a report by the Energy Efficiency Center at UC Davis, argues that any prediction of future price is, "inherently subject to a high degree of uncertainty."[43] Predicting the cost of renewable energy generation against the cost of fossil fuel generation with any degree of certainty, he concludes, is nearly impossible.[44]

Mike Hager, a member of North Carolina's House of Representatives, argued that the state RPS creates hidden costs by deterring businesses from starting or expanding in the state. Because it entails higher electricity prices, North Carolina's RPS dissuades entrepreneurs and businesses from starting up or expanding.[45]

TAX INCENTIVES

Many states have also created tax credits to incentivize the development of renewable energy and wind power in particular.[46] These include exemptions, exclusions, abatements and credits provided to producers of wind power and other forms of renewable energy. The tax incentives, as defined by DSIRE, "[P]rovide that the added value of a renewable energy system is excluded from the valuation of the property for taxation purposes."[47]

One of MidAmerican Energy's wind projects in Iowa, for example, is expected to reap a total of about $300 million in tax benefits over the next 20 years due to the federal PTC and forgiveness of state property taxes. Of those benefits, about $175 million stem from the federal program and $130 million from the state's incentive programs.[48]

In addition to incentives that benefit retail producers of wind energy, states have also created programs that benefit consumers. The State of Vermont, for example, offers a sales tax exemption for renewable energy systems with up to 250 kilowatts in capacity. Vermont does not require any sales tax be paid on any parts needed for a wind system to be built.[49] The State of Oregon funds the Alternative Energy Device Credit, which provides up to $6,000 in income tax credits for the installation of a small-scale wind system.[50]

December 11, 2014 from: http://instituteforenergyresearch.org/wp-content/uploads/2011/01/IER-RPS-Study-Final.pdf

[43] Cook, J. 2013, December. "The Future Of Electricity Prices In California: Understanding Market Drivers And Forecasting Prices To 2040." Pg. 18-20. Retrieved from: http://eec.ucdavis.edu/files/02-06-2014-The-Future-of-Electricity-Prices-in-California-Final-Draft-1.pdf

[44] Ibid.

[45] Mendenhall, G. n.d. "Capturing Methane to Make Energy." Whole Hog. Retrieved from: http://www.wholehognc.org/energy.html

[46] National Conference of State Legislatures. 2014, January 16. "State Renewable Portfolio Standards and Goals." Retrieved from: http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx

[47] Database of State Incentives for Renewables and Efficiency (DSIRE). 2014. "Glossary." U.S. Department of Energy. Retrieved December 20, 2014 from: http://www.dsireusa.org/glossary/

[48] Schleede, G. 2005, April 14. "'Big money' discovers the huge tax breaks and subsidies for wind energy while taxpayers and electric customers pick up the tab." AWEO. Retrieved from: http://www.aweo.org/Schleede.html#subsidies

[49] Renewable Energy Vermont. 2014. "Incentive Types." Retrieved from: http://www.revermont.org/main/go-renewable/incentive-types/

[50] Oregon Department of Energy. n.d. "Wind Information for Land Owners." Retrieved December 21, 2014 from:

TRANSMISSION COSTS

Most wind resources within the U.S are located in the Great Plains states.[51] These states are far from population centers where demand for electricity is high, creating a complication that has prompted many states to make billion-dollar investments in transmission infrastructure. Because state policies often mandate that such investments involve taxpayer dollars, transmission costs must be counted as another hidden cost of wind energy.

Nebraska's Power Review Board recently reported that it would cost $4 billion to install the required infrastructure to export wind energy to other states. The analysis concludes that, "A potentially significant portion of this cost would likely have to be borne by Nebraska utilities and their customers."[52] These higher costs may be partially offset by reducing the congestion of transmission already inherent in the electrical grid.[53] Many other states, including Texas, have already undertaken large-scale transmission improvement projects at substantial cost to taxpayers.

STATE-LEVEL CASE STUDIES

In this section, we examine the cases of two states that have enacted significant wind energy policy to illustrate how state-level policy affects the true cost of energy. California and Texas are both national leaders in wind power production, and both have enacted policies to boost wind power production—with differing results.

WIND ENERGY IN CALIFORNIA

At the end of 2013, California had over 6,000 megawatts of installed wind capacity, generating over 12 million megawatt-hours of electricity.[54] This equates to 6.6 percent of total in-state energy generation. This makes California the third largest producer of wind energy in the nation.[55] As will be shown in this case study, these statistics do not tell the entire story.

California has a history of enacting policies to encourage the development of renewable energy. These policies, combined with federal incentives, have resulted in the growth of renewable energy capacity in the state. This capacity, however, is the total amount of electric output the

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http://www.oregon.gov/energy/RENEW/Pages/wind/windinfo.aspx

[51] U.S. Energy Information Administration - EIA - Independent Statistics and Analysis. 2011, August 2. Retrieved from: http://www.eia.gov/todayinenergy/detail.cfm?id=2470

[52] Hubbard, R. 2014, December 16. "Building infrastructure to sell wind energy could cost $4 billion, Nebraska power board says." *Omaha World-Herald*. Retrieved from: http://www.omaha.com/money/building-infrastructure-to-sell-wind-energy-could-cost-billion-nebraska/article_e8385988-abde-5013-9cdc-f046bac43344.html

[53] Ibid.

[54] California Energy Commission. 2014. "Electricity From Wind Energy Statistics & Data." Retrieved December 18, 2014 from: http://energyalmanac.ca.gov/renewables/wind/index.php

[55] McFarland, A. 2014, April 15. "Twelve states produced 80% of U.S. wind power in 2013." U.S. Energy Information Administration. Retrieved from: http://www.eia.gov/todayinenergy/detail.cfm?id=15851

generators can produce under specific conditions, not the amount of energy that is actually generated. This wind capacity has come at a substantial cost to California taxpayers, who are ultimately paying for an energy source that must have backup power. Thus, Californians are paying twice—once for the intermittent renewable power and then again for the reliable backup power.

HISTORY OF CALIFORNIA STATE POLICIES

In 1978 Congress passed the Public Utilities Regulatory Policies Act (PURPA). Before this act, utilities produced their own power. PURPA, however, required utilities to purchase electricity from independent electricity producers, as long as these producers could produce power at a cheaper rate than the utility itself.[56]

The federal agency responsible for overseeing PURPA left responsibility to the states for determining the price that utilities were required to pay for non-utility power. The California Energy Commission (CEC) established a rate three to seven times higher than that of most other states, incentivizing development of wind energy in the state.[57] The California Public Utilities Commission (CPUC) negotiated the first "Interim Standard Offer Contracts" with independent energy producers. These contracts established standard, long-term agreements with high guaranteed prices for wind producers .[58] These contracts, combined with the high non-utility rate set by the CEC, helped ensure the early development of wind power in California.

Oil and natural gas prices dropped in the late 1980s, however, and renewable energy became expensive in comparison. As the contracts with wind producers expired, many utilities did not renew them. This ended the booming construction of new turbines.[59]

ADDITIONAL STATE INCENTIVES

In 1980, California passed a 25 percent state investment tax credit, along with accelerated depreciation and property tax exemptions for property that contained renewable energy generating facilities.[60] Nearly 50 percent of the installation costs for new wind projects during the 1980s was covered by the combination of state and federal tax incentives.[61]

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[56] Union of Concerned Scientists. No date. Retrieved from: http://www.ucsusa.org/clean_energy/smart-energy-solutions/strengthen-policy/public-utility-regulatory.html#.VGP1xpPF9yE

[57] Hinman, J. 2009 "The Green Economic Recovery: Wind Energy Tax Policy After Financial Crisis and the American Recovery and Reinvestment Tax Act of 2009." Pg. 50. University of Oregon School of Law. Retrieved from: http://law.uoregon.edu/wp-content/uploads/2014/03/Hinman.pdf

[58] Harris, F. and P. Navarro. 1999. "Policy Options for Promoting Wind Energy Development in California." Pg. 12-19. Prepared for the Governor and State Legislature of California. University of California-Irvine. Retrieved from: http://www.e-renewables.com/documents/Wind/Promoting%20Wind%20Energy%20in%20California.pdf

[59] Hinman, J. 2009 "The Green Economic Recovery: Wind Energy Tax Policy After Financial Crisis and the American Recovery and Reinvestment Tax Act of 2009" Pg. 52-53. University of Oregon School of Law. Retrieved from: http://law.uoregon.edu/wp-content/uploads/2014/03/Hinman.pdf

[60] Harris, F. and P. Navarro. 1999, November. "Policy Options for Promoting Wind Energy Development in California." Pg. 13. Prepared for the Governor and State Legislature of California. Irvine, California. Retrieved from: http://www.e-renewables.com/documents/Wind/Promoting%20Wind%20Energy%20in%20California.pdf

[61] Hinman, J. 2009. "The Green Economic Recovery: Wind Energy Tax Policy After Financial Crisis and the American Recovery

These state incentives, combined with federal tax incentives, encouraged small companies and entrepreneurs to install enough turbines to generate 1,200 megawatts of power capacity in California by 1986.[62] Many projects were built primarily for the tax credits and without concern for how successful the project would be in the long run.[63] But when federal investment tax credits expired in 1986, wind power's growth slowed across the nation.[64] This was the first "wind bust" in the state. California's wind industry would not see its next big boom until passage of the state's Renewable Portfolio Standard.

