U.S. House of Representatives
Committee on Science, Space, and Technology
Subcommittee on Oversight and Subcommittee on Energy

HEARING CHARTER

Assessing the Efficiency and Effectiveness of Wind Energy Incentives

Tuesday, April 16, 2013
2:00 p.m. – 4:00 p.m.
2318 Rayburn House Office Building

Purpose

On April 16, 2013, the Subcommittee on Oversight and the Subcommittee on Energy will hold a hearing titled "Assessing the Efficiency and Effectiveness of Wind Energy Incentives." This hearing builds upon an earlier hearing held by the Energy and Environment and Investigations and Oversight Subcommittees that reviewed the impact of tax policies on the commercialization of energy technology[1] as well as a recent hearing held by the Energy Subcommittee that reviewed federal financial support for all energy technologies.[2] While those hearings addressed a broad range of energy technologies, this hearing will focus specifically on the efficiency and effectiveness of federal incentives for onshore and offshore wind technology.

Witnesses

- Mr. Frank Rusco, Director, Natural Resources and the Environment, Government Accountability Office
- Dr. Robert Michaels, Professor of Economics, Mihaylo College of Business and Economics, California State University, Fullerton
- Ms. Audra Parker, President and Chief Executive Officer, Alliance to Protect Nantucket Sound
- Mr. Robert Gramlich, Interim Chief Executive Officer and Senior Vice President for Policy, American Wind Energy Association

Background

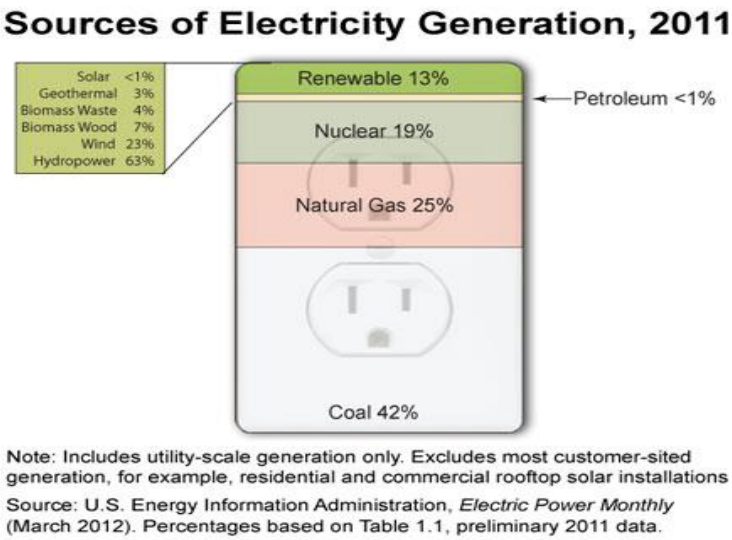
According to the Energy Information Agency (EIA):

> "[o]ver the lifetime of the plant, electricity from wind power generally costs more than electricity from power plants burning fossil fuels. However, wind power is expected to continue to grow worldwide because of favorable government policies. Multiple types of government support exist, including a production tax

[1] http://science.house.gov/hearing/subcommittee-investigation-and-oversight-subcommittee-energy-and-environment-%E2%80%93-joint-hearing
[2] http://science.house.gov/hearing/subcommittee-energy-federal-financial-support-energy-technologies-assessing-costs-and

credit and State renewable electricity portfolio standards. Although wind farms have relatively low operating costs, capital investment costs are significant. In addition, the intermittent nature of wind results in relatively low capacity factors, such that a wind plant will generate less electricity than a conventional thermal or hydroelectric plant of the same size and over the same period of time. As a result of the high capital costs and intermittency associated with wind, the "levelized cost of electricity" (LCOE) – or the sum of the plant's present value of capital and operating costs, divided by its generation over the plant's lifetime – tends to be higher for wind than for most conventional generation types."[3]

EIA reported that United States wind energy generation increased from approximately 6 billion kilowatt-hours (kWh) in 2000 to 120 billion kWh in 2011. Wind energy accounts for approximately three percent of total U.S. electricity generation.[4]



