

What factors will affect the cost of offshore wind energy in the future?

The cost of offshore wind energy could decrease significantly over the next 20 to 25 years. As the industry gains experience deploying offshore wind turbines, manufacturing, installation and maintenance are likely to become more efficient. Increased investment in research and development will likely reduce the cost of turbines, while increased access to financing may also reduce project costs. As federal and state regulators gain experience evaluating offshore wind projects, permitting processes are anticipated to be more efficient. Offshore wind may also become more competitive with other types of fossil fuel-based energy if policies that regulate carbon

emissions are implemented or if changes in the supply of fossil fuels lead to price increases. Table 3 outlines the U.S. Department of Energy's projections for the cost of offshore wind energy between 2010 and 2030.

Table 3: Potential Offshore Wind Cost Reductions 2010-2030

	2010	2020	2030
Installed Capital Cost (\$/kW)*	\$4,259	\$2,900	\$2,600
Turbine Size (MW)	3.6	8.0	10.0
Annual Energy Production/Turbine (MWh)	12,276	31,040	39,381
Cost of Energy (\$/kWh)*	\$0.27	\$0.10	\$0.07

*Values are expressed in 2009 dollars.

Adapted from DOE 2011

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Image Sources

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Wind resource map: <http://www.mainebiz.biz/article/20090126/CURRENTEDITION/301269998>

Supply chain diagram: adapted from http://www.bls.gov/green/wind_energy/

Hywind turbine and components being towed: <http://www.nordicenergysolutions.org/inspirational/hywind>

Founded in 1983, the Island Institute is a membership-based nonprofit organization headquartered in Rockland, Maine, focused on helping to sustain the year-round island and remote coastal communities of the Gulf of Maine. As the Gulf of Maine increasingly attracts attention for its robust offshore wind resource, the Institute is working with island communities, fishermen, regulators, researchers, developers, manufacturers and others to enable them to effectively share information on ocean energy development with each other.

For more information on the Island Institute's ocean renewable energy efforts, please contact Heather Deese, vice president of programs, at hdeese@islandinstitute.org, (207) 594-9209 x 112 or Suzanne MacDonald, community energy director, at smacdonald@islandinstitute.org, (207) 594-9209 x 144.

The following web resources are also available:

<http://www.islandinstitute.org/oceanrenewableenergy.php> • <http://www.islandinstitute.org/mappingworkingwaters.php>

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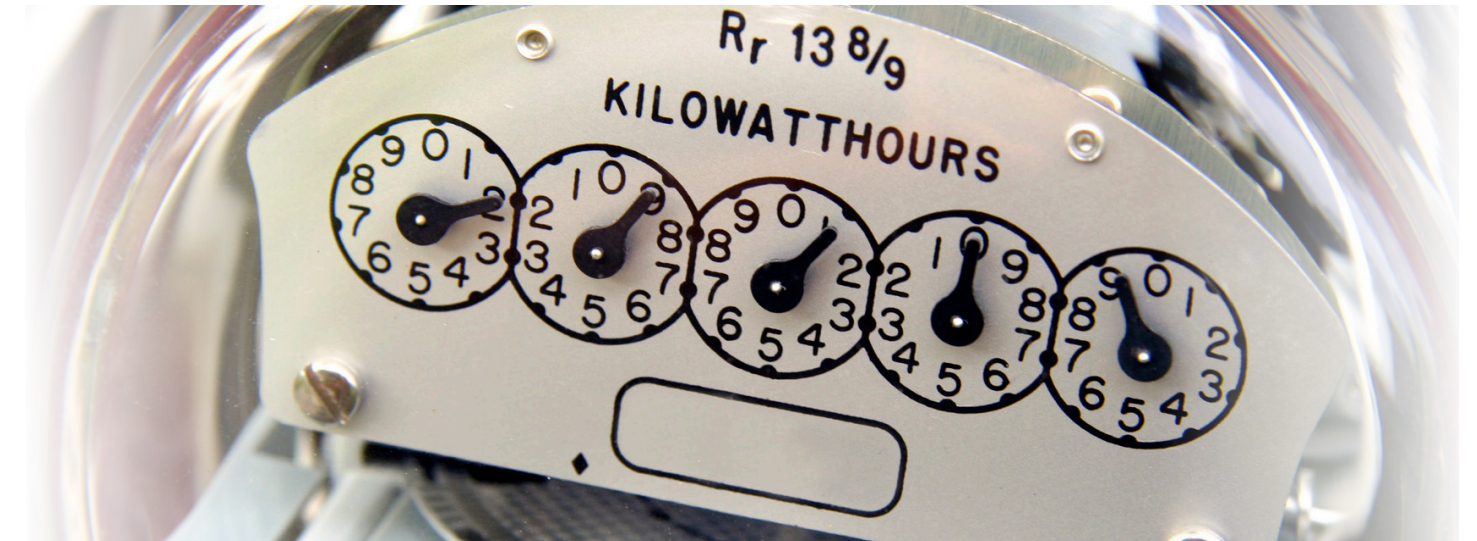
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Economics of Offshore Wind Energy in Maine