CALIFORNIA'S RENEWABLE PORTFOLIO STANDARD

Although political debate on the topic began in 1995, California's RPS was not adopted until 2002. The standard originally required that 20 percent of the state's electricity come from renewable sources by 2017. Eligible renewable sources include wind, solar, small hydroelectric, and biomass facilities. This RPS was accelerated in 2006 to require that 20 percent come from renewable resources by the end of 2010.[65]

Between 2002 and 2007, California added only 242 megawatts of renewable energy, and was lagging behind in meeting the RPS requirement.[66] Despite this, in 2008 California further accelerated its RPS to require utilities to serve 33 percent of their load with renewable energy by 2020. [67]

As of 2010, California failed to meet its RPS goal. Only 18 percent of the state's electricity comes from renewable sources, just shy of the 20 percent mandated.[68] Lieutenant Governor Gavin Newsom called the 33 percent requirement "a stretch goal," indicating that the state expected the goal to be difficult to reach.[69]

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and Reinvestment Tax Act of 2009." Pg. 50. Journal of Environmental Law and Litigation, 35-74. Retrieved from: http://law.uoregon.edu/wp-content/uploads/2014/03/Hinman.pdf

[62] American Wind Energy Association (AWEA). 2013. "Turbine Timeline: 1980s." AWEA. Retrieved November 26, 2014 from: http://www.awea.org/About/content.aspx?ItemNumber=773

[63] Hinman, J. 2009. "The Green Economic Recovery: Wind Energy Tax Policy After Financial Crisis and the American Recovery and Reinvestment Tax Act of 2009." Pg. 52. Journal of Environmental Law and Litigation, 35-74. Retrieved from: http://law.uoregon.edu/wp-content/uploads/2014/03/Hinman.pdf

[64] Wind Energy Foundation. n.d. "FAQs." Retrieved November 26, 2014 from: http://www.windenergyfoundation.org/about-wind-energy/faqs

[65] Behles, D. 2011, July 1. "Why California Failed to Meet Its RPS Target." Pg. 164-167. Golden Gate University School of Law. Retrieved from: http://digitalcommons.law.ggu.edu/cgi/viewcontent.cgi?article=1431&context=pubs

[66] Behles, D. 2011, July 1. "Why California Failed to Meet Its RPS Target." Pg. 169. Golden Gate University School of Law. Retrieved from: http://digitalcommons.law.ggu.edu/cgi/viewcontent.cgi?article=1431&context=pubs

[67] California Energy Commission. 2014, November 14. "Renewables Portfolio Standard (RPS)." Retrieved from: http://www.energy.ca.gov/portfolio/

[68] Behles, D. 2011, July 1. "Why California Failed to Meet Its RPS Target." Pg. 170. Golden Gate University School of Law. Retrieved from: http://digitalcommons.law.ggu.edu/cgi/viewcontent.cgi?article=1431&context=pubs

[69] Bryce, R. 2012, February. "The High Cost of Renewable Electricity Mandates." Manhattan Institute. Retrieved from: http://www.manhattan-institute.org/html/eper_10.htm

California's RPS allows hefty fines of up to $25 million per year to be imposed on utilities that fail to meet the standard.[70] To date, however, no non-compliance penalties have been issued [71] Although utilities are not reaching the goal as mandated, flexible compliance programs allow utilities the freedom to choose how they satisfy RPS program targets. The result is a non-stringent compliance program that allows utilities to fail to meet RPS goals.[72]

Despite the state's failure to meet its current RPS goals, groups like CalCEF, the California Clean Energy Fund, propose even more aggressive RPS policies. They hope to raise the 20 percent target to over 50 percent of the state's electricity coming from renewables. Governor Jerry Brown supports these efforts, telling reporters "I believe we can get to 40 percent, and I think we should."[73]

These costs extend beyond the residential electricity market, as California's industrial electricity prices are 65 percent higher than the U.S. average. Approximately 700,000 manufacturing jobs have been lost because of high electricity pricing, and these prices help contribute to California being ranked the worst state in the nation for business. Over three businesses leave California each week for the friendlier business climate and lower energy costs of Texas.[74]

THE TRUE COST OF WIND IN CALIFORNIA

RPS may serve to increase the use of renewable energy, but they also have negative consequences for California's consumers. RPS require utilities to purchase electricity from renewable sources that are more expensive than their non-renewable counterparts. By requiring utilities to purchase more expensive fuel, utilities must make up that cost by increasing the rates they charge customers.

Before California enacted its RPS, residential electricity prices rose 8 percent from 1993 to 2003. In 2003, the state RPS was enacted. The next 10 years saw an increase in rates of 34 percent; a four-fold increase over the previous decade.[75] The RPS helps contribute to California having retail rates 53 percent higher across all sectors than the U.S. average.[76]

The RPS creates a demand for wind energy that normally would not exist. Without an RPS, wind producers would be forced to make wind technology cost effective for consumers. Clean wind

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[70] Institute for Energy Research (IER). n.d. "The Status of Renewable Electricity Mandates in the States." Pg. 12. Institute for Energy Research. Retrieved December 11, 2014 from: http://instituteforenergyresearch.org/wp-content/uploads/2011/01/IER-RPS-Study-Final.pdf
[71] Behles, D. 2011, July 1. "Why California Failed to Meet Its RPS Target." Pg. 176. Golden Gate University School of Law. Retrieved from: http://digitalcommons.law.ggu.edu/cgi/viewcontent.cgi?article=1431&context=pubs
[72] Ibid.
[73] Wesoff, D. 2011, April 12. "It's Official: 33% RPS Now the Law in California." Greentech Media. Retrieved from: http://www.greentechmedia.com/articles/read/its-official-33-rps-now-the-law-in-california
[74] Clemente, J. 2014, October 27. "Hey EPA: 'The California Model' Doesn't Work, and We'll Need More Electricity." Forbes. Retrieved from: http://www.forbes.com/sites/judeclemente/2014/10/27/hey-epa-the-california-model-doesnt-work-and-well-need-more-electricity/
[75] Ibid.
[76] Zycher, B. 2013, January. "The Looming Rate Bomb." Pg. 10. Pacific Research Institute. Retrieved from: http://pacificresearch.org/fileadmin/templates/pri/images/Studies/PDFs/2013-2015/ElectricityCosts_Zycher_F2.pdf

technology is attractive in theory, but the price paid for wind is too high when the price of energy from other sources is considered.

The success of wind farms in California depends on the availability of subsidies and other incentives. If the PTC and other incentives are extended, these farms will continue to operate at taxpayer expense. If these policies were allowed to expire, then California's wind industry would stand or fall on its own merits.

The true cost of wind energy in California has been obscured by government subsidies and regulations, both state and federal. Subsidies leave taxpayers to cover the costs of a product that cannot succeed in a free and competitive market. Regulations increase costs for consumers by requiring utilities to purchase expensive power. Ending state policies such as the RPS and other subsidies, both federal and state, is the only way to know if wind energy is actually viable in a competitive energy market.

