WIND ENERGY FACT SHEET

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Comparative Cost Of Wind And Other Energy Sources

The cost of wind energy is declining steadily. Long-term forecasts of the early 1990s by Pacific Gas & Electric and the Electric Power Research Institute (EPRI) that wind would ultimately become the least expensive electricity generation source are no longer pipe dreams. It is clear that wind's costs are now in a competitive range with those of mainstream power technologies.

Based on its knowledge of current market conditions, the American Wind Energy Association (AWEA) estimates the levelized cost [1] of wind energy at good sites as ranging from 3.0 to 6.0 cents per kilowatt-hour (kWh), not including the U.S. federal production tax credit (PTC). The credit (1.5 cents/kWh, adjusted for inflation) applies to the first 10 years that a new wind plant operates, and can reduce the levelized cost of wind by about 0.7 cents/kWh over the plant's 30-year lifetime.

The following table compares the costs of major energy sources with wind energy. The figures are from the California Energy Commission's 1996 *Energy Technology Status Report [2]*, which examined the costs and market readiness of various energy options. The CEC calculations do not include subsidies or environmental costs.

Fuel	**Levelized costs (cents/kWh) (1996)**
Coal	4.8-5.5
Gas	3.9-4.4
Hydro	5.1-11.3
Biomass	5.8-11.6
Nuclear	11.1-14.5
Wind (without PTC)	4.0-6.0
Wind (with PTC)	3.3-5.3

The cost of natural gas has increased since 1996, so that the levelized cost of gas–fired power plants would now be considerably higher. In January 2001, the cost of natural gas generated power was running as high as 15 cents to 20 cents per kWh in certain markets [3]. The cost of wind power, meanwhile, has declined slightly.

Four additional points about the economics of wind energy should be considered when estimating its relative cost.

First, the cost of wind energy is strongly affected by average wind speed and the size of a wind farm. Since the energy that the wind contains is a function of the cube of its speed, small differences in average winds from site to site mean large differences in production and, therefore, in cost. The same wind plant will, all other factors being equal, generate electricity at a cost of 4.8 cents/kWh in 7.16 m/s (16 mph) winds, 3.6 cents/kWh at 8.08 m/s (18 mph) winds, and 2.6 cents/kWh in 9.32 m/s (20.8 mph) winds. Larger wind farms provide economies of scale. A 3-MW wind plant generating electricity at 5.9 cents per kWh would, all other factors being equal, generate electricity at 3.6 cents/kWh if it were 51 MW in size.

Second, wind energy is a highly capital-intensive technology; its cost reflects the capital required for equipment manufacturing and plant construction. This in turn means that wind's economics are highly sensitive to the interest rate charged on that capital. One study found that if wind plants were financed on the same terms as natural gas plants, their cost would drop by nearly 40%. [4]

Third, the cost of wind energy is dropping faster than the cost of conventional generation. While the cost of a new gas plant has fallen by about one-third over the past decade, the cost of wind has dropped by 15% with each doubling of installed capacity worldwide, and capacity has doubled three times during the 1990s. Wind power today costs only about one-fifth as much as in the mid-1980s, and its cost is expected to decline by another 35-40% by 2006. [5]

Fourth, if environmental costs were included in the calculation of the costs of electricity generation, wind energy's competitiveness would increase further because of its low environmental impacts. Wind energy produces no emissions, so there is no damage to the environment or public health from emissions and wastes such as are associated with the production of electricity from conventional power plants. Wind energy is also free of the environmental costs resulting from mining or drilling, processing, and shipping a fuel. [6]

NOTES

1. Levelized costing calculates in current dollars all capital, fuel, and operating and maintenance costs associated with the plant over its lifetime and divides that total cost by the estimated output in kWh over the lifetime of the plant.
2. California Energy Commission (CEC) *Energy Technology Status Report 1996*. Sacramento. All CEC estimates are in constant dollars as of 1993, with costs "levelized over a typical lifetime (usually 30 years) beginning in 2000" (p. 57). All cost estimates are for investor-owned utility (IOU) ownership.
3. *Wall Street Journal*, January 26, 2001, p B1.
4. Wiser, Ryan, and Edward Kahn. 1996. "Alternative Windpower Ownership Structures." LBNL-38921. Berkeley, Calif.: Lawrence Berkeley Laboratory. May.
5. Chapman, Jamie, Steven Wiese, Edgar DeMeo, and Adam Serchuk. 1998. "Expanding Wind Power: Can Americans Afford It?" Research Report No. 6. Washington, D.C.: Renewable Energy Policy Project.
6. State attempts to set up a process by which some of the environmental costs of electricity production, or externalities, could be taken into account in economic calculations have focused on air emissions alone and set externalities estimates in the range of 3-6 cents per kWh for coal and 0.5 to 2 cents for natural gas. For a comprehensive study of environmental costs, see Richard Ottinger et al.

Environmental Costs of Electricity, Pace University Center for Environmental Studies, New York, Oceana Publications, 1991.