The National Renewable Energy Laboratory (NREL) noted in a report in 2008 two separate and distinct power system challenges that block widespread adoption of wind energy. The report said: "One challenge lies in the need to reliably balance electric generation and load over time when a large portion of energy is coming from a variable power source such as wind, which, unlike many traditional power sources, cannot be accessed on demand or is 'nondispatchable.' The other challenge is to plan, build and pay for the new transmission facilities that will be required to access remote wind resources."[5]

The frequency with which wind blows and wind turbines actually produce electricity impacts the viability of wind as a reliable energy source. Intermittency impacts energy supply and demand,

[3] U.S. Energy Information Administration. Accessed at http://www.eia.gov/energy_in_brief/article/wind_power.cfm
[4] U.S. Energy Information Administration. Accessed at http://www.eia.gov/energyexplained/index.cfm?page=wind_electricity_generation
[5] DOE, Office of Energy Efficiency and Renewable Energy, *20% Wind Energy by 2030,* July 2008. Accessed at: http://www.nrel.gov/docs/fy08osti/41869.pdf

as well as overall grid stability. For example, when EIA calculates the levelized cost of electricity, they account for a capacity factor, or percentage of time which energy is actually produced. The EIA uses a capacity factor of only 30 percent for wind energy projects, compared to 85 percent for coal and 90 percent for nuclear.[6] When electricity demand is high and wind energy is not being produced, backup sources of electricity are required. Typically natural gas-fired plants serve in this function.

According to the Congressional Research Service (CRS), "[t]wo primary policies provide market and financial incentives that support the wind industry and have contributed to U.S. wind power growth: (1) production tax credits (PTC)—a federal tax incentive of 2.2 cents for each kilowatt-hour of electricity produced by a qualified wind project, and (2) renewable portfolio standards (RPS)—state-level policies that encourage renewable power by requiring that either a certain percentage of electricity be generated by renewable energy sources or a certain amount of qualified renewable electricity capacity be installed."[7] In addition to these policies, numerous other government programs, incentives, and direct spending also support wind energy production.

Production Tax Credits (PTC)

U.S. wind projects that incorporate turbines larger than 100 kW are eligible to receive federal tax incentives in the form of production tax credits and accelerated depreciation for ten years, beginning on the date the facility is placed in service. Originally established as part of the Energy Policy Act of 1992, the PTC played a role in the evolution and growth of the U.S. wind industry, as wind energy producers have been the largest beneficiary of federal production tax credits.[8] Although this tax credit was established in 1992, wind energy capacity did not increase until 1998 when most states began to implement RPS.[9] The PTC cost only $5 million in 1998.[10]

This tax credit has expired and been renewed by Congress on several occasions.[11] Last January, the *American Taxpayer Relief Act of 2012* extended the PTC for one additional year through the end of 2013 at an estimated to cost $12.1 billion.[12] This extension also modified the definition for qualifying projects to "the construction of which begins before January 1, 2014." The Internal Revenue Service (IRS) has yet to issue guidance to clarify this revised definition. Also,

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[6] EIA, Levelized Cost of New Generation Resources in the Annual Energy Outlook 2012, July 2012. Accessed at: http://www.eia.gov/forecasts/aeo/pdf/electricity_generation.pdf

[7] Phillip Brown, *U.S. Renewable Electricity: How Does Wind Generation Impact Competitive Power Markets*, Congressional Research Service, November 7, 2012.

[8] Phillip Brown, *U.S. Renewable Electricity: How Does the PTC Impact Wind Markets*, Congressional Research Service, November 7, 2012.

[9] David E. Dismukes, Ph.D., *Removing Big Wind's 'Training Wheels,'* American Energy Alliance, November 1, 2012.

