Environmental and Energy Study Institute

Fact Sheet

Offshore Wind Energy

October 2010

Image courtesy RenewableUK

Offshore wind turbines harness the energy of ocean winds and turn it into electricity. Several European and two Asian countries have offshore wind farms, which supply local, clean, renewable energy. Although land-based wind turbines are prevalent in the United States, there are no offshore wind farms in U.S. waters. However, projects are under development in the wind-rich areas of the East Coast, Great Lakes, and Pacific Coast. Offshore wind energy can help meet multiple state and national goals, including reducing energy imports, reducing air pollution and greenhouse gas emissions which cause climate change (by displacing fossil-fueled power generation), meeting renewable electricity standards, and creating jobs and local business opportunities.

TECHNOLOGY

Air moving over the blades of a turbine creates aerodynamic lift causing the rotor and blades to rotate. Wind sensors can detect the optimal direction for the turbine to point, allowing the turbine's yaw controller to turn the blades into or away from the wind. Each turbine has a generator that converts the mechanical power of the blades in motion into electricity, which is then transmitted through subsea cables.[1] The service life of a wind turbine is at least 20 years.[2]

The amount of electricity produced depends on wind speed, turbine size, and the arrangement of the turbines. Offshore wind turbines typically generate more energy per hour than land-based turbines due to their larger size and higher wind speeds. Similar to land-based turbines on utility scale wind farms, the height of an offshore wind turbine tower is about 80 meters (262 feet). Offshore turbines have larger rotors than land-based turbines, reaching 90-107 meters (295-351 feet) in diameter,[3] about the length of a football field. In 2009, the average capacity of an offshore wind turbine in Europe was around three megawatts (MW), and the capacity of future turbines is expected to increase to five MW.[4]

One megawatt powers around 750 American homes.

http://www.principlepowerinc.com/news/articles/sfChronicle_090803.pdf

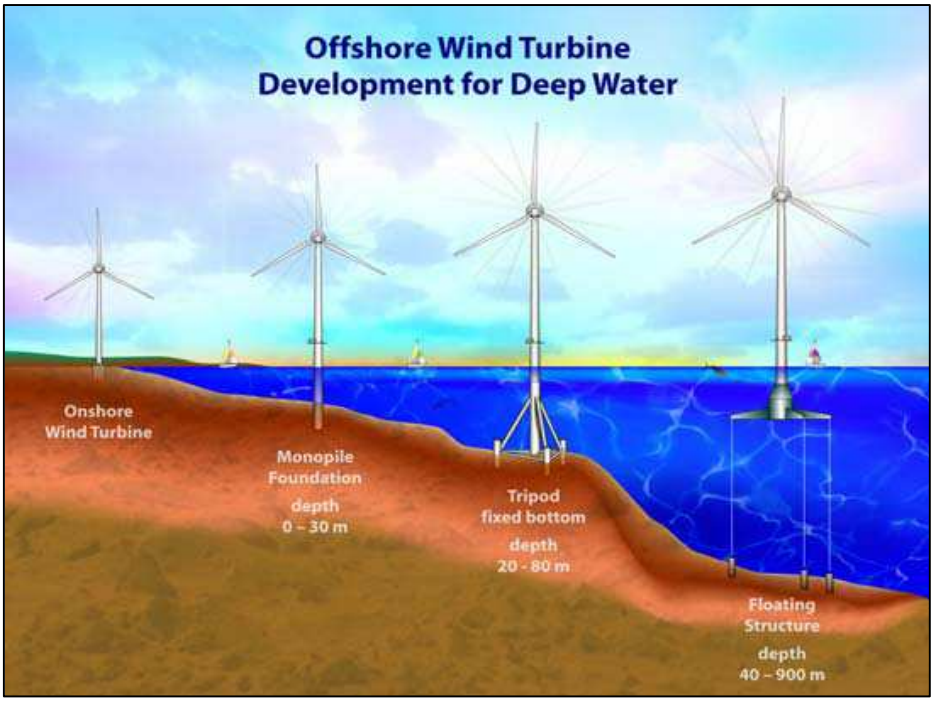


Image courtesy National Renewable Energy Lab

At different depths, turbines require different types of bases for stability. A monopile base is a single column, six meters (20 feet) in diameter, and is installed in water up to 30 meters (98 feet) deep. In water 20-80 meters (66-262 feet) deep, turbines use a base with a tripod or a steel jacket for stabilization.

