WIND ENERGY COST

Depends on Operating Wind Speed, Utility Factor, and Service Life

- Power Rate Varies as Cube Operating Wind Speed, V_{opp}^3
- Utility Factor (fraction of Name-Plate Power delivered on average) varies as fraction of time that actual temporal wind speed, V(t), is within factor of ~2 of V_{opp}
- Service Life (mean time to failure of machine) depends mostly on differences in actual local wind speed, V(x,y), across the swept area of the rotor blades, which produce torques generator shaft.

Thus, cost depends on Location of high wind, Location of steady wind, and Location of non-turbulent wind. High winds occur at high latitudes and at many other places (e.g., Texas). The US Wind Energy Assoc. 2001 Fact Sheet states that a wind turbine producing electricity at $48/MWh in 7.16 m/s wind could produce it at $36/MWh in 8.08 m/s wind and $26/MWh in 9.32 m/s wind. However, Texas and the like with high winds at low latitudes, "Tornado Alley", tend not to have steady nor non-turbulent wind. Mountain passes often have high wind and sometimes steady wind, but do not have non-turbulent wind. (Altamont Pass, California was a poor choice of location.) Best locations are generally at high latitudes on near beaches or in water. Locations at high latitude plains, e.g., North Dakota, are OK choices.

Prevailing wind energy rates at wind farms in various locations (US $/ MWh):

Iceland	North Dakota	Minnesota	Austin, Texas	Toronto, CA	Munich, DE
14	25	35	60	90	110

We conclude that at the best sites for wind-energy generation (e.g., Aleutian Islands, Scottish Islands, Falkland Islands, Tierra del Fuego, Svalbard Island, etc) wind energy can be produced for less than $20/MWh (= $0.02/kWh).

Wind energy cost is also very sensitive to financing rates because the vast majority of total cost is up-front investment. The US WEA 2001 Factsheet says that costs would be 40% lower if wind farms were financed in the same way as gas-fire generators are.

Written by
James A. Van Vechten, PhD
July 29, 1942 — June 20, 2013