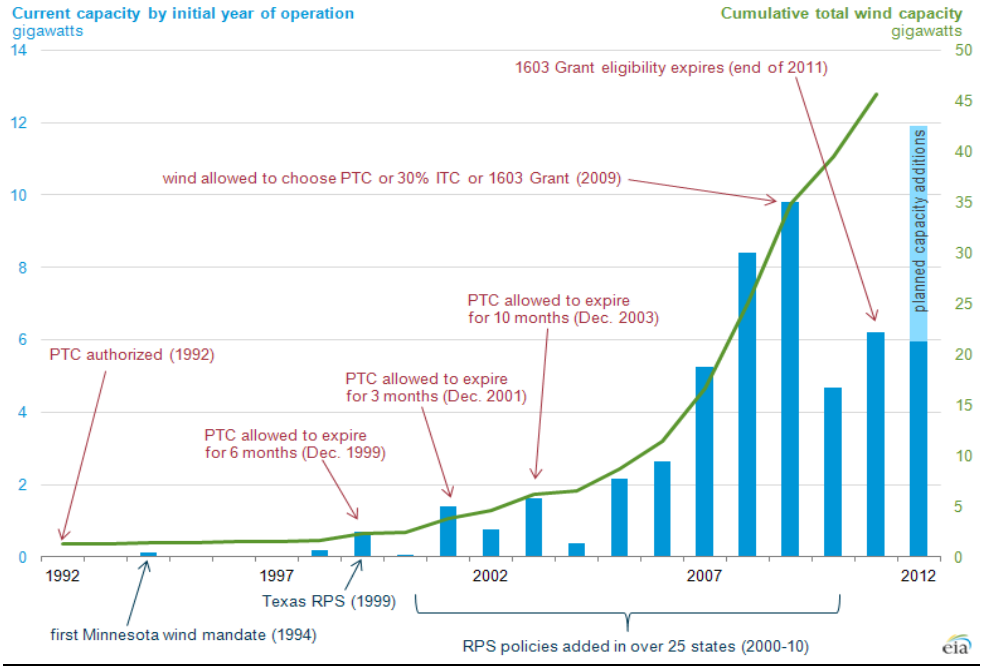
[10] Testimony of Ms. Lisa Linowes, *Impact of Tax Policies on the Commercial Application of Renewable Energy Technology*, U.S. House of Representatives, Committee on Science, Space, and Technology, Subcommittee on Oversight and Subcommittee on Energy and Environment, April 19, 2012.

[11] The PTC was also extended in 1999 (P.L. 102-486), 2002 (P.L. 106-170), 2004 (P.L. 107-147), 2005 (P.L. 108-311), 2006 (P.L. 109-432), 2008 (P.L. 110-343), and 2009 (P.L. 111-5).

[12] The Joint Committee on Taxation, *Estimated Revenue Effects of the Revenue Provisions Contained in an Amendment in the Nature of a Substitute to H.R. 8, The "American Taxpayer Relief Act of 2012," As Passed by the Senate on January 1, 2013*, January 3, 2013.

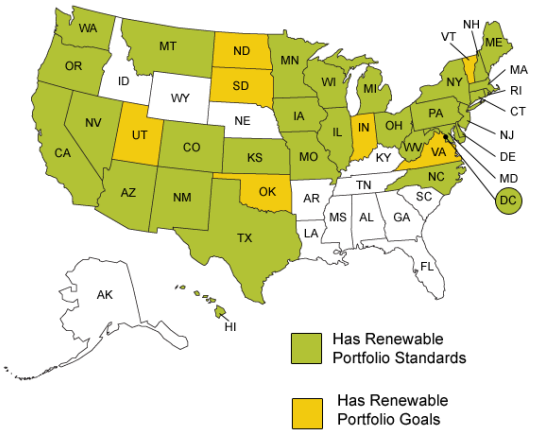
the IRS recently raised the PTC from 2.2 cents per kilowatt/hour to 2.3 cents per kilowatt/hour that created a five percent increase in cost, an additional $500 million cost to taxpayers.[13]

The following chart demonstrates how wind capacity did not grow until states began adopting Renewable Portfolio Standards (RPS).



Renewable Portfolio Standards (RPS)

Most States Have Renewable Portfolio Standards or Goals



Source: Interstate Renewable Energy Council, Database of State Incentives for Renewables & Efficiency (accessed September 2011).

According to the Congressional Research Service (CRS), "States essentially create demand for wind power projects by implementing renewable portfolio standard (RPS) policies that require a certain amount of renewable power to be generated by a certain date. For example, a state-level RPS may require that 25 percent of retail electricity sales be derived from renewable energy sources by 2025. As of September 2012, 29 states and the District of Columbia had established binding RPS policies. Each state RPS policy is unique with respect to its design, goals, and means of compliance."[14] While many sources of renewable energy can meet RPS requirements, wind energy accounts for 90 percent of all new RPS production.[15]

[13] NOTE: See Federal Register/ Vol. 78, No. 64 / Wednesday, April 3, 2013 / Notices. Accessed at http://www.gpo.gov/fdsys/pkg/FR-2013-04-03/pdf/2013-07773.pdf

[14] See supra 4.