Advancing Technologies

Several companies are developing floating turbines for deeper waters. Norway-based SWAY has designed a floating turbine that can operate in waters 100-400 meters (328-1,312 feet) deep,[5] and StatOil Hydro is testing a turbine for waters up to 700 meters (2,297 feet) deep that is based on floating concrete constructions used in North Sea oil installations.[6]

EUROPE AND ASIA

Several European countries and two Asian countries have offshore wind farms (see graph on page 3). The global growth rate of offshore wind energy is 30 percent installed capacity per year.[7]

Europe is the world leader in offshore wind energy, with farms installed as early as 1991 and an operating capacity of 2,396 MW as of June 2010.[8] There are 39 offshore wind farms in waters off Belgium, Denmark, Finland, Germany, Ireland, the Netherlands, Norway, Sweden, and the United Kingdom. These farms are in water depths ranging from 0.8 to 220 meters (2.6-722 feet) and use gravity, monopile, jacket, tripod, and floating technologies. Their distances from shore range from 0.03 to 43 kilometers (0.02-27 miles).[9] Largely propelled by the European Union's renewable energy and climate goals, as well as by legislation within individual nations, the coming years will see further development of Europe's offshore wind industry. As of September 2009, there were more than 100 GW (or 100,000 MW) of offshore wind projects proposed or under development in Europe. The European Wind Energy Association has set targets of 40 GW installed by 2020 and 150 GW by 2030.[10]

Case Study: Denmark

In 1991, Denmark began operating the world's first offshore wind farm. Denmark has the industry's simplest permitting framework. The Danish Energy Agency acts a "one-stop-shop" for offshore wind farm permitting, coordinating with other agencies to issue all three required licenses: a license to carry out preliminary investigations, a license to establish the offshore wind turbines, and a license to exploit wind power for a given number of years including, for projects greater than 25 MW, an approval for electricity production. All offshore wind projects are subject to an environmental impact assessment.[11]

According to a 2009 survey, 91 percent of Danes think that Denmark should continue developing wind farms in the coming decade, and 96 percent believe that the Danish government should support the development of wind energy so that Denmark can remain a leader in this expanding clean energy market. Defying NIMBY-ism ("not-in-my-backyard," or

the idea that people support a concept but wouldn't want it near them), 64 percent of Danes think that more wind turbines should be built in their own neighborhood.[12]

Case Study: United Kingdom

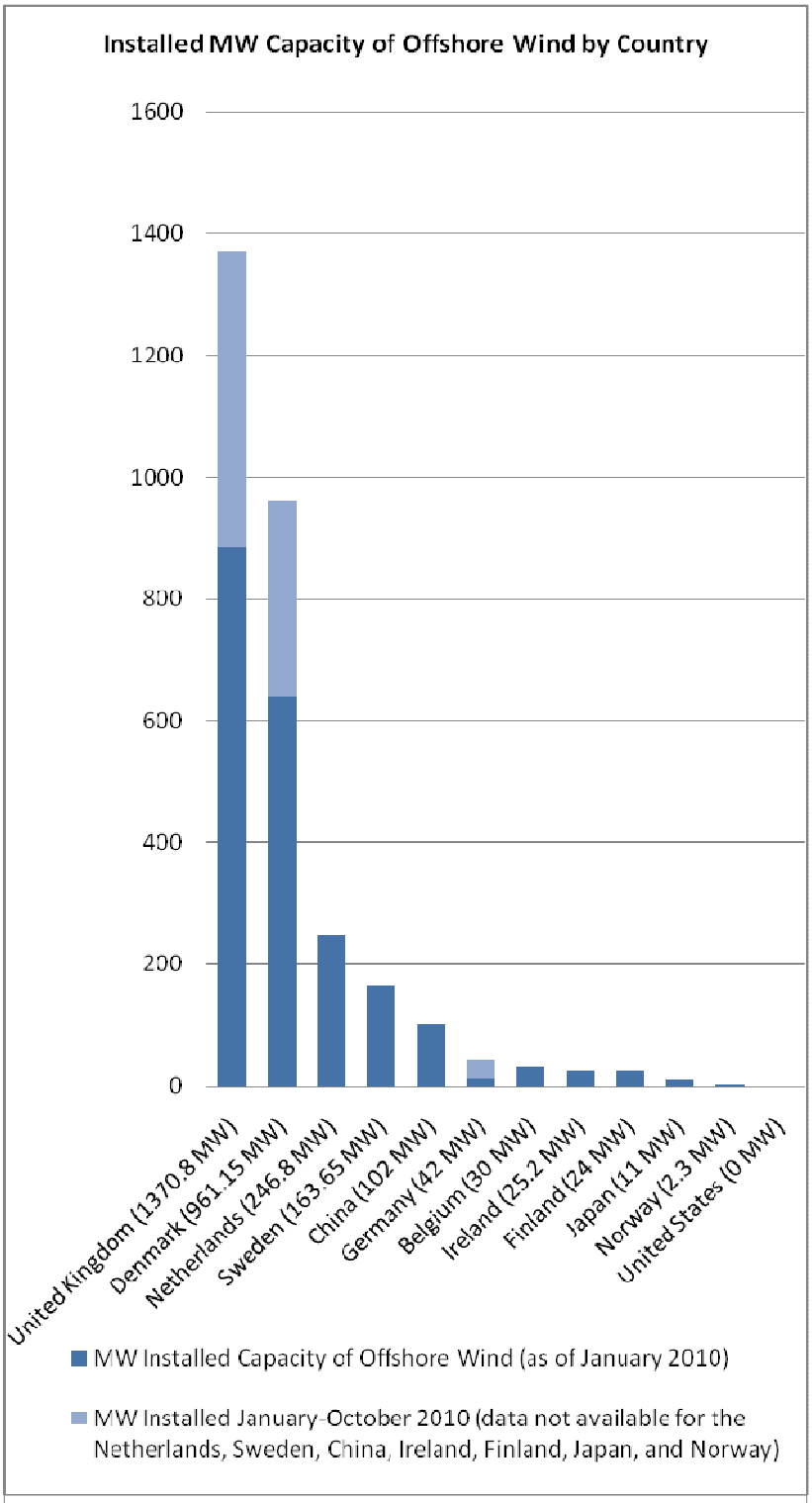
The UK has a mandate to reach 15 percent renewable energy sources for electricity by 2020. Since the UK's first offshore wind farm was commissioned in December 2000, the UK has moved aggressively to continue developing this renewable resource.[13] In 2008, the UK overtook Denmark as a leader in MW capacity of offshore wind power.[14] In September 2010, the 300 MW Thanet wind farm came online,[15] bringing the UK total to 13 operational offshore wind farms with a cumulative capacity of 1,341 MW. Another four offshore wind farms are under construction, and seven more have been approved, which would add another 3,772 MW of capacity upon completion.[16]