WIND ENERGY IN TEXAS

Texas has more wind power capacity than any other state. At the close of 2012, Texas boasted an installed wind capacity of over 12,000 megawatts, with an additional 7,000 megawatts under construction in 2014.[77] In total, wind generated about 8 percent of Texas's electricity in 2012.[78] This figure is almost twice the U.S. average.[79] Texas ranks second for commercial viability of wind resources according to the U.S. Department of Energy.[80]

Texas has sought to take advantage of its plentiful wind resources by enacting state policies to incentivize the development of the wind industry. The state's policies have largely been successful in encouraging wind development, although such development has come at a substantial cost to the state's taxpayers.

STATE POLICIES

Texas provides a plethora of financial incentives for renewable energy generation within the state. For example, Texas Tax Code § 11.27 allows for a 100 percent property tax exemption for any property value increase from renewable facilities built, and this includes wind energy.[81] The Manhattan Institute reports that local jurisdictions in Texas have foregone over $700 million in

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[77] American Wind Energy Association (AWEA). 2014, March 5. “American Wind Power Reaches Major Power Generation Milestones in 2013.” Retrieved from: http://www.awea.org/MediaCenter/pressrelease.aspx?ItemNumber=6184;
Del Franco, M. 2014. "Nearly Completed CREZ Lines Unlock Wind Congestion." Pg. 4. Zackin Publications. Retrieved December 6, 2014 from:
http://www.nawindpower.com/issues/NAW1307/FEAT_01_Nearly_Completed_CREZ_Lines_Unlock_Wind_Congestion.html
[78] Department of Energy (DOE). 2013, August. "2012 Wind Technologies Market Report." Pg. 9. Retrieved from: http://www1.eere.energy.gov/wind/pdfs/2012_wind_technologies_market_report.pdf
[79] Permian Basin Energy Magazine. 2014, May. "Texas Takes Top Spot in the US Rankings for Wind Power in 2013." Pg. 38. Permian Basin Energy Inc. Retrieved from: http://issuu.com/pbenergy/docs/pbemag-may-2014-virtual/38
[80] Elliott, L., Wendell, L., and Gower, L. 1991, August. "An Assessment of the Available Windy Land Area and Wind Energy Potential in the Contiguous United States." Pg. 59. Pacific Northwest Laboratory. Retrieved from: http://www.osti.gov/scitech/servlets/purl/5252760
[81] Database of State Incentives for Renewables and Efficiency (DSIRE). 2014, August 8. "Renewable Energy Systems Property Tax Exemption." U.S. Department of Energy. Retrieved from: http://programs.dsireusa.org/system/program/detail/173

property taxes from this exemption and other laws designed to encourage the growth of the wind industry.[82]

In 1999, the Texas state legislature passed the state's first RPS legislation. The RPS required Texas to have 2,000 megawatts of electricity generated from renewable sources before the year 2009.[83] Texas quickly met the quota and the state legislature amended the RPS, raising the required amount of renewable energy to 10,000 megawatts by 2025. The 2025 goal was surpassed in 2010, 15 years before the deadline.[84] The renewable energy developed to meet this goal was almost entirely wind energy, which prompted the state to encourage diversification by adding a voluntary stipulation that 500 megawatts of the generated renewable energy required by the RPS be from non-wind sources.[85]

Texas's RPS program places the burden of compliance on the retail electric providers. The RPS also includes a Renewable Energy Credit (REC) market whereby the electricity providers meet the portfolio standards. The tradable credits program allows utilities with little access to renewable energy to purchase credits from utilities with greater access to renewable energy.[86] The REC market was intended to incentivize renewable energy development in the private sector. But according to a report by the Center for Energy Economics at the University of Texas at Austin, the prices collapsed and failed to provide incentives for wind developers. The researchers attribute wind's success in Texas to the PTC, not the RECs.[87]

The Texas Public Policy Foundation (TPPF) estimates that the cost of compliance with the RPS, specifically through the REC market, will be about $1.4 billion by 2025. These costs, however, are likely to be lower than estimated. The Foundation's analysis assumed the average cost of a REC would be $4.50.[88] According to the U.S. Department of Energy the actual price of each REC has been significantly lower than $4.50 since late 2008.[89] This means the cost of purchasing RECs to comply with the RPS would be lower than TPPF’s analysis suggests. Despite this, there are other compliance costs associated with complying with the RPS and with buying RECs, and most of these costs are ultimately passed on to the consumer.

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[82] Bryce, R. 2012, February. "The High Cost of Renewable Electricity Mandates." Manhattan Institute. Retrieved from: http://www.manhattan-institute.org/html/eper_10.htm
[83] Durrwachter, H., and W. Lasher. 2012. "Wind Power in the Power System in Texas." T. Ackermann (Ed.), Wind Power in Power Systems (2nd ed. pp. 649-666). John Wiley & Sons.
[84] Ibid.
[85] Database of State Incentives for Renewables and Efficiency (DSIRE). 2015, February 4. "Renewable Generation Requirement." U.S. Department of Energy. Retrieved from: http://programs.dsireusa.org/system/program/detail/182; Energy Information Administration (EIA). U.S. Department of Energy. 2014, November 20. "Texas State Profile and Energy Estimates." Retrieved from: http://www.eia.gov/state/analysis.cfm?sid=TX
[86] Gülen, G., M. Foss, R. Makaryan, and D. Volkov. 2009, January 1. "RPS in Texas - Lessons Learned & Way Forward." Pg. 5-6. Center for Energy Economics, Bureau of Economic Geology, University of Texas at Austin. Retrieved from http://www.usaee.org/usaee2009/submissions/OnlineProceedings/Gulen et al.pdf
[87] Center for Energy Economics. 2009, July. "Lessons Learned from Renewable Energy Credit (REC) Trading in Texas." Pg. 7-8. Jackson School of Geosciences at the University of Texas at Austin. Retrieved from: http://www.beg.utexas.edu/energyecon/transmission_forum/CEE_Texas_RPS_Study.pdf
[88] Peacock, B. 2008, October. "The True Cost of Wind Energy." Pg. 1-2. Retrieved from: http://www.texaspolicy.com/sites/default/files/documents/2008-10-PP18-truecostofwind-bp.pdf
[89] Department of Energy (DOE). 2014. "Renewable Energy Certificates (RECs)." Retrieved from: http://apps3.eere.energy.gov/greenpower/markets/certificates.shtml?page=5

Texas's government is losing revenue and distorting the electricity market through state policies intended to incentivize renewable energy development.[90] Demand for renewable energy, specifically wind, is unnaturally increased by the state's RPS.[91] The RPS also raises the cost of running a utility in Texas by increasing the cost of meeting electricity demand. These higher costs are inevitably passed onto consumers.[92]

TRANSMISSION COSTS

The small west Texas town of McCamey became the state's wind energy capital in 2001 by virtue of a resolution passed by the Texas state legislature. The city gained its distinction because of its plentiful wind resources and the large number of wind projects in the area.[93] Wind development in McCamey was soon so successful that it outstripped the capabilities of the transmission lines in the small town. McCamey's wind production capabilities stood at about 750 megawatts, but the area's transmission lines could only carry 450 megawatts.[94]

Transmission infrastructure problems like those McCamey experienced are common throughout areas that are developing renewable resources, and many states have started investing in their transmission lines to order to solve the problem. Texas, for instance, created the Competitive Renewable Energy Zone project to determine areas ripe for connection to the grid because of the wind energy potential and fund construction of transmission lines to these regions.[95]

The $7 billion CREZ project is Texas's most expensive subsidy to date, and its total cost falls on consumers served by the Electrical Reliability Council of Texas (ERCOT).[96] The Texas Public Utility Commission has stated the typical ratepayer was charged an additional $6 every month because of the CREZ project.[97] Proponents of the program, however, argue that increasing transmission capability will decrease energy congestion on the transmission lines leading to lower electricity costs. Less congestion on the grid means fewer price hikes for consumers during peak demand periods.[98]

