Advantages of Wind Power

- Wind is a clean, renewable resource
- Wind energy is free and easy to harness with proper technology
- Energy payback ratio (EPR) - The ratio between energy extracted from the system and energy supplied to the system.
  - A greater EPR implies a higher efficiency
  - Wind power has an EPR three times the size of a coal fired power plant
- Energy payback period (EPP) - An estimate of the time required for an energy system to payback all of the energy it consumes.
  - Wind farms pay for themselves in approximately eight months compared to about 3.5 years for a coal fired power plant.
- Pollution elimination - Running a 1 MW wind turbine for one year eliminates the following pollutants from entering the atmosphere:
  - 1500 tons of carbon dioxide
  - 6.5 tons of sulfur dioxide
  - 3.2 tons of nitrogen oxides
  - 60 pounds of mercury

Disadvantages of Wind Power

- Variability of the wind - Wind varies by geographic location, time of the year, and time of the day
- Environmental concerns -- Aesthetics, noise, and avian
  - Large wind farms are an eyesore to some
  - High-speed turbine blades produce a great deal of noise
  - The differential pressure gradients around the turbine blades can suck birds into the blades’ path, potentially killing the wildlife
- Cut-in and cut-out wind speeds -- At low speeds, no power is produced, at high wind speeds, turbine operation becomes dangerous
  - Cut-in wind speed 4 m/s (9 mph)
  - Cut-out wind speed 15 m/s (34 mph)
  - Ideal wind speeds 7-10 m/s (16-22 mph)

Advances in Technology Required

**Required Technological Advances for Blades:** Investigations will be aimed at advanced materials, improved manufacturing processes, and more efficient blade designs in an attempt to make the blades lighter, stronger, and cheaper. The goals are to design a blade that can withstand high winds and maintain structural integrity for up to 30 years. These issues will become more pronounced as wind turbines become larger.

**Required Technological Advances for Structures:** Stronger, more durable materials are needed to make the turbines structurally sound at high wind speeds. Also, some sort of vibration dampening could be useful for limiting the amount of vibration the turbine feels.
**Required Technological Advances for Transmission:** Since some of the best wind energy is located in remote regions, an advance in transmission is necessary. Transmission systems need to be upgraded so the wind energy is readily accessible by regions with high electricity demands throughout the country.[2] Electric Utilities current electric grids are not set up to move large amounts of electricity from one region of the nation to another. Therefore, the grid needs to be redesigned to operate like an "electric superhighway" so customers across the country have access to the energy. Also, political differences need to be worked out between states and the national government if any improvements are to be made on the grid.[3] Additional information on electricity transmission can be found on the Infrastructure pages of this site at the following link: Infrastructure.

**Required Technological Advances for Energy Storage:** Advances in the ability to store energy are required to enhance wind turbines’ performance and practicality. Information on energy storage can be found at the following link: Energy Storage.

**Conclusions**

Wind power is a fast growing source of clean, renewable energy. The key to harvesting this energy is the wind turbine and the advancements in technology that have been made and are currently being developed related to it. Wind energy has great potential to become a large player in the production of electricity in the U.S. With the current technology, it is forecasted that wind could provide 20 to 30% of America’s electricity needs by 2030. New advances in technology will only increase the likelihood of this happening.

**References**

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