Case Study: Germany

Germany's first offshore wind farm was installed in 2008. The German wind industry expects 300 MW of new offshore wind capacity to be installed in 2010. An amended version of the *German Renewable Energy Sources Act* made projects more financially viable by obligating utilities to purchase offshore wind energy for a premium price for a fixed time period – a policy instrument known as a "feed-in tariff". The new *Power Line Expansion Law* makes it easier to use underground cables and allows the costs of connecting the offshore wind farm to the grid to be spread nationwide. Offshore wind is projected to reach a capacity of 10,000 MW in Germany by 2020.[17]

Case Study: China

In early 2010, China's first offshore wind farm was completed, with 34 turbines off the coast of Shanghai. The wind farm will generate 102 MW – or enough power for 200,000 Chinese households.[18] China is planning four offshore wind farms – for a total capacity of 1,000 MW – along the coast of the eastern province of



Sources for graph:

- http://www.powergenworldwide.com/index/display/articledisplay/9522709653/articles/powergenworldwide/renewables/wind/2010/07/china-powers_up_first.html
- http://ewea.org/fileadmin/ewea_documents/documents/statistics/OperationalOffshoreFarms2009.pdf
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- http://www.siemens.com/press/en/pressrelease/?press=/en/pressrelease/2010/renewable_energy/ere201010003.htm

Jiangsu.[19] China is the global leader in offshore wind energy technology manufacturing, currently holding a 61 percent share of the $47 billion market.[20]

UNITED STATES

There are no offshore wind farms in the United States. In 2009, U.S. wind power – all of which is produced onshore – produced slightly less than two percent of the nation's electricity supply.[21] The Department of Energy (DOE) issued a report in 2008 finding that the United States could produce 20 percent of its electricity from wind by 2030. To reach the 20 percent level, 293 GW of wind energy would need to be added, including 50 GW of offshore wind, according to the DOE scenario which considered resource potential, technologies, and costs.[22] In September 2010, DOE released a strategic work plan for achieving 54 GW of offshore wind power at a cost of 7-9 cents per kilowatt-hour by 2030.[23]

DOE estimates that the wind resources along American coasts – oceans and Great Lakes – are capable of providing 900,000 MW of electricity, an amount nearly equivalent to the nation's current total installed electric capacity.

http://www.usowc.org/pdfs/PathForwardfinal.pdf

Most potential offshore wind sites are relatively close to major urban load centers where energy costs are high and land for onshore wind development is limited.[24] Of the 48 contiguous states, 28 have a coastal boundary on the Atlantic Ocean, Pacific Ocean, Gulf of Mexico, or Great Lakes. Those 28 states consume 78 percent of the nation's electricity, and many states have enough offshore wind potential to meet 100 percent of their electricity needs.[25]