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[90] Thornley, D. 2009, June 9. "Texas Wind Energy: Past, Present, and Future." Pg. 99. Environmental & Energy Law & Policy Journal: University of Houston Law Center. Retrieved from: https://www.law.uh.edu/eelpj/publications/4-1/Thornley.pdf
[91] Thornley, D. 2009, June 9. "Texas Wind Energy: Past, Present, and Future." Pg. 75. Environmental & Energy Law & Policy Journal: University of Houston Law Center. Retrieved from: https://www.law.uh.edu/eelpj/publications/4-1/Thornley.pdf
[92] Peacock, B. 2010, December. "Texas' Renewable Energy Experiment: High Costs, Poor results." Pg. 4-5. Texas Public Policy Foundation. Retrieved from: http://www.texaspolicy.com/sites/default/files/documents/2010-12-PP25-TexasRenewableEnergyExperiment-paper4-bp.pdf
[93] McCamey. n.d. "Wind Energy Capital of Texas". McCamey, Texas. Retrieved January 7, 2015 from: http://mccameycity.com/index.php?tag=5TGKF0Y6M8
[94] Durrwachter, H., & Lasher, W. 2012. "Wind Power in the Power System in Texas." T. Ackermann (Ed.), Wind Power in Power Systems (2nd ed. pp. 649-666). John Wiley & Sons.
[95] Lee, A. 2014, June 24. "Fewer wind curtailments and negative power prices seen in Texas after major grid expansion." U.S. Energy Information Administration. Retrieved from: http://www.eia.gov/todayinenergy/detail.cfm?id=16831
[96] Peacock, B. 2010, December. "Texas' Renewable Energy Experiment: High Costs, Poor results." Pg. 2. Texas Public Policy Foundation. Retrieved from: http://www.texaspolicy.com/sites/default/files/documents/2010-12-PP25-TexasRenewableEnergyExperiment-paper4-bp.pdf
[97] Wald, M. 2014, July 23. "Texas is Wired for Wind Power, and More Farms Plug in." New York Times. Retrieved from: http://www.nytimes.com/2014/07/24/business/energy-environment/texas-is-wired-for-wind-power-and-more-farms-plug-in.html?_r=1
[98] Minora, L. 2014, May 5. "CREZ RE-energizes Texas, Reduces Congestion Costs." Oncor. Retrieved from:

Unfortunately, only PTC-fueled wind farms are likely to be able to compete in areas where CREZ lines have been built, as these areas are generally remote and were chosen for their wind resources. This means the CREZ program essentially functions only as a subsidy to the wind industry. While the benefits of this subsidy will go to wind producers, the costs will be borne by Texas' electricity consumers.[99]

These costs are not always considered in analyses of the true cost of wind energy. The TPPF estimates that adding over 11,000 megawatts of wind generation capacity to take advantage of the additional transmission lines would increase backup generation and reduced reliability costs by $1.82 billion per year. These costs stem from the variable nature of wind and the resulting necessity of keeping other forms of energy on backup.[100] If these costs were evenly shared among Texas households, each would pay $204.81 to subsidize wind power added onto the electrical grid.[101]

THE PRODUCTION TAX CREDIT (PTC)

The PTC is another key policy that fuels the expansion of the Texas wind industry. The PTC is crucial for enabling wind energy to compete with fossil fuels.[102] The policy is the driving force behind negative pricing in the state. Negative pricing occurs when producers of electricity pay others to take their electricity, rather than charging positive prices. Wind farm operators do this because the PTC and other tax credits only accrue when the farm is generating electricity.[103]

The PTC pays wind energy producers $23 for each megawatt they produce, allowing them to bid lower than other power sources. This large subsidy incentivizes wind producers to run their facilities even when the demand for electricity is low. The Energy Information Administration's data show that negative pricing in Texas has become less common as the Competitive Renewable Energy Zones initiative nears completion. As more transmission lines are built, excess electricity is allowed to flow more freely to areas with higher demand. Thus, wind power producers are less likely to have to pay utilities to accept their power.[104]

Travis Fisher, a researcher with the Institute for Energy Research, argues that even if negative pricing has decreased, there is the additional hidden cost of reduced reliability from wind energy, an inherently unreliable resource.[105] As more wind energy is added onto the grid, backup

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http://thewire.oncor.com/News/Archives/CREZ-Re-energizes-Texas-Reduces-Congestion-Costs.aspx

[99] Peacock, B. 2010, December. "Texas' Renewable Energy Experiment: High Costs, Poor results." Pg. 2-3. Texas Public Policy Foundation. Retrieved from: http://www.texaspolicy.com/sites/default/files/documents/2010-12-PP25-TexasRenewableEnergyExperiment-paper4-bp.pdf

[100] Ibid, Pg. 5.

[101] Based on US Census data that puts the number of Texas households at 8.886 million.

[102] Durrwachter, H., & Lasher, W. 2012. "Wind Power in the Power System in Texas." T. Ackermann (Ed.), Wind Power in Power Systems (2nd ed. pp. 649-666). John Wiley & Sons.

[103] Baldick, R. 2011, February 17. "Wind and Energy Markets: A Case Study of Texas." Systems Journal, IEEE. Retrieved from: https://www.diw.de/documents/dokumentenarchiv/17/diw_01.c.429141.de/baldick_wind_energy_markets.pdf

[104] Lee, A. 2014, June 24. "Fewer wind curtailments and negative power prices seen in Texas after major grid expansion." U.S. Energy Information Administration. Retrieved from: http://www.eia.gov/todayinenergy/detail.cfm?id=16831

[105] Fisher, T. 2014, April 23 April. "AWEA's Bold Push for More Wind Welfare." Institute for Energy Research. Retrieved from:

generation must be maintained in order to account for times when the wind unexpectedly stops blowing.

Donna Nelson, the Chairwoman of the Public Utility Commission of Texas, notes that federal tax incentives have, "distorted the competitive wholesale market in ERCOT." Nelson also asserts that the PTC and other federal incentives are the primary cause of Texas's resource adequacy problems.[106] Resource adequacy is having the necessary supply of electric generation to meet demand and support grid reliability.[107] According to Nelson, the flood of subsidized wind turbines threatens to push coal and natural gas power plants out of business, destabilizing the state's electricity grid.[108]

An analysis by the economic and strategic consulting firm, the NorthBridge Group, affirms the fears of Chairwoman Nelson about the threat the PTC poses to grid stability. The NorthBridge Group's report finds that the PTC threatens the long-run stability of the grid system by discouraging the development of conventional generation sources that are critical for reliability.[109]

Relying on wind power requires backup generation in case there is no wind. Only conventional sources can provide the backup power necessary to ensure the lights stay on when the wind stops blowing. Unsubsidized conventional generation sources cannot compete with wind generators who can draw a profit despite negative pricing and are, therefore, forced out of the market. As these conventional sources are driven out, reliability will be reduced even further.[110]

Any attempt to fully understand the wind industry's impact on the true cost of energy must also consider the costs of maintaining the grid system's reliability, and the risks of creating a system based on a volatile source of energy. Any benefits provided by the developing wind industry must be analyzed within a wider context that includes these costs.

TRUE COST OF ENERGY IN TEXAS

The wind industry in Texas has thrived not because of wind energy's own merits, but rather because state policies like the RPS create artificial demand for renewable energy. State and local policies alike have brought in lavish subsidies for wind power developers in Texas. The PTC, for example, provides a direct subsidy for electricity generation from wind facilities. Wind

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http://instituteforenergyresearch.org/analysis/aweas-bold-push-for-more-wind-welfare/

[106] Huntowski, F., A. Patterson, and M. Schnitzer. 2012, September. "Negative Electricity Prices and the Production Tax Credit." Pg. 2. The NorthBridge Group. Retrieved from: http://www.hks.harvard.edu/hepg/Papers/2012/Negative_Electricity_Prices_and_the_Production_Tax_Credit_0912.pdf

[107] Electricity Reliability Council of Texas (ERCOT). 2005. "Resource Adequacy." Retrieved December 21, 2014 from: http://www.ercot.com/gridinfo/resource

[108] Huntowski, F., A. Patterson, and M. Schnitzer. 2012, September. "Negative Electricity Prices and the Production Tax Credit." Pg. 3-4. The NorthBridge Group. Retrieved from: http://www.hks.harvard.edu/hepg/Papers/2012/Negative_Electricity_Prices_and_the_Production_Tax_Credit_0912.pdf

[109] Ibid.

[110] Ibid.

development has also been fueled by indirect subsidies, such as transmission programs, that the citizens of Texas will fund through higher costs.

Texas has created a favorable legal and political environment, which allowed wind energy to quickly develop. The costs of development, however, have not been borne by wind developers. Rather, the costs have largely been externalized and dispersed among consumers in Texas through the CREZ program, and onto other citizens in the United States through the federal PTC.