The Gulf of Maine has been identified by the U.S. Department of Energy and the wind energy industry as an "outstanding" location for offshore wind energy development because of its strong, consistent winds (Schwartz et al. 2010). Nevertheless, many questions remain about the economic impacts of offshore wind development in Maine. How much will it cost to construct an offshore wind energy project in the Gulf of Maine? If a project is built, how much will the electricity

it generates cost, and how does this cost compare to other sources of power? How many jobs could offshore wind development create in Maine?

This fact sheet sheds light on these questions, although the answers remain uncertain, given that the offshore wind industry is relatively new and there are no offshore wind projects currently installed in the United States.

How much does it cost to build an offshore wind energy project?

Because offshore wind energy projects do not require fuel inputs, most of their costs are in the form of upfront capital development expenses. Capital costs for offshore wind energy are determined by:

- Price and availability of manufactured and raw materials;
- Financing costs (which are affected by government incentives and financing structures);
- Transport costs (e.g., turbines, steel, concrete);
- Installation costs (e.g., water depth, bottom type);
- Permitting and legal costs (which can be affected by levels of local support or opposition);
- Transmission costs (e.g., submarine cable, grid interconnect fees); and
- Overall experience of wind industry (because prices of projects decrease as industry experience increases).

Table 1: Wind Project Cost Comparison

Project Name	Nameplate Capacity (MW)	Total Project Cost	Cost per MW of installed capacity (\$/MW)
Cape Wind (MA)	468	\$2.8 billion	\$5.3 million
Sheringham Shoal Offshore Wind Farm (UK)	317	\$1.8 billion	\$5.7 million
Block Island Wind Farm (RI)*	30	\$250 million	\$8.3 million
Kibby Mountain Wind Farm (ME)**	120	\$320 million	\$2.7 million

*The Block Island Wind Farm is a small-scale pilot project.

** The Kibby Mountain Wind Farm is an onshore (terrestrial) wind project in Maine.

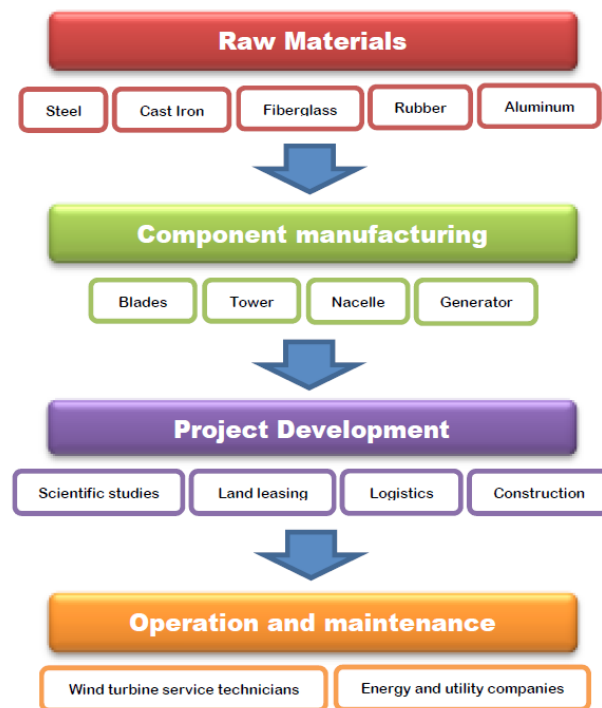


What determines the price of electricity after an offshore wind energy project is built?