Government Incentives

Twenty-nine states and the District of Columbia have laws that require a minimum percentage of electricity to be produced from renewable sources such as water, biomass, wind, solar, and geothermal energy.[26] On the federal level, the U.S. House of Representatives passed a Renewable Electricity Standard of 20 percent by 2020 in June 2009, but similar legislation has yet to be approved by the Senate. There is a federal Production Tax Credit (PTC) for wind power, initially created by the *Energy Policy Act of 1992* and subsequently amended and extended, but it is set to expire at the end of 2012, likely before any currently proposed offshore wind farms would be installed.[27] *The American Recovery and Reinvestment Act of 2009* (P.L. 111-5) allocated nearly $100 million to offshore wind research and test facilities.[28]

Siting and Permitting

U.S. offshore wind farms require the approval of several federal and/or state agencies. State jurisdiction extends up to three miles from the coast; projects from three to 200 miles from the coast are in federal waters, but the cables that transmit the power would still cross through state jurisdiction.[29] The Bureau of Ocean Energy Management, Regulation and Enforcement (formerly the Minerals Management Service) is the lead federal authority for renewable energy on the Outer Continental Shelf, and the Army Corps of Engineers is the lead federal agency concerning project siting in the Great Lakes.[30] In 2009, the Department of the Interior established a program to grant leases, easements, and rights-of-way for renewable energy on the Outer Continental Shelf, the first program of its kind to consider offshore wind.[31]

The period of time from a company's submission of request to install an offshore wind farm to the final decision takes about 6-8 months in Belgium because of the country's straightforward permitting framework.

http://www.mumm.ac.be/EN/Management/Sea-based/windmills.php

Government Agencies and Their Siting/Permitting Roles (Authorizing Legislation in Parentheses)[32]

Affected State Governments

- Require a water quality certificate for anything within three miles of state's coast (Clean Water Act)
- Certify actions affecting land, water use of natural resources of coastal zone (Coastal Zone Management Act)

Army Corps of Engineers
- Analyzes compatibility with other uses; consult/coordinate with other agencies (NOAA, BOE, and EPA) and make "public interest" determination about obstructions in navigable water (Rivers and Harbors Act, Outer Continental Shelf Lands Act)
- Issues permit for any dredging and filling actions within three miles of shore (Clean Water Act)

Bureau of Ocean Energy Management, Regulation and Enforcement (BOE), Department of the Interior
- Regulates renewable energy development on the Outer Continental Shelf (Energy Policy Act of 2005)

Council of Environmental Quality (CEQ)[33]
- Reviews environmental assessments and environmental impact statement (National Environmental Protection Act)

Coast Guard
- Authorizes actions in areas of private aids to navigation (United States Code and Code of Federal Regulations)

Department of Defense (DOD)
- Participates in the FAA's studies regarding radar

Department of Energy (DOE)
- Reviews how wind farms affect government agencies

Department of the Interior (DOI)
- Issues land leases for projects on the Outer Continental Shelf

Environmental Protection Agency (EPA)
- Can veto Army Corps permit for dredging and filling (Clean Water Act)

Federal Aviation Administration (FAA)
- Conducts notice, marking, and lighting if a structure is over 200 feet high or near a runway. Turbines are considered individually – not as part of a farm. If higher than 500 feet (or under other conditions) considered an obstruction (Federal Aviation Act)

Federal Energy Regulatory Commission (FERC)
- Sets rates for the sale and transmission of electricity between producer and wholesaler (Federal Power Act)

Fish and Wildlife Service (FWS), Department of the Interior
- Conducts formal fish and wildlife consultation (Fish and Wildlife Coordination Act)
- Conducts formal consultation about jeopardizing species or have adverse critical habitat modification (Endangered Species Act)
- Conducts coordination to prohibit marine mammal takes (Marine Mammals Protection Act)
- Conducts coordination to prohibit migratory bird takes (Migratory Bird Treaty Act)

National Marine Fisheries Service, National Oceanic and Atmospheric Administration
- Conducts formal consultation for essential fish habitats (Magnuson-Stevens Fishery Conservation and Management Act)
- Conducts formal consultation if project could jeopardize species or have adverse critical habitat modification (Endangered Species Act)
- Conducts coordination to prohibit marine mammal takes (Marine Mammal Protection Act)

National Oceanic and Atmospheric Administration (NOAA)
- Conducts formal consultation for essential fish habitats (Magnuson-Stevens Fishery Conservation and Management Act)
- Conducts formal consultation when affecting marine sanctuary (Marine Protection, Research and Sanctuaries Act)

State Historic Preservation Officer and Advisory Council on Historic Preservation
- Conduct formal consultation in jurisdiction of historic shipwrecks, archaeological sites, and views from historic districts (jurisdiction is limited to state waters and land) (National Historic Preservation Act)

REGIONAL PROGRESS

Offshore wind projects are moving forward in several areas. The best offshore wind resources in U.S. waters are along the North- and Mid-Atlantic Coast, in the Great Lakes, and off the coast of the Pacific Northwest (see map on page 6).