Wind assets in Texas are being developed, but only because of a legal and political environment that provides lucrative subsidies and benefits to developers. Eventually these costs will find their way to the consumer, either through higher electricity prices or steeper taxes. The true cost of wind energy in Texas is obscured by these massive subsidies, transmission projects that are difficult to factor into cost estimates, and threats to reliability created by flooding the energy market with underpriced wind power.

COMPARING STATE POLICIES: CALIFORNIA VS. TEXAS

Although both states have enacted policies to incentivize the growth of wind power, Texas has more than double the installed wind power capacity of California.[111] Several major factors account for this difference in wind energy development between the two states. These include the quality of wind resources, the amount of tax subsidies received, and the regulatory environment.

Texas has some of the best wind resource potential in the country, while California's are much more limited.[112] California’s optimal wind production areas are confined to three specific locations.[113] These locations are now home to San Gorgonio, Tehachapi, and Altamont Pass wind farms, and nearly all of California’s wind energy is produced there.[114] Because Texas has much more plentiful wind resources, wind energy production in Texas is much more viable and attractive in comparison. A side-by-side comparison of the two states, seen in *Figures 5 and 6*, clearly depicts the significantly greater wind potential in Texas.

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[111] WIND Exchange. 2014, October 23. "Installed Wind Capacity." United States Department of Energy. Retrieved from: http://apps2.eere.energy.gov/wind/windexchange/wind_installed_capacity.asp

[112] National Renewable Energy Laboratory (NREL). 2010. "Texas Annual Average Wind Speed at 80 m." Retrieved from: http://apps2.eere.energy.gov/wind/windexchange/images/windmaps/tx_80m.jpg

[113] National Renewable Energy Laboratory (NREL). 2010. “California Annual Average Wind Speed at 80 m.” Retrieved from: http://apps2.eere.energy.gov/wind/windexchange/images/windmaps/ca_80m.jpg

[114] California Energy Commission. (n.d.). Overview of Wind Energy in California. Retrieved May 12, 2015, from http://www.energy.ca.gov/wind/overview.html

FIGURE 5: TEXAS ANNUAL AVERAGE WIND SPEED[115]

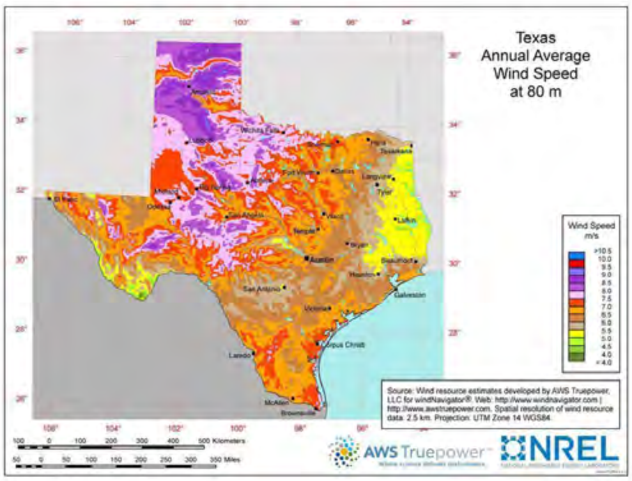
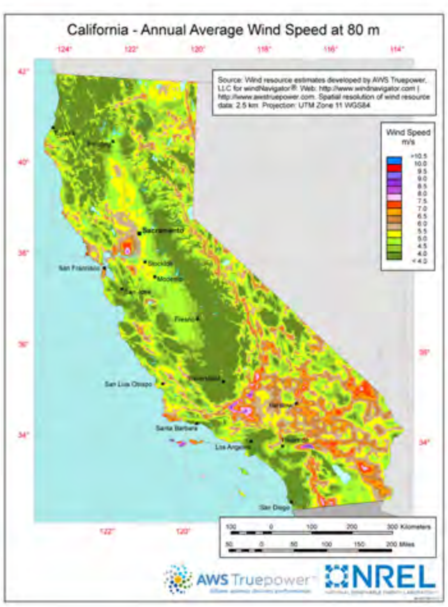


FIGURE 6: CALIFORNIA ANNUAL AVERAGE WIND SPEED[116]



One of the primary differences between wind development in the two states is likely due to Texas receiving a much larger net benefit from the PTC than California.[117] California carried a

[115] National Renewable Energy Laboratory (NREL). 2010. "Texas Annual Average Wind Speed at 80 m." Retrieved from: http://apps2.eere.energy.gov/wind/windexchange/images/windmaps/tx_80m.jpg
[116] National Renewable Energy Laboratory (NREL). 2010. "California Annual Average Wind Speed at 80 m." Retrieved from: http://apps2.eere.energy.gov/wind/windexchange/images/windmaps/ca_80m.jpg
[117] Institute for Energy Research (IER). 2013, December. "Estimating the State-Level Impact of Federal Wind Energy Subsidies."

total tax burden of $330.8 million in 2012 from the PTC, while receiving only $134.9 million in subsidies. California is therefore an overall net payer by almost $196 million. Texas, however, carried a tax burden of $248 million from the PTC, while receiving $642.5 million. This makes Texas a net taker by over $395 million.[118] Although Texas has put this money to use by installing wind power capacity, it has done so at the expense of taxpayers nationwide.

Texas and California also have very different regulatory environments. Like most states, California's electrical grid system is under the control of the Federal Energy Regulatory Commission (FERC). Texas's grid regulation, however, is unique because ERCOT, the Independent Service Operator that fulfills 85 percent of electricity demands in Texas, is entirely governed by Texas's state legislature and run by Texas's Public Utility Commission.[119] The uniformity that ERCOT provides has allowed the state to avoid potential bureaucratic obstacles during its development of wind power. Other projects, especially those spanning multiple states, are sometimes delayed due to the difficulty of dealing with multiple grid authorities and incompatible federal and state regulations.[120]

The transmission infrastructure improvements in Texas have been more successful than those in California. Texas's CREZ program to build transmission lines out to remote wind resources is almost complete and, once finished will add almost 3,600 miles of transmission lines and infrastructure to carry 18,500 megawatts of energy.[121] California's attempt to build transmission lines, however, has been slowed by the state's more stringent environmental regulations.[122]

Finally, although both states have enacted an RPS, California's is much more aggressive. California requires 33 percent of electricity come from renewable energy by 2020.[123] Texas, on the other hand, has an RPS that only requires 10,000 megawatts by 2025. Texas was able to meet its 2025 goal early.[124] California is, according to the Governor's 2015 inaugural address, on track to meet its RPS by 2020. The Governor even proposed increasing the RPS to 50 percent.[125]

Retrieved from: http://instituteforenergyresearch.org/wp-content/uploads/2013/12/State-Level-Impact-of-Federal-Wind-Subsidies.pdf

[118] Ibid.

[119] Texas Office of Public Utility Counsel. n.d. "Electric Reliability Council of Texas." Retrieved December 5, 2014 from: http://www.opuc.texas.gov/ERCOT.html

[120] Malewitz, J. 2013, October 14. "$7 Billion CREZ Project Nears Finish, Aiding Wind Power." Texas Tribune. Retrieved from: http://www.texastribune.org/2013/10/14/7-billion-crez-project-nears-finish-aiding-wind-po/

[121] Del Franco, M. 2014. "Nearly Completed CREZ Lines Unlock Wind Congestion." Pg. 1-2. Zackin Publications. Retrieved December 6, 2014 from: http://www.nawindpower.com/issues/NAW1307/FEAT_01_Nearly_Completed_CREZ_Lines_Unlock_Wind_Congestion.html; Note that 18,500 MW converts to 18.5 GW.