The price of power for the ratepayer depends on the capital costs, which are generally amortized over the project's expected life (typically 20 years), as well as several ongoing factors, including:

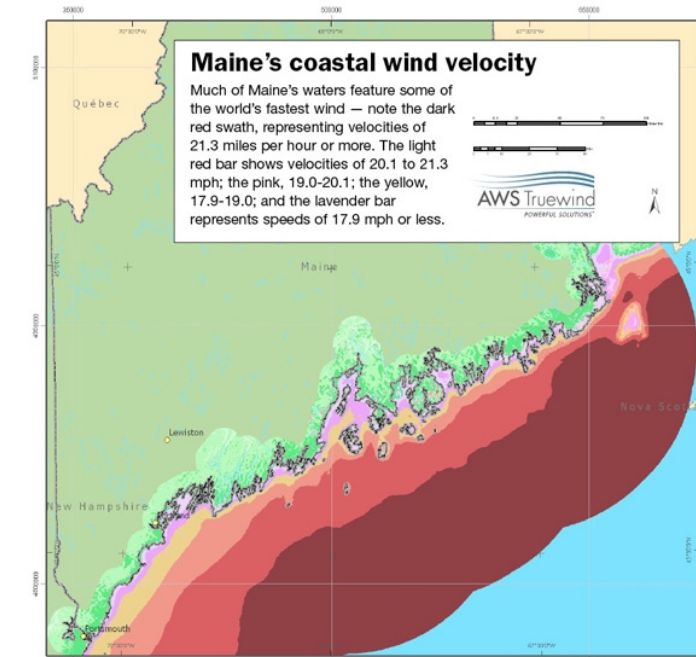
- Wind resource and capacity for generation (i.e., the amount of power the turbines will actually produce at any given site due to wind speed and consistency)
- Operations and maintenance costs
- Principle and interest payments
- Terms of Power Purchase Agreement (PPA) signed with utility

(Terrestrial) Wind Energy Supply Chain



What does this mean for my electric bill?

If, as projected, offshore wind projects generate power at more than 20 cents/ kilowatt hour (kWh) (Hunt 2010), won't ratepayers see a huge increase in their monthly bills? For the current projects under consideration by the Maine Public Utilities Commission, the answer is no. The 25 megawatts (MW) of offshore wind power for which the State of Maine has solicited proposals represents a relatively small amount of the total generating capacity in the region. In addition, the Maine Legislature decided to limit the potential impact of a 25



Who pays for offshore wind energy development?

Any offshore wind energy project that is built in the Gulf of Maine will primarily be financed by a private developer. The developer will pay for upfront project capital costs and make a significant investment in the operation of the project. Prior to construction, the developer will also enter into at least one Power Purchase Agreement (PPA) with a utility that will buy power generated by the project. The PPA(s) must then be approved by the utilities commission in the state in which the power will be sold. Securing a PPA in the early stages of development is critical because it helps the developer access financing for the project by assuring lenders and investors that there will be a buyer for the generated power. Like most energy sources, offshore wind energy projects are also eligible to receive government subsidies and incentives in the form of grant support for research and development, tax credits and/or loan guarantees.

MW offshore project on electric rates to approximately a tenth of a cent (Garratt-Reed 2010). For the average residential ratepayer, this might mean an increase of approximately 75 cents per month, or about \$9.00 per year. The amount of offshore wind power put onto the grid, combined with the cost of that power (as it relates to industry experience and capital costs) and the State's interest in restricting rate increases will ultimately determine if this impact grows or decreases as a result of any future projects.