Atlantic Coast

In May 2009, 11 governors[i] wrote a letter to Congress recognizing the opportunities to develop local offshore wind resources and calling for federal policies to promote its development.[34] In June 2010, governors of ten East Coast states[ii] and the Department of the Interior formally established the Atlantic Offshore Wind Energy Consortium to coordinate state and federal efforts relating to permitting, environmental studies, technical and financial barriers, and the infrastructure needed to deploy and maintain offshore wind farms and turbine manufacturing plants.[35]

[i] Governors of Conn., Del., Maine, Md., Mass., N.H., N.J., N.Y., R.I., Vt., and Va.
[ii] Governors of Del., Maine, Md., Mass., N.H., N.J., N.Y., N.C., R.I., and Va.

Coastal states from Maine through North Carolina have actively pursued offshore wind energy and have been targeted by developers because of public support for clean energy, advancing state policies, and excellent wind potential. In South Carolina and Georgia, state agencies and universities are engaging in offshore wind research.[36]

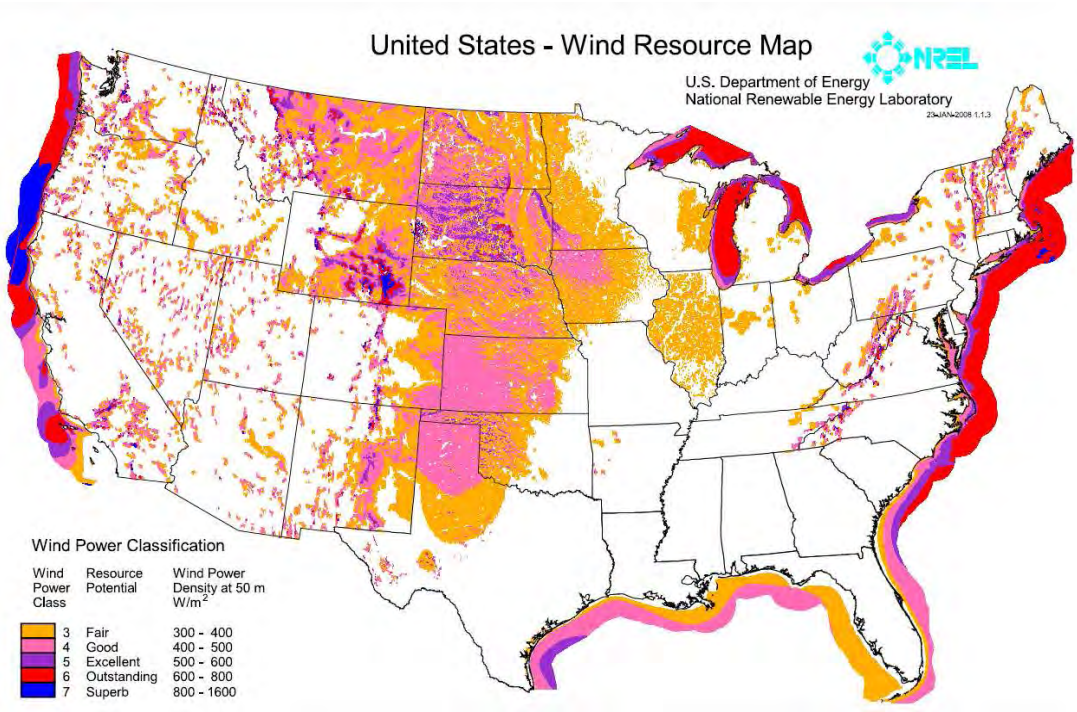

Image courtesy National Renewable Energy Lab
See http://www.nrel.gov/docs/fy10osti/45889.pdf for NREL's state-by-state breakdown of offshore wind resources