[122] Galbraith, K. 2009, October 17. "California and Texas: Renewable Energy's Odd Couple." New York Times. Retrieved from: http://www.nytimes.com/2009/10/18/weekinreview/18galbraith.html?_r=0

[123] Database of State Incentives for Renewables and Efficiency (DSIRE). 2015, March. "Renewable Portfolio Standard Policies." U.S. Department of Energy. Retrieved from: http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2014/11/Renewable-Portfolio-Standards.pdf

[124] Database of State Incentives for Renewables and Efficiency (DSIRE). 2015, February 4. "Renewable Generation Requirement." U.S. Department of Energy. Retrieved from: http://programs.dsireusa.org/system/program/detail/182

[125] Brown Jr., E. (2015, January 5). Governor Brown Sworn in, Delivers Inaugural Address. Retrieved from

Wind energy's success in Texas and its failure in California has resulted from the natural advantages Texas has in wind resources as well as the more favorable business and regulatory environment Texas provides. A comparison of both states' wind resources clearly shows Texas has a huge natural advantage over California. In California the development of wind resources has been slowed by stringent environmental regulations, while wind development in Texas enjoys a less restrained regulatory climate.[126]

COST FACTORS

The price of wind is constantly changing, and many studies and reports have attempted to calculate that price. Some focus on capital costs, others on wind's place in the energy market. Still others look to comprehensively understand the entire cost of wind energy projects. Each looks to answer the question: "what is the cost of wind energy?" In this section we look to analyze key studies that examine the cost of wind power, comparing the factors included in the reports and the methods used to measure them.

The reports examined for this review are the Energy Information Administration's(EIA) *Annual Energy Outlook* (AEO), the National Renewable Energy Laboratory's (NREL) *2011 Cost of Wind Energy Review*, and Lazard's *Levelized Cost of Energy Analysis Version 8.0*.

While these studies are straightforward calculations of the cost of wind energy, other studies take the traditional cost estimate techniques and attempt to integrate the social costs of energy, as is the case with the Hamilton Group's report, *A Strategy for America's Energy Future: Illuminating Energy's Full Costs*. Two other reports, George Taylor and Thomas Tanton's *The Hidden Costs of Wind Electricity* and Michael Giberson's *Assessing Wind Power Cost Estimates* seek to modify the wind costs provided by the EIA and the NREL, respectively, by estimating their own costs based on including the cost of backup power, among other factors. Giberson calculates his own costs based on a 2011 NREL report and arrives at a final cost of $109 per megawatt-hour. We added some of his estimates for costs not traditionally calculated in the LCOE, including transmission costs ($15 per megawatt-hour), baseload cycling ($2 per megawatt-hour), and the PTC ($23 per megawatt-hour) to create a final $149 per megawatt-hour figure. This figure is referred to as modified Giberson.

In estimating the true cost of energy from wind power, we examine only onshore wind power. Although offshore wind has the benefit of being able to take advantage of plentiful coastal winds, the technology's costs are much higher than onshore wind energy production. Offshore wind projects enjoy different federal and state incentives, face different environmental siting issues, and require much higher maintenance costs than onshore wind. Because onshore wind

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http://gov.ca.gov/news.php?id=18828

[126] Galbraith, K. 2009, October 17. "California and Texas: Renewable Energy's Odd Couple." New York Times. Retrieved from: http://www.nytimes.com/2009/10/18/weekinreview/18galbraith.html?_r=0

and offshore wind differ so dramatically in so many different ways, this report leaves the study of the true cost of offshore wind to future research.

COST OF ONSHORE WIND ENERGY PRICED LOW TO HIGH

	LAZARD	NREL	EIA	HAMILTON	MODIFIED GIBERSON	TANTON/TAYLOR
Total Cost ($/MWh)	$59[127]	$72	$80.3	$97	$149[128]	$151

The studies examined show a market where subsidized wind is competitive, and one where unsubsidized wind is much less viable. Wind energy is dependent on subsidies, and when these are removed from the calculation, the costs of wind energy increase enough to make it an unfavorable choice in the energy market.

There is no single best method for calculating the true cost of energy; wind energy has many factors and is at the center of a contentious and ongoing debate. Various factors are included or ignored depending on the focus of the report. To find the true cost of wind energy, an effort should be made to include as many factors as possible and to consider every existing subsidy. Here we look at some major factors and determine their value in finding the true cost of wind energy.

CAPITAL COSTS AND OPERATION AND MAINTENANCE COSTS

The two core components of the cost of an energy project are the capital costs and the operations and maintenance costs. The capital costs of wind energy are generally made up of turbine costs, construction and installation costs, transmission costs, and financing costs. Operations and maintenance costs cover both fixed (planned) and variable (unplanned) costs. These are the most basic, easily understandable costs that apply to all projects across all energy types. Although there is some variation in cost estimates for capital and operations and maintenance, most cost estimates fall within $20 per megawatt-hour of each other. The only significant outlier for either cost is Giberson's 2013 report, whose estimates fall almost $22 per megawatt-hour above the average of the reports examined, a difference that is attributable to his use of a lower-than-average capacity factor, an adjusted discount rate, and the inclusion of the additional cost of the

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[127] This value was found by taking the average of the high ($81 per megawatt-hour) and low ($37 per megawatt-hour) estimates used by Lazard.

[128] To reach this number, we took Giberson's modified $109 per megawatt-hour levelized cost of electricity and added his estimates for costs not traditionally calculated in the LCOE, including transmission costs ($15 per megawatt-hour), baseload cycling ($2 per megawatt-hour), and subsidies ($23 per megawatt-hour).

Modified Accelerated Cost Recovery System, a 5-year tax depreciation system that saves tax costs and frees revenue for future investment.[129]

CAPITAL COST

	LAZARD	NREL	EIA	HAMILTON	GIBERSON	TANTON/TAYLOR
Capital Cost ($/MWh)	$48[130]	$61	$64.1	N/A	$88	$71.8

OPERATIONS AND MAINTENANCE COSTS

	LAZARD	NREL	EIA	HAMILTON	GIBERSON	TANTON/TAYLOR
O&M Cost ($/MWh)	$11.5[131]	$11	$13	N/A	$21	$9.8

CAPACITY FACTOR

The capacity factor of a turbine is a measurement of how efficiently a wind plant can turn wind into energy. This is calculated as the energy output of a plant as a percentage of its maximum energy capacity. A high capacity factor can drastically lower the cost of wind energy, and vice versa. The capacity factor is a significant part of calculating the cost of wind, yet estimates of the average market capacity factor vary widely from report to report. While moderate studies such as the EIA's *Annual Energy Outlook* and the NREL's *Cost of Wind Energy Review* use capacity factors at around 35 to 38 percent, more generous reports, like that from Lazard (2014), use a 41 percent capacity factor.[132]

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[129] Giberson, M. 2013, October. "Assessing Wind Power Cost Estimates." Pg. 5-7. Institute for Energy Research. Retrieved from: http://instituteforenergyresearch.org/wp-content/uploads/2013/10/Giberson-study-Final.pdf

[130] The value for Lazard's capital costs was found by averaging the high ($66 per megawatt-hour) and low ($30 per megawatt-hour) estimates used by Lazard.

[131] The value for Lazard's operations and maintenance was found by averaging the high ($15 per megawatt-hour) and low ($8 per megawatt-hour) estimates used by Lazard.

[132] Energy Information Administration (EIA). U.S. Department of Energy. 2014, April. "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2014." Retrieved from: http://www.eia.gov/forecasts/aeo/pdf/electricity_generation.pdf; Tegen, S., E. Lantz, M. Hand, B. Maples, A. Smith, and P. Schwabe. 2013, March. "2011 Cost of Wind Energy Review." National Renewable Energy Laboratory. Retrieved from: http://www.nrel.gov/docs/fy13osti/56266.pdf; Lazard. 2014, September. "Lazard's Levelized Cost of Energy Analysis - Version 8.0." Lazard. Retrieved from: http://www.lazard.com/PDF/Levelized%20Cost%20of%20Energy%20-%20Version%208.0.pdf

More conservative estimates, like that found in Giberson's *Assessing Wind Power Cost Estimates,* fall around 33 percent.[133] The *2013 Wind Technologies Market Report* found that capacity factor technology has stagnated at approximately 33 percent since 2005, though in recent years it has breached roughly 38 percent.[134]

CAPACITY FACTOR

	LAZARD	NREL	EIA	HAMILTON	GIBERSON	TANTON/TAYLOR
Capacity Factor	41%[135]	38%	35%	34%	33%	33%

TRANSMISSION COSTS

Both Giberson, and Taylor and Tanton remark that established studies on the cost of wind energy neglect to include the total cost of creating new transmission lines once the existing infrastructure is occupied.[136] As a location-dependent power source, these costs are specific to the availability of wind and would not be required if not for power generation from wind. Wind-friendly sites are rarer than natural gas or coal sites. They accurately claim that the extra cost of building transmission lines should be included in any calculation of the cost of wind energy. To calculate transmission construction costs, Giberson returns to a Berkeley Labs 2009 technology review, finding that the median cost to build transmission lines was $15 per megawatt-hour.[137] Taylor and Tanton calculated a $27 per megawatt-hour added cost.[138]

TRANSMISSION COSTS

	LAZARD	NREL	EIA	HAMILTON	GIBERSON	TANTON/TAYLOR
Cost of adding transmission($/MWh)	N/A	N/A	N/A	N/A	$15	$27[139]

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[133] Giberson, M. 2013, October. "Assessing Wind Power Cost Estimates." Pg. 6. Institute for Energy Research. Retrieved from: http://instituteforenergyresearch.org/wp-content/uploads/2013/10/Giberson-study-Final.pdf

[134] Wiser, R., and M. Bolinger. 2014, August. "2013 Wind Technologies Market Report." Prepared for the U.S. Department of Energy. Retrieved from: http://emp.lbl.gov/sites/all/files/2013_Wind_Technologies_Market_Report_Final3.pdf

[135] The value for Lazard's capacity factor was found by averaging the high (52%) and low (30%) estimates used by Lazard.