Section 1603 Program

The American Recovery and Reinvestment Act (ARRA) in 2009 created the Section 1603 program that offers renewable energy project developers cash payments in lieu of the Production Tax Credit (PTC) or Investment Tax Credit (ITC). The value of the grant is equivalent to 30 percent of the project's cost, except for microturbines where the value is 10 percent.[16] The 1603 Program expired in 2012, though the Department of Treasury continues to make payments to recipients as qualified projects begin energy production. The estimated cost for the years 2011-2015 is estimated at $15.9 billion.[17] As of July 20, 2012, $9.2 billion went to wind projects, accounting for the majority of Section 1603 funding.[18]

Investment Tax Credit (ITC)

The Energy ITC was first established as part of the Energy Tax Act of 1978 (P.L. 95-618) and has since been modified several times. Section 48 of the Internal Revenue Code (IRC) provides a non-refundable income tax credit for business investments in solar, fuel cells, small wind turbines (up to 100 kW in capacity), geothermal systems, microturbines, and combined heat and power (CHP). Solar, fuel cell, and small wind turbine investments qualify for a 30 percent credit. The tax credit for investments in geothermal systems, microturbines, and CHP is 10 percent. For microturbines, the credit is limited to $200 per kW of capacity. Generally, the ITC is available for property placed in service by December 31, 2016. The estimated 2011-2015 cost for all ITC credits, not just wind, is $2.5 billion.[19]

48C Manufacturing Tax Credits

The American Recovery and Reinvestment Act (ARRA) of 2009 also created the Advanced Energy Manufacturing Tax Credit. This provision, commonly referred to as "48C", allows for a credit amounting to 30 percent of investment in manufacturing facilities for clean energy technologies. The 48C program is administered by the Internal Revenue Service (IRS), though the Department of Energy reviews project applications and recommends specific projects based on statutory criteria. The DOE said recently that they also evaluate programs based on "program policy factors" not directed in law.[20]

Tax credits were awarded to 183 projects submitted by 136 different companies. Based on information voluntarily submitted by companies, wind energy companies received 35 tax credits

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[15] See supra 13.

[16] Department of Treasury, Overview of Status Update on the Sec. 1603 program, July 20, 2012, Accessed at : http://ww.treasury.gov/initiatives/recovery/Documents/STATUS%20OVERVIEW.pdf

[17] Phillip Brown and Molly F. Sherlock, *ARRA Section 1603 Grants in Lieu of Tax Credits for Renewable Energy: Overview, Analysis, and Policy Options*, CRS Report R41635, November 9, 2011.

[18] See supra 14

[19] U.S. Congress, Joint Committee on Taxation, *Present Law and Analysis of Energy-Related Tax Expenditures*, JCX-28-12, March 27, 2012. Accessed at http://www.jct.gov/publications.html?func=startdown&id=4414.

[20] Treasury Inspector General for Tax Administration, *Assessment of the Internal Revenue Service's Interpretation of Section 1302 of the Recovery Act: Qualifying Advanced Energy Project Credit,* Reference Number 2013-40-029, March 21, 2013.

or 19.1 percent of total credits, and $258,519,981 or 11.2 percent of total.[21] The IRS recently announced $150 million in funding for additional 48C allocations using funds not fully utilized by previous awardees, which is to be reallocated on a competitive basis.

Loan Guarantees

Section 1703 of the Energy Policy Act of 2005 (EPAct) created a loan guarantee program to support investment in a breadth of energy technology areas and innovative clean-energy facilities. ARRA also added what is known as the Section 1705 loan program to support loans for renewable energy technologies, including wind. The authority for the Section 1705 loan program expired on September 30, 2011, while 1703 authority remains. After receiving numerous complaints alleging impropriety (including the company Solyndra), the Department of Energy's Office of Inspector General placed the Loan Guarantee Program on its "Watch List" for additional oversight.[22]

Over the life of this program, the Department of Energy (DOE) guaranteed loans to 26 projects amounting to $16 billion in financial capital. Of this, four were wind projects that accounted for full or partial guarantees for over $1.6 billion.[23] According to the General Accountability Office (GAO), the DOE is also actively reviewing two additional wind projects for future loan guarantees under the 1703 program and "planned to use all of the remaining $170 million in credit subsidy appropriations to support active applications for energy efficiency and renewable energy projects."[24]

Direct Spending

Additional support for wind energy also comes in the form of direct expenditures such as research and development. The following chart details the funding levels for direct spending, as well as those initiatives previously discussed such as the PTC, ITC, 1603, 48C, and Loan Guarantees.