Case Study: Maine

Maine has selected three demonstration sites for offshore wind development and was awarded $20 million by the DOE to develop deep water offshore wind.[37] State legislation passed in April 2010 directs the utilities commission to solicit proposals for a power purchase agreement from offshore wind developers. The legislation specifies that the wind farms would need to consist of floating turbines in water at least 300 feet deep and be located at least 10 miles from shore.[38] In addition to coordinating efforts with other East Coast states, Maine Governor John Baldacci made a pledge along with his counterpart in the Canadian province of Nova Scotia to bring together researchers, policymakers, and developers from the private sector to pursue ocean energy opportunities – both offshore wind and tidal power projects.[39]

To encourage smaller scale offshore wind projects as well, the *Draft Massachusetts Ocean Management Plan*, published in June 2009, allows for community scale offshore wind projects of 10 or fewer turbines in state waters.

http://www.usowc.org/pdfs/PathForwardfinal.pdf

Case Study: Massachusetts

America's first proposed offshore wind farm was Cape Wind, which was to be sited off the coast of Nantucket Sound in 2001. In average winds, the 130 turbine project would provide 170 MW, or three-quarters of the electricity needs of Cape Cod, Martha's Vineyard, and Nantucket. A group of property owners in the area actively oppose Cape Wind because of concerns for wildlife and electricity costs, and have delayed construction by pushing for more research and governmental involvement (see "Public Concerns and Benefits" section on page 7). After extensive studies and the completion of state and local permitting, the project was issued a favorable Environmental Impact Statement in January 2009.[40] In October 2010, Interior Secretary Ken Salazar and Cape Wind Associates, LLC signed the first lease for commercial wind energy development in U.S. waters.[41]

Case Study: New York

The state of New York is in a unique position because it has offshore wind potential in both the Atlantic Ocean and the Great Lakes. The Long Island-New York City Offshore Wind Collaborative has proposed a 350-700 MW wind farm to be sited 13 miles off Long Island's Rockaway Peninsula.[42] On the western side of the state, the New York Power Authority is selecting developers to build 40-160 wind turbines in Lake Erie and/or Lake Ontario. The project is anticipated to deliver up to 500 MW of power beginning in 2016.[43]

Great Lakes

Throughout the Great Lakes area, public officials are calling for more data on offshore wind energy, sensible regulatory and permitting processes, and wind farm proposals from project developers. Michigan and Ohio leaders see the opportunity for offshore wind farms as a race to attract jobs to their states. A report ordered by Michigan Governor Jennifer Granholm found that 20 percent, or 7,874 square miles, of the Great Lakes waters within Michigan's territory have a depth of 30 meters or less (practicable for offshore wind development), of which 537 square miles are most favorable for offshore wind farms.[44] Governor Ted Strickland and U.S. Senator Sherrod Brown of Ohio aim to make Lake Erie the site of the first freshwater offshore wind farms, and are pushing for legislation at the state and federal levels to accelerate offshore wind development.[45] There are also several proposed offshore wind farms in the Canadian-controlled waters of the Great Lakes.[46]

Gulf of Mexico

In 2005 and 2007, the Texas General Land Office issued leases for offshore wind projects to Wind Energy Systems Technology, Inc. The leases allow the company to conduct wind resource assessments, monitor avian patterns, and gather data from meteorological towers in areas off the coast of Galveston, Texas.[47] Unlike other states, the Texas government has regulatory control over coastal waters up to 10.3 miles from land.[48]

Louisiana's Public Service Commission has explored the possibility of using oil rigs set for decommission as platforms for wind turbines. Each oil rig costs between $400,000 and $5 million to remove, and since 1997 more than 1,000 oil rigs have been removed from Louisiana's waters.[49]

Pacific Coast

The water on the Pacific Coast becomes deeper much closer to the shore compared to the East Coast, making offshore wind development more challenging. However, the Pacific Coast has the potential for high capacity offshore wind turbines; the winds off California's coast alone could generate as much as 130 GW of electricity, about twice the state's needs on a hot afternoon. Seattle-based Principle Power aims to install America's first deepwater offshore wind farm off the coast of central Oregon. The company has signed an agreement with the locally owned Tillamook People's Utility District in Oregon to install floating wind turbines.[50]

PUBLIC CONCERNS AND BENEFITS

After Cape Wind was proposed in 2001, some of the area's waterfront property owners organized to oppose the project, contributing to the delays in construction. A 2006 survey by the University of Delaware near the proposed Cape Wind development found that residents most frequently based their decision to support or oppose the wind farm on perceived impacts to marine life, the environment, electricity rates, aesthetics, fishing, and boating. Residents believed the most positive impacts would be on electricity rates, job creation, and air quality. Forty-seven percent of local residents surveyed increased their support for Cape Wind if they were told it was the "first of many" offshore wind projects along the Atlantic Coast – indicating that residents prefer to feel like part of a larger solution with "important benefits."[51]