[136] Giberson, M. 2013, October. "Assessing Wind Power Cost Estimates." Institute for Energy Research. Retrieved from: http://instituteforenergyresearch.org/wp-content/uploads/2013/10/Giberson-study-Final.pdf; Taylor, G., and T. Tanton. 2012, December. "The Hidden Costs of Wind Electricity." Pg. ES-1. American Tradition Institute. Retrieved from: http://www.atinstitute.org/wp-content/uploads/2012/12/Hidden-Cost.pdf

[137] Giberson, M. 2013, October. "Assessing Wind Power Cost Estimates." Pg. 8. Institute for Energy Research. Retrieved from: http://instituteforenergyresearch.org/wp-content/uploads/2013/10/Giberson-study-Final.pdf

[138] Taylor, G., and T. Tanton. 2012, December. "The Hidden Costs of Wind Electricity." Pg. ES-1. American Tradition Institute. Retrieved from: http://www.atinstitute.org/wp-content/uploads/2012/12/Hidden-Cost.pdf

[139] This number was found on the first page of the Executive Summary of Taylor and Tanton's report, in Table 1: Levelized Cost of Wind Electricity, (starting from the assumptions in the Energy Information Administration's 2012 Annual Energy Outlook). Added to the existing 12.4 cents per kilowatt-hour of wind added to natural gas is the estimated cost of transmission and transmission losses, which comes out to 2.7 cents per kilowatt-hour. This figure was then converted to $27 per megawatt-hour.

BASELOAD CYCLING

In areas with high levels of wind power, the grid relies on existing energy plants to provide electricity when the wind is not blowing. These generators ensure that the station is always supplying a minimum amount of energy, also known as “baseload” power. Even though the generators are not used when the wind turbines are supplying plenty of power, they must be kept on standby, ready to be fired up at a moment’s notice. The generators “cycle” between use and non-use, hence the term “baseload cycling.”[140]

Baseload cycling increases operation and maintenance costs as two energy plants (the wind farm and the baseload generator) are kept running to do the job of one.[141] Researchers at the National Renewable Energy Laboratory note that cycling increases emissions because firing up a plant multiple times in a single day uses more fuel than running at a steady rate throughout the day.[142]

BASELOAD CYCLING

	LAZARD	NREL	EIA	HAMILTON	GIBERSON	TANTON/TAYLOR
Cost of baseload cycling ($/MWh)	N/A	N/A	N/A	N/A	$2	$23[143]

Taylor and Tanton include baseload cycling in their summary of the hidden costs of wind not included in the EIA's *Annual Energy Outlook*. They estimate that baseload cycling adds $23 per megawatt-hour to the cost of wind energy.[144] Giberson also discusses baseload cycling, citing research that adds only $2 per megawatt-hour to the NREL’s original cost.[145]

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[140] Giberson, M. 2013, October. "Assessing Wind Power Cost Estimates." Pg. 9. Institute for Energy Research. Retrieved from: http://instituteforenergyresearch.org/wp-content/uploads/2013/10/Giberson-study-Final.pdf

[141] Giberson, M. 2013, October. "Assessing Wind Power Cost Estimates." Pg. 9. Institute for Energy Research. Retrieved from: http://instituteforenergyresearch.org/wp-content/uploads/2013/10/Giberson-study-Final.pdf

[142] Cochran, J., D. Lew., and N. Kumar. 2013, December. "Flexible Coal: Evolution From Baseload to Peaking Plant." Pg. 8. National Renewable Energy Laboratory. Retrieved from: http://www.nrel.gov/docs/fy14osti/60575.pdf

[143] This number was found on the first page of the Executive Summary of Taylor and Tanton’s report, in Table 1: Levelized Cost of Wind Electricity, (starting from the assumptions in the Energy Information Administration’s 2012 Annual Energy Outlook). Added to the existing 10.1 cents per kilowatt-hour of wind added to natural gas is the cost of keeping the primary plant available and the extra fuel that these plants consume, which comes out to 2.3 cents per kilowatt-hour. This figure was then converted to $23 per megawatt-hour.

[144] Giberson, M. 2013, October. "Assessing Wind Power Cost Estimates." Pg. 9. Institute for Energy Research. Retrieved from: http://instituteforenergyresearch.org/wp-content/uploads/2013/10/Giberson-study-Final.pdf

[145] Ibid.

Many studies fail to account for the cost of baseload cycling, however. Baseload cycling is a required component of wind power that adds to the true cost of wind energy. Therefore baseload cycling should be included in any estimation of the true cost of wind power.

SOCIAL AND ENVIRONMENTAL COST

Another way of calculating the cost of electricity is to examine the various costs and externalities that the production of electricity imposes on society. These include potential health problems that energy plants can create for the nearby population, negative effects of energy production on the environment, the effect of production on global climate change, effects on the large-scale economy, and international effects. Some, such as The Hamilton Project's *A Strategy for America's Energy Future: Illuminating Energy's Full Costs*, argue that factoring in social cost is useful because even if a project is financially attractive, potential social negatives could outweigh its value.[146]

The reason so few reports include estimates of social and environmental cost is the incredible difficulty of quantifying it. As a result, social and environmental cost is largely absent from energy cost estimates. The only study we reviewed that assigned a dollar value to social and environmental cost is Hamilton's *A Strategy for America's Energy Future*.[147] Hamilton calculates the added social cost of a new wind project at $9 per megawatt-hour.[148] These added costs are a result of carbon emissions associated with the construction and installation of energy plants, and the non-carbon costs that construction can have on the environment. Comparatively, the added social and environmental costs of coal amount to $53 per megawatt-hour, due to continued emissions after construction.[149]

A common argument made for renewable energies like wind power is that the technologies have low emissions and social and environmental costs, and do not contribute to the potential for catastrophic human-caused climate change. Some argue that the benefit of reduced carbon emissions should be subtracted from the cost of wind power to more accurately portray the net cost of producing electricity from wind.[150] Attempts have been made to price carbon emissions based on their social and environmental effects; however, these numbers vary widely and require

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[146] Greenstone, M., and A. Looney. 2011, May. "A Strategy for America's Energy Future: Illuminating Energy's Full Costs." The Hamilton Project. Retrieved from: http://www.hamiltonproject.org/files/downloads_and_links/05_energy_greenstone_looney.pdf

[147] Greenstone, M., and A. Looney. 2011, May. "A Strategy for America's Energy Future: Illuminating Energy's Full Costs." Pg. 18. The Hamilton Project. Retrieved from: http://www.hamiltonproject.org/files/downloads_and_links/05_energy_greenstone_looney.pdf

[148] This value was found by adding coal's Non-Carbon Social Costs and Carbon Emission Costs found in the table on page 18 of "A Strategy for America's Energy Future," and then converting the sum from cents per kilowatt-hour to dollars per megawatt-hour.

[149] This value was found by adding coal's Non-Carbon Social Costs and Carbon Emission Costs found in the table on page 18 of "A Strategy for America's Energy Future," and then converting the sum from cents per kilowatt-hour to dollars per megawatt-hour.