[21] Derived from 48C award data available at http://www.whitehouse.gov/sites/default/files/48c_selection_011310.xls.

[22] Testimony of Gregory Friedman, Inspector General, DOE, Top Challenges for Science Agencies: reports from the Inspectors General Part 2, *Subcommittee on Oversight, Committee on Science, Space, and Technology,* March 14, 2013. Accessed at: http://science.house.gov/sites/republicans.science.house.gov/files/documents/HHRG-113-SY21-WState-GFriedman-20130314.pdf

[23] DOE Loan Program Office, accessed at https://lpo.energy.gov/?page_id=45

[24] GAO, *Status of DOE Loan Programs: Briefing to Appropriations Committees,* February 2013. Accessed at http://www.gao.gov/assets/660/653064.pdf

Actual and Estimated Obligations for Activities Specifically Related to Wind, by Agency, in Fiscal Year 2011[25]

Agency[a]	Number of wind-related initiatives for which data were provided	Actual obligations	Estimated obligations	Total obligations
Treasury	1	$2,716,933,281	$0	**$2,716,933,281**
DOE	17	73,940,581	73,161,968	**147,102,549[b]**
Interior	15	10,206,170	15,778,339	**25,984,509**
USDA	9	4,850,539	56,000	**4,906,539[c]**
Commerce	4	2,332,038	415,462	**2,747,500**
NSF	2	2,104,544	0	**2,104,544**
EPA	2	30,000	210,000	**240,000**
Total	**50**	**$2,810,397,153**	**$89,621,769**	**$2,900,018,922**

Source: GAO analysis of agency-provided data.

Note: Because GAO summarizes obligations data by agency, agency-level data typically reflect a mix of actual and estimated obligations. However, obligations reported for any specific initiative are either actual or estimated. For instance, EPA's data on its two initiatives above reflect one initiative for which actual obligations of $30,000 were reported, and one for which estimated obligations of $210,000 were reported.

a. In addition to the 50 initiatives at the seven agencies listed here, FERC did not provide obligations data for its one wind-related initiative because it noted that all costs to the government associated with the initiative are recovered through charges to regulated entities. SBA did not provide obligations data for either of its two initiatives because, according to agency officials, one initiative provided loan guarantees whose costs were offset by fees, and the second initiative was in the early planning stages in fiscal year 2011.

b. Of the $147 million obligated by DOE for activities specifically related to wind in 2011, about $51 million was obligated for credit subsidy costs—the government's estimated net long-term cost, in present value terms, of the loans it guarantees as part of the Title XVII Section 1705 Loan Guarantee Program. Credit subsidy costs exclude administrative costs and any incidental effects on governmental receipts or outlays. Present value is the worth of the future stream of returns or costs in terms of money paid immediately. In calculating present value, prevailing interest rates provide the basis for converting. future amounts into their current equivalents.

c. This amount does not reflect a guarantee for a $204 million loan provided for a wind project in fiscal year 2011 through USDA's Direct and Guaranteed Electric Loan Program. USDA officials said that based on the historical performance of the loans and the creditworthiness of applicants for the program, they estimate zero credit subsidy costs for the program.

GAO's Wind Energy Report

The GAO released a report last month titled *Wind Energy: Additional Actions Could Help Ensure Effective Use of Federal Financial Support.* This report found 82 different federal initiatives subsidizing wind energy that are fragmented, duplicative, and overlapping.[26]

Key findings of the GAO report:

- Nine different federal agencies implemented 82 different wind-related initiatives in FY2011. Together, the initiatives incurred about $4 billion of federal support—$2.9 billion in wind-related spending obligations and $1.1 billion in wind-related tax subsidies.
- Almost half of the initiatives (39 of 82) have been launched since 2009, and most (68 of 82) overlapped with at least one other initiative.
- GAO identified ten different initiatives that have provided or could provide duplicative support to deploy wind facilities. For example, a single wind project could receive federal support from a Section 1603 grant, accelerated depreciation, and a DOE loan guarantee,

[25] GAO, Wind Energy: Additional Actions Could Help ensure Effective Use of Federal Support, March 2013. Accessed at http://www.gao.gov/assets/660/652958.pdf

[26] Ibid

along with state support from tax incentives and indirect subsidies due to a state Renewable Portfolio Standard.