Real Estate Values

Multiple U.S. studies show no precedent of land-based wind farms affecting real estate values. After studying 7,500 single-family property sales between 1996 and 2007, Lawrence Berkeley National Laboratory found that the view of wind facilities and the proximity of homes to wind turbines have no consistent, measurable, or statistically significant effect on home sale prices.[52] A 2006 Bard College study on a Madison, N.Y. onshore wind farm also found no evidence that wind turbines affected home values. In 2003, the Renewable Energy Policy Project studied 24,000 home sales surrounding 11 U.S. onshore wind farms, and found no evidence of adverse effects on property values. In some communities, the homes near the turbines increased in value faster than the control group.[53]

Tourism

Beaches are the lead tourist destination of the United States, and coastal states garner about 85 percent of all tourism-related revenue. A 2006 poll of New Jersey beachgoers revealed that 15 percent would be more likely to visit the beach with a wind farm ten kilometers offshore, and 72 percent would not be more or less likely to visit.[54] A study conducted at Delaware beaches found that about one-quarter of beachgoers would switch beaches if the project was ten kilometers offshore. Positive feelings about wind farms increase when the turbines are sited at greater distances. The Delaware poll found that 94 percent of tourists would return to a beach with wind turbines 22 kilometers offshore, and 99 percent would return if the turbines were too far from the coast to be visible. Wind farms polled more favorably than fossil fuel power plants: 74 percent of the Delaware tourists said they would visit a beach with offshore wind turbines, whereas 61 percent said they would visit the same beach with a coal or natural gas plant located the same distance inland. Studies in Europe where offshore wind farms already exist have found similar patterns of support among tourists.[55]

The Scroby Sands wind farm off the coast of Scotland has become a local tourist attraction, with around 35,000 visits per year.

http://www.power-technology.com/projects/scrobysands

Radar and Military Activities

Turbines, like any large structure, can cause blockage or clutter interference with surveillance radars and electromagnetic systems. These problems can be overcome by careful location selections, or by upgrading the software in existing radars (about 80 percent of which date back to the 1950s-80s), or replacing older radars.[56] In one specific study, the Department of Defense (DOD) assessed potential sites for offshore wind farms in Virginia. Of the 25 tracts identified for optimum winds, the report found that 18 are compatible with military needs and rules. Most of the feared offshore interferences – submarines and live munitions practices – occur beyond the ideal area for wind turbines.[57] The DOD calls fossil fuel dependence itself an issue of national security, and views wind energy as an energy alternative that can be compatible with military readiness and homeland security.[58]

Birds and Bats

Birds and bats can be killed by wind turbines – just as they are threatened by many human activities and means of energy production – with 20,000 to 37,000 bird fatalities attributed to U.S. wind turbines in 2003. In comparison, collisions with buildings, power lines, and automobiles cause a total of nearly one billion bird fatalities per year; pesticides account for 67-72 million fatalities per year.[59] Pre-development site evaluation and consideration of migration routes can decrease the risk of a wind farm harming birds and bats.[60] A 2009 study by the National University of Singapore showed that coal power – responsible for mountain top removal coal mining, acid rain pollution, mercury pollution, and greenhouse gas emissions which cause climate change – causes an average of 5.18 avian fatalities per gigawatt hour (GWh). The same study found that wind turbines cause 0.279 fatalities per GWh.[61] Studies of European offshore wind farms have found minimal risks to bird mortality, and in some site-specific cases, wind farms might be expected to have lower impacts offshore than onshore. A study of 1.5 million seabirds migrating at Swedish wind farms reported a 1 in 100,000 mortality risk.[62]

The Massachusetts and Delaware chapters of the Audubon Society have approved specific proposed wind farms off the shores of their states, and, in general, the National Audubon Society supports wind energy projects because it recognizes climate change as a far greater threat to birds, other wildlife, and their habitats.[63] The combined effects of climate change and habitat destruction could leave 950-1800 bird species imperiled by 2100.[64]

Marine Life and Fishing

In the long term, offshore wind farms generally result in higher fish densities and biomass, but can be detrimental to the fishing industry. The foundations of turbines can function as artificial reefs for marine species. Studies of European wind farms show that habitat disturbance caused by construction and installation of wind farms is temporary, and the presence of wind turbines can significantly enhance local abundance of bottom-dwelling fish and crabs.[65]

In 2007, a group of commercial fishermen formed Fishermen's Energy LLC, an offshore wind energy company that has proposed a wind farm off the coast of New York. This group views offshore wind as a job opportunity because fishermen who already have experience handling heavy machinery in high winds and rough seas are best suited for the construction, installation, and maintenance jobs at an offshore wind farm.