[150] Greenstone, M., and A. Looney. 2011, May. "A Strategy for America's Energy Future: Illuminating Energy's Full Costs." The Hamilton Project. Retrieved from: http://www.hamiltonproject.org/files/downloads_and_links/05_energy_greenstone_looney.pdf

multiple assumptions be made. Estimates for the social cost of carbon vary widely, from $5 to $100 per ton, but are more commonly thought to be in the range of $5 to $35 per ton.[151]

The value placed on carbon emissions (or the avoidance thereof), depends on many factors, which are difficult, and sometimes even impossible, to determine. It is difficult to know just how much one ton of carbon contributes to environmental changes such as climate change. It is even more difficult to know at what point in the future a ton of carbon emitted today will have noticeable environmental impacts. Ultimately, the value placed on carbon emissions depends on how catastrophic one believes human-caused climate change will be, and how difficult one believes it will be for human beings to adapt to that change.

Even if an accurate social cost of carbon could be determined, any environmental benefits of wind power, in the form of reduced emissions, are likely to be partially offset by baseload cycling and the resulting increase in emissions. Wind power is unpredictable, so coal and nuclear plants must be kept on backup to make up for when wind power is unable to meet demand. These plants create carbon emissions, offsetting the environmental benefits of wind power. According to a modeling study by Katzentstein and Apt, the average amount of this offset due to baseload cycling is 20 percent.[152] So, efforts to reduce carbon emissions through wind power are likely to be about one-fifth less effective than claimed.

The high degree of uncertainty surrounding the magnitude of the link between carbon emissions and climate change implies that any valuation of the social and environmental cost of carbon requires one to make multiple assumptions, which may not be founded on strong evidence. We do not recommend making policy decisions that impose billions of dollars of costs on American taxpayers in the hopes of securing some uncertain, future environmental benefit.

COST OF SUBSIDIES

Of all the non-private costs associated with wind energy, the cost of subsidies is the most important. Because federal and state subsidies are intrinsic to the success of wind energy, calculations that do not include subsidies return a cost of wind energy that is artificially low.

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[151] Litterman, B. 2013. "What Is the Right Price for Carbon Emissions?" *Regulation: Energy & Environment.* Summer 2013. CATO. Retrieved from: http://object.cato.org/sites/cato.org/files/serials/files/regulation/2013/6/regulation-v36n2-1-1.pdf
[152] Katzenstein, W. and J. Apt. 2009. "Air Emissions Due to Wind and Solar Power." *Environmental Science & Technology,* 43(2), 253-258. DOI: 10.1021/es801437t

COST OF SUBSIDIES

	LAZARD	NREL	EIA	HAMILTON	GIBERSON	TANTON/TAYLOR
Cost of subsidies ($/MWh)	$19[153]	Subsidies included but no values given	Subsidies included but no values given	N/A	$23	$19[154]

Some reports examined here make an effort to show the influence of federal and state subsidies on the cost of wind. Each of those reports has taken a different approach with different results. Lazard calculates both the subsidized and unsubsidized cost of wind in their 2014 report, finding a $19 per megawatt-hour cost of subsidies.[155] Taylor and Tanton also found a $19 per megawatt-hour subsidy cost.[156]

SUMMARY

Estimating the true cost of wind power is inherently difficult, as a wide variety of factors must be included. Some factors, like opportunity cost and reduced reliability of the electrical grid, are difficult to quantify, but every attempt should be made to estimate them as they add significant costs to the true cost of wind power. In order to come up with the most accurate estimate possible, both explicit and implicit costs of producing electricity from wind power should be included:

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[153] The value for Lazard's cost of subsidies was found by subtracting the average of their values for subsidized wind (40.5 per megawatt-hour) from the average of their values for unsubsidized wind ($59 per megawatt-hour) and then rounding the result to the nearest one ($19 per megawatt-hour).

[154] This number was found on page 1 of the Executive Summary of Taylor and Tanton's report, in Table 1: Levelized Cost of Wind Electricity, (starting from the assumptions in the Energy Information Administration's 2012 Annual Energy Outlook). Added to the existing 8.2 cents per kilowatt-hour of wind added to natural gas is the implicit cost of subsidies, which comes out to 1.9 cents per kilowatt-hour. This figure was then converted to $19 per megawatt-hour.

[155] Lazard. 2014, September. "Lazard's Levelized Cost of Energy Analysis - Version 8.0." Pg. 3. Lazard. Retrieved from: http://www.lazard.com/PDF/Levelized%20Cost%20of%20Energy%20-%20Version%208.0.pdf

[156] Taylor, G., and T. Tanton. 2012, December. "The Hidden Costs of Wind Electricity." Pg. ES-1. American Tradition Institute. Retrieved from: http://www.atinstitute.org/wp-content/uploads/2012/12/Hidden-Cost.pdf

CAPITAL COSTS OPERATION & MAINTENANCE COSTS CAPACITY FACTOR TRANSMISSION COSTS		FEDERAL POLICIES STATE POLICIES OPPORTUNITY COST REDUCED RELIABILITY BASELOAD CYCLING SOCIAL AND ENVIRONMENTAL COSTS		
EXPLICIT COSTS	**+**	**IMPLICIT COSTS**	**=**	**TRUE COST OF WIND ENERGY**

Of the reports examined here, Michael Giberson's *Assessing Wind Power Cost Estimates* is the most comprehensive and evenhanded, correcting the NREL report's mistakes and relying on more realistic expectations about the cost of wind energy. The inclusion of Giberson's estimates for transmission and baseload cycling costs are as important as his modifications to the original estimates for capital and operation and maintenance costs.

Giberson attempts to correct the NREL study by including the PTC in his calculations. This subsidy adds $23 per megawatt-hour to the cost of wind.[157] These costs range from $19 to $23 per megawatt-hour, all of which could drastically affect whether wind energy is feasible in the market.

When compared to the modified Giberson standard, the other cost estimates examined underestimate the true cost of wind power by an average of 48 percent. These studies range from the Hamilton report, which underestimates the true cost of wind by 35 percent, to Lazard's *Levelized Cost of Energy Analysis Version 8.0*, which underestimates the true cost by 60 percent.[158]

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[157] Giberson, Michael. 2013, October. "Assessing Wind Power Cost Estimates." Pg. 15. Institute for Energy Research. Retrieved from: http://instituteforenergyresearch.org/wp-content/uploads/2013/10/Giberson-study-Final.pdf
[158] This does not include the Taylor and Tanton study, as the authors actually estimate wind power as being even more expensive than Giberson's finding.

KEY FINDINGS

Regardless of how cost factors are considered, the true cost of wind energy in the United States is, on average, 48 percent higher than most estimates claim. This is because generating electricity from wind power entails many hidden costs. A true estimate of the cost of wind power to the American public must account for the following factors:

The federal PTC, a crucial subsidy for wind producers, has distorted the energy market by artificially lowering the cost of expensive technologies and directing taxpayer money to the wind industry.

States have enacted Renewable Portfolio Standards (RPS) that require utilities to purchase electricity produced from renewable sources, which drives up the cost of electricity for consumers.

Wind resources are often located far from existing transmission lines. Expanding the grid, whether by private or public funding, is expensive, and the costs are passed on to taxpayers and consumers.

Because wind power is unreliable, conventional generators must be kept on backup to meet demand when wind is unable to do so. This drives up the cost of electricity for consumers, as two plants are kept running to do the job of one.

Billions of taxpayer dollars are used to subsidize the wind industry. Allowing consumers to pick which energy to use, based on price, would result in greater economic efficiency than allowing government to decide how the resources of consumers should best be allocated.

CONCLUSION

The true cost of wind energy is higher than most cost estimates calculate. Mandates requiring the use of wind energy increase electricity costs for consumers, and subsidies mask the actual cost of doing so. RPS require intermittent renewable energy to exist, but at the expense of utilities and consumers. The PTC makes wind power cheaper for utilities and consumers, but at the expense of taxpayers.

Through such policies, U.S. policymakers have essentially decided that electricity consumers will have wind power, even if it is more expensive. The cost of this decision has fallen to U.S. taxpayers and consumers of electricity. When weighing the costs and benefits of wind power, not including all of the hidden costs makes wind power appear to be a more attractive option than it actually is. Energy policy decisions, however, should be based on a more complete estimate of the cost of wind energy.

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