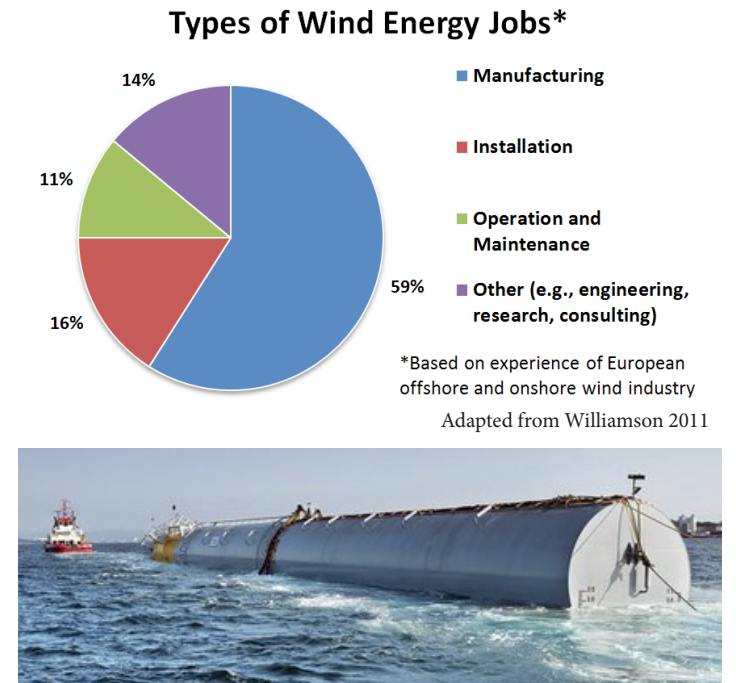
Will offshore wind development create jobs in Maine?

It is difficult to predict how many jobs will be created by offshore wind energy projects and how many of those jobs will be in Maine. Maine's experienced manufacturing workforce and its tradition of jobs at sea make it an attractive place to wind developers. Maine has set a goal of developing 5,000 MW (5 gigawatts) of offshore wind generation by 2030 (LD 1810, 2010). Projections for job creation and economic impact vary widely depending on how much of the manufacturing and installation of equipment occurs in Maine. For example, the University of Maine's DeepCwind Consortium projects

that between 7,000 and 15,000 jobs could be created by offshore wind development in Maine (University of Maine 2011). This is an optimistic projection because it assumes that all of the manufacturing and installation would occur in the state. The Maine Wind Industry Initiative (MWII) projects that between 23 and 65 maintenance vessels could be required for the upkeep of offshore wind turbines (Williamson 2011). The operations and maintenance work done by these vessels could create jobs for Maine boat crews and boat builders.



Hywind turbine being towed at sea in deep water



Hywind turbine components being towed from Åmøyfjorden to Karmøy

Federal offshore wind energy cost goals

The federal government has set a goal to achieve 54,000 MW of installed offshore wind energy generation at a price of \$0.07/kWh by the year 2030 (U.S. DOE 2011). Energy prices from the first offshore wind energy pilot projects are expected to start out at around \$0.20 per kWh (Hunt 2010). Prices are then expected to decrease steadily as the industry matures. A study from the University of Maine projects that the levelized cost of energy (LCOE)—the price at which electricity must be generated from a specific source to break even—of offshore wind will reach \$0.09-\$0.10/kWh by 2030 (Hunt 2010). Table 2 shows a comparison of the LCOE for various types of power plants.

Table 2: Projected Average Levelized Cost for Power Plants Entering Service in 2016

Plant Type	LCOE (\$/kWh)*
Conventional Coal	\$0.094
Natural Gas Conventional Combined Cycle	\$0.066
Advanced Nuclear	\$0.114
Terrestrial Wind	\$0.097
Offshore Wind	\$0.243
Solar Photovoltaic	\$0.21

*Values are expressed in 2009 dollars.

Adapted from EIA 2011