http://www.fishermensenergy.com/faq.html

Offshore wind farms can hinder the ability to conduct trawling – a method of fishing that involves pulling a large fishing net behind one or more boats. Scientists have found this to have broad, positive effects upon marine life,[66] although the fishing industry is opposed to trawling limitations and exclusions. Consideration of local industries when siting wind farms can lessen this challenge for wind developers. For example, 80 percent of the lobster catch in Maine is within three miles of land, so the lobster industry can coexist with a wind farm located farther offshore.[67]

Wind Variability

Wind is variable, but predictable. No power plant is one hundred percent reliable, so an integrated system with multiple sources is already commonly used.[68] In December 2009, nine European countries – Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Sweden, and the United Kingdom – agreed to work together to make a large renewable electricity grid in the North Sea, connecting wind farms, solar power, tidal power, and hydroelectric sources.[69] In October 2010, transmission company Trans-Elect announced the Atlantic Wind Connection project to connect offshore wind resources from northern New Jersey to southern Virginia. This "backbone" electric grid would help stabilize the impacts of regional wind variability and is intended to accelerate the development of U.S. offshore wind projects in the Atlantic. The proposed project is sponsored by Google, investment firm Good Energies, and Marubeni Corporation, a Japanese trading company.[70]

Extreme Weather

Offshore wind turbines are designed to slow down or turn off in severe weather, such as when winds exceed 50 miles per hour.[71] Wind farms can be built and designed to withstand winds exceeding 150 mph, a Category 4 hurricane.[72]

Costs

Offshore wind farms are more expensive to build and maintain than onshore wind farms due to the higher cost of larger turbine structures, offshore turbine foundations, and sea transmission cables.[73] DOE estimates that constructing and installing an offshore wind farm costs at least $2,400 per kilowatt of capacity, compared to $1,650 (in 2006 dollars) for an onshore wind farm.[74] In July 2010, the Cape Wind developers and a local utility set a price of 18.7 cents per kilowatt-hour for residential consumers,[75] somewhat higher than the average 2010 residential retail price of 16.6 cents per kilowatt-hour in New England.[76] A 2010 report by the UK Energy Research Centre predicted that the cost of offshore wind power was likely to drop 25 percent by 2025.[77]

Local Economy and Jobs

The European experience shows that offshore wind farms generate more jobs per megawatt installed than onshore wind farms. In 2007, 6,370 people were employed in the EU offshore wind energy sector – including manufacturing, installation, operations, and maintenance jobs – which was then operating at a capacity of 210 MW (less than ten percent of the EU 2010 offshore wind capacity). The European Wind Energy Association estimates that by 2030, more than 215,000 people will be employed in the European offshore wind sector.[78]

In a three-year period in Michigan, 35 firms were created or retooled (from formerly producing auto parts) to supply parts to the commercial wind industry. About 400 other Michigan manufacturers have the capability to craft gear boxes, brakes, generators and other parts for utility-size wind turbines.

http://www.detnews.com/article/20090507/BIZ/905070406/Wind-turbines-generate-Michigan-job-hopes

Offshore wind developments drive the need for local sourcing and manufacturing due to the high cost of transportation. American manufacturers are seizing the market opportunity provided by the onshore wind sector. The majority of blades and towers used in U.S. onshore developments are produced domestically, and around 85,000 Americans were employed (directly and indirectly) in the wind manufacturing sector in 2009.[79] A Virginia study found that within two decades, 9,700 to 11,600 jobs could be created in Virginia with the development of 3,200 MW of offshore wind. If the turbines for wind farms off the coast of Virginia were manufactured within the state, the capital costs of the offshore wind projects would decrease by $480 per kilowatt. Regardless of where the turbines are manufactured, a 588 MW offshore wind project would attract an investment of $403 million to the local economy.[80] The National Renewable Energy Lab estimates that if 54 GW of offshore wind were installed (as outlined in the DOE's strategic work plan), 43,000 permanent jobs would be created in operations and maintenance, and more than 1.1 million job-years would be required to manufacture and install the turbines.[81] Local manufacturing and jobs also contribute to the local tax base.

Climate Change

By displacing electricity that would otherwise be generated by coal or natural gas, offshore wind power reduces the greenhouse gas emissions which cause climate change. DOE estimates that each GW of wind power capacity would save 1.2 million tons of coal or 20.9 billion cubic feet of natural gas, avoiding 1.8 million metric tons of carbon emissions and saving 1.3 billion gallons of water.[82]

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