- According to financial professionals, federal initiatives have provided cumulative support worth about half of the capital costs for many wind projects.
- GAO also found that "it is it is unclear if the incremental support some initiatives provided was always necessary to build projects. In the event that some wind projects receive more federal funding than is required to induce them to be built, this additional funding could potentially be used to induce additional projects to be built or simply withheld, thereby reducing federal expenditures." GAO recommended that agencies "formally assess and document whether the federal financial support of their initiatives is needed for applicants' wind projects to be built."

Additional Issues for this Hearing:

Spending on Research and Development (R&D) vs. Deployment

While members of the Administration have called for increased funding for renewable energy resources as an investment in innovation, the GAO points out in its report, deployment activities—not research and development—account for the largest number of initiatives in the federal government. The GAO noted that "[o]f the reported $2.9 billion in actual and estimated obligations for wind-related activities in fiscal year 2011, $2.86 billion (99 percent) was obligated by the 58 initiatives that included support for deployment."[27]

Number and Percentage of Federal Wind-Related Initiatives Supporting Each Technology Advancement Activity in Fiscal Year 2011[28]

Technology advancement activity	Number of initiatives	Percentage of initiatives
Basic research	13	16
Applied research	34	41
Demonstration	29	35
Commercialization	24	29
Deployment	58	71

Source: GAO analysis of agency-provided data.

Note: Because many wind-related initiatives supported multiple technology advancement activities, the percentage of initiatives does not total 100, and the number of initiatives does not total 82, the number of initiatives identified in our review.

Tax Incentives vs. Direct Spending

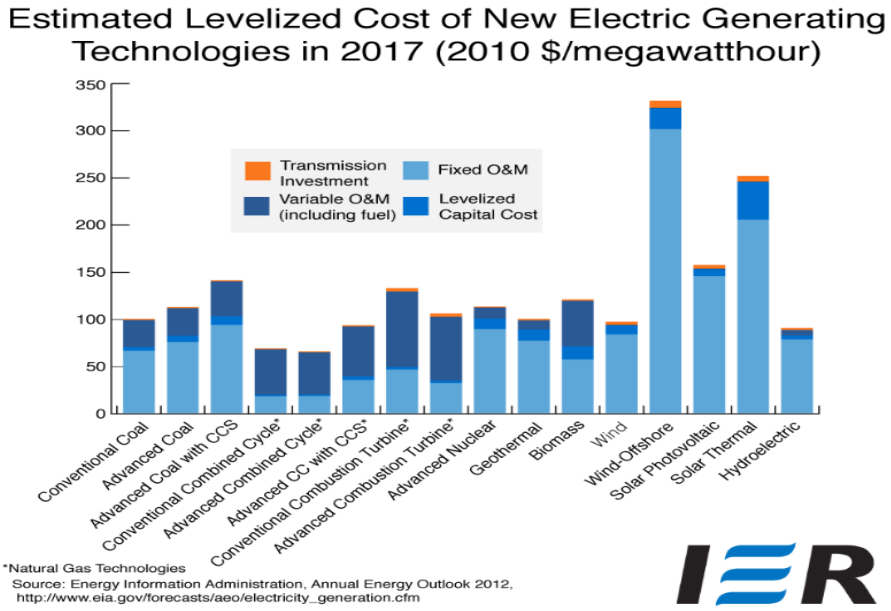
The nonpartisan Congressional Budget Office issued a report last year which stated that tax incentives "are generally an inefficient way to reduce environmental and other external costs of energy." Further saying, "[Tax incentives] often reward businesses for investments and actions

