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Wind Power costs and installation

As of 2001, the total cost of production and installation of a utility grade (approximately 1.5-2 MW turbine) wind turbine exceeded \$1.5 million. As of Aug 2007, these costs rose as a result of rising material prices and shortage of turbine production. These factors led to an increase in total costs to over \$2.5 million for a typical 1.5 MW turbine¹. The shortage of manufacturing is such that large developers have secured all turbines for the next couple years, leaving manufacturers no supply for smaller, community wind projects of 10 MW or less. GE and Vestas are the top wind turbine manufacturers, but more manufacturers have entered the market which may allow for turbine prices to stabilize in the coming years².

For larger, utility scale turbines, the majority of materials needed to produce turbines are steel and fiberglass. Steel composes 95% of the tower, hub, and nacelle, and 80% of the turbine machinery. Fiberglass composes of more than 95% of most turbine blades though newer turbines may use carbon fiber or other lightweight materials. However, turbine blades make up 10% of the Thus, the material cost of towers is closely related to steel prices³.

Wind turbines have an expected lifespan of around 30 years and its components are expected to survive 4×10^8 fatigue stress cycles, which is hardier than aircraft components or many other man-made structures⁴.

The National Renewable Energy Laboratory in 2002 made a model to estimate the cost of manufacturing and installing single wind turbine towers and scaling the cost by the size of the rotor diameter. This model took into account differences in turbine design by estimating the mass of the materials in each turbine and estimating each material's cost per kilogram. In addition, it takes account for installation and operation costs. Through their estimates, normalized to the year 2002, they came up with a figure of about \$1 million for the production of a 1.5 MW, land-based turbine and about \$0.4 million for the installation leading to an initial cost of capital of \$1.4 million dollars. For upkeep and operation, including a typical land lease fee, there is a cost of around \$50,000 each year. In sum, this leads to a cost of \$0.048/kWh which is only slightly more expensive than coal at a cost of \$0.04/kWh. This number will change based on all inputs plus the financing involved for the project. In addition, when the rotor diameter is increased to 90 meters to create a 3 MW turbine and the turbine is placed in shallow water, the cost doubles since cost relates to the rotor length cubed in addition to the extra difficulty in installing turbines at sea⁵.

¹http://seattletimes.nwsourc.com/html/business/technology/2003861483_windmillshortage31.html?syndication=rss

²http://seattletimes.nwsourc.com/html/business/technology/2003861483_windmillshortage31.html?syndication=rss

³ http://www.awea.org/pubs/factsheets/windpowertoday_2007.pdf

⁴ http://www.awea.org/pubs/factsheets/windpowertoday_2007.pdf

⁵ <http://www.nrel.gov/wind/pdfs/40566.pdf>

Another variable involved in pricing wind power relates to the size of a wind project. Electricity from individual turbines will cost more than that from a group of turbines given that operation and maintenance costs can be spread over more turbines and the cost of transmission decreases⁶.

Lastly, ownership of a wind turbine can affect electricity costs mostly based on the financing available. A vast majority of wind power projects are owned by independent, private power producers who do not get as good a deal on financing as large electric utilities. The difference in financing can lead to up to a 30% increase in electricity costs over large electric utilities⁷.

According to DOE National Energy Survey, the US produced 4.6×10^8 kWh of electricity, which at 5 cents a kWh would cost the nation \$203 billion dollars a year. In order to place enough 1.5 MW wind turbines to produce that much electricity, the cost would be around \$690 billion dollars where each year the carrying cost would be on the order of \$23 billion a year.

⁶ <http://www.awea.org/pubs/factsheets/EconomicsOfWind-Feb2005.pdf>

⁷ <http://www.awea.org/pubs/factsheets/EconomicsOfWind-Feb2005.pdf>