[27] Ibid
[28] Ibid

they intended to take anyway."[29] In GAO's recent report, they also stated that "agencies do not make documented assessments of whether or how much of their initiatives' financial support is needed for projects to be built and, as a result, it is unclear to what extent they assess need in order to determine what amount of support to provide. Moreover, it is unclear whether the incremental support some initiatives provided was always necessary for wind projects to be built."[30]

Onshore vs. Offshore Wind

According to EIA, the cost to build an offshore wind energy facility is nearly $6,000/kw as compared to onshore wind ($2,438/kw) and natural gas ($978/kw combined cycle).[31] Offshore wind is extraordinarily expensive to construct, especially when projects deliver electricity intermittently. With high upfront costs and fewer hours to spread the cost, long-term (15+ year) power purchase agreements with state agencies are required to attract private investor financing.[32]



National Security

An additional factor involved in wind energy production is its impact on radar systems to monitor aircraft and even missile threats against the United States. The Department of Energy (DOE), Federal Aviation Administration (FAA), and Department of Defense (DoD) have evaluated the potential impacts and mitigation strategies associated with large-scale, offshore

[29] CBO, Federal Financial Support for the Development and Production of Fuels and Energy Technologies, March 2012. Accessed at: http://www.cbo.gov/sites/default/files/cbofiles/attachments/03-06-FuelsandEnergy_Brief.pdf
[30] See Supra 23
[31] EIA, Updated Capital cost Estimates for Electricity Generation Plants, November 2010. Accessed at: http://www.eia.gov/oiaf/beck_plantcosts/
[32] See Supra 10

wind turbines. Currently-available wind turbines have blade tips towering over 400 feet above the surface of the water, and some turbines being developed that sweep an area three times the size of a football field.[33] As highlighted in previous testimony before the Committee, "by 2008, nearly 40% of our long-range radar systems were already compromised by wind turbines.[34] We've doubled our wind capacity since then but the problem of radar interference persists. Our military services and federal agencies have conducted numerous studies on the radar question, as have multiple international military and private interests.[35] Not all studies agree on levels of severity and potential mitigations, but all agree that large scale industrial wind turbines have the potential to negatively affect military installations, radar, and navigation aids."[36]

One of the most important radar systems, PAVE PAWS, is located on Cape Cod Air Force Station. PAVE PAWS is designed to detect and track Sea Launch Ballistic Missiles (SLBM) as well as Earth-orbiting satellites. A 2007 report from the Missile Defense Agency reviewed the impact of wind turbines on the radar's effectiveness and concluded that "utility class wind farms could have a significant impact on radars, including the missile defense early warning radars (EWRs), the PAVE PAWS radar at Cape Code AFS, MA, and the Upgrade Early Warning Radar (UEWR) at Beale AFB, CA."[37] In order to mitigate this impact, the report recommended a twenty-five kilometer exclusion zone around the radar, and further study regarding turbine height within this zone. Since these reports, the Cape Wind project reconfigured its towers from a height of 417 ft to 440 ft. It is unknown what impact this increase in tower height would have on the radar.

Health

There is a significant debate within the scientific community as to whether or not wind turbines adversely impact human health.[38]

- A 2001 Report by the National Institutes of Health indicated that infrasound (a very low frequency type of noise caused by wind turbines) can cause vertigo as well as "fatigue, apathy, and depression, pressure in the ears, loss of concentration, drowsiness."[39]
- In 2009, the American Wind Energy Association and the Canadian Wind Energy Association commissioned a report to look at the health impacts of wind turbines and noise and found that "There is no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects." Additionally, it found that the vibrations from the turbines are "too weak to be detected by, or to affect,

[33] ClimateWire, Scientific American, *Offshore Wind Turbines Keep Growing in Size*, September 19, 2011. Accessed at: http://www.scientificamerican.com/article.cfm?id=offshore-wind-turbines-keep

[34] Long Range Radar Joint Program Office Wind Farm Brief http://www.windaction.org/?module=uploads&func=download&fileId=2178 (Slide 3)

[35] Department of Defense, Report to the Congressional Defense Committees, *The Effect of Windmill Farms On Military Readiness, 2006*. Accessed at: http://www.defense.gov/pubs/pdfs/windfarmreport.pdf

[36] See Supra 10

[37] MDA, *Wind Turbine Analysis for Cape Cod Air Force Station Early Warning Radar and Beale Air Force Base Upgrade Early Warning Radar*, Spring 2007.

[38] Robert Bryce, *Wind Energy, Noise Pollution*, National Review Online, February 2, 2012. Accessed at: http://www.nationalreview.com/blogs/print/289920

[39] NIH, *Infrasound: Brief Review of Toxicological Literature,* Infrasound Toxicological Summary, November 2001. Accessed at http://ntp.niehs.nih.gov/ntp/htdocs/Chem_Background/ExSumPdf/Infrasound.pdf

humans." However, that same study also said that extended exposure to unwanted noise can cause a number of symptoms, including "dizziness, eye strain, fatigue, feeling vibration, headache, insomnia, muscle spasm, nausea, nose bleeds, palpitations, pressure in the ears or head, skin burns, stress, and tension."[40]

- A 2012 report conducted for the Commonwealth of Massachusetts concluded that generally there were no adverse health impacts;[41] however, the Acoustic Ecology Institute, a non-profit organization, has argued that this study did not fully address all relevant factors.[42]
- An article in the *Bulletin of Science, Technology & Society* with several first-person accounts of residents living near wind farms concluded that "overwhelming evidence that wind turbines cause serious health problems in nearby residents, usually stress-disorder type diseases, at a nontrivial rate."[43]
- An October 2012 article in the international scientific journal *Noise & Health* found that those individuals who lived close to a wind turbine experienced a "lower overall quality of life, physical quality of life, and environmental quality of life. Those exposed to turbine noise also reported significantly lower sleep quality, and rated their environment as less restful. Our data suggest that wind farm noise can negatively impact facets of HRQOL [health-related quality of life]."[44]
- Dr. Alec Salt, a research scientist at the Cochlear Fluids Research Laboratory at the Washington University School of Medicine in St. Louis, has published several articles related to the health impacts of wind turbines and concludes that it "can be hazardous to human health."[45]

While a scientific dispute still remains about the effects of wind turbines adversely affecting human health, numerous state and local initiatives around the world have sought to either prevent future wind turbine construction (such as the moratorium sought in Wisconsin[46]), or remove existing structures (as in Falmouth, MA[47]).

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[40] W. David Colby, M.D. et al, *Wind Turbine Sound and Health Effects: An Expert Panel Review,* December 2009. Accessed at: http://www.awea.org/_cs_upload/issues/siting/7970_1.pdf

[41] Massachusetts Department of Environmental protection, Massachusetts Department of Public Health, *Wind Turbine Health Impact Study: Report of Independent Expert Panel,* January 2012. Accessed at: http://www.mass.gov/dep/energy/wind/turbine_impact_study.pdf

[42] The Acoustic Ecology Institute, January 24, 2012. Accessed at: http://aeinews.org/archives/1782#more-1782

[43] Carl Phillips, *Properly Interpreting the Epidemiological Evidence About the Health Effects of Industrial Wind Turbines on Nearby Residents,* Bulletin of Science, Technology & Society, August 2011. Accessed at: *http://www.acousticecology.org/wind/winddocs/health/Phillips%20BSTS%20properly%20interpreting%20epidemiological%20evidence.pdf*

[44] Daniel Shepherd, et al, *Evaluating the impact of wind turbine noise on health-related quality of life*, Noise & Health, Vol. 13, October 2011. Accessed at : http://noiseandhealth.org/article.asp?issn=1463-1741;year=2011;volume=13;issue=54;spage=333;epage=339;aulast=Shepherd

[45] Dr. Alex Salt, Cochlear Fluids Research Laboratory, Washington University in St. Louis. Publications referenced at: http://oto2.wustl.edu/cochlea/wind.html

[46] Doug Schneider, *Wisconsin wind turbine Moratorium sought by Sen. Frank Lasee, R-Ledgeview,* Green Bay Press-Gazette, October 11, 2011. Accessed at: http://www.greenbaypressgazette.com/article/20111011/GPG0101/110110429/Wisconsin-wind-turbine-moratorium-sought-by-Sen-Frank-Lasee-R-Ledgeview

[47] Jay Linday, *Mass. Town votes against dismantling wind turbines*, ABC6 News, April 9, 2013. Accessed at: http://www.abc6.com/story/21924817/mass-town-may-be-first-to-tear-down-turbines