

TECHNOLOGY DEVELOPMENT PROJECT FACT SHEET

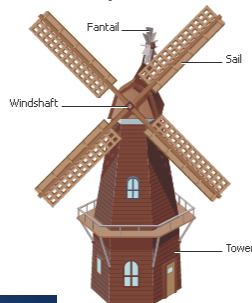
RT009: Wind Technology

Wind Energy is the energy contained in the force of the winds blowing across the earth's surface. Wind is created when air that has been warmed over sun-heated land rises, leaving a vacuum in the space it once occupied. Cooler surrounding air then rushes in to fill the vacuum. This movement of rushing air is what we know as wind.

Egyptians may have been the first to capture wind energy when they sailed boats up the Nile River beginning around the 4th century BC. Wind energy has been harnessed on land since the first windmill was developed by the ancient Persians in the 7th century AD. Windmills have since been used to mill grain, pump water, saw timber, and provide other forms of mechanical energy.

Early Persian windmills were crude devices consisting of a simple tower supporting an array of paddles made from bundled reeds. These paddles spun around a vertical axis, with a wall to protect the blades as they spun back into the direction of the wind. These early windmills were used for grinding grain.

Traditional European windmills have been used for centuries on the lowlands of northern Europe. In fact, the term *windmill* derives from using these machines to grind, or mill, grain.



The first windmills to appear in Europe were built during the 12th century in northwestern France and southern England. Use of the windmill subsequently spread into northern Belgium, Germany, and north to Denmark during the late 12th and 13th centuries.

The American farm windmill, ideally suited for pumping water from deep underground, became an integral part of agricultural communities across the American West.



The modern wind turbine is the result of design and material advances made during the 1980s and 1990s, which have enabled wind turbines to become increasingly efficient. Today, wind turbines the same size as the traditional European windmill can generate 250 to 300 kilowatts of power—a nearly tenfold increase in efficiency. Modern wind energy systems consist of three basic components: a tower on which the wind turbine is mounted; a rotor that is turned by the wind; and the *nacelle*, which houses the equipment, including the generator, that converts the mechanical energy in the spinning rotor into electricity. The most successful wind turbine generators for large-scale power generation have been of medium size (from 50 to 100 ft in diameter, with power ratings of 100 to 400 kW). These are sometimes installed in groups or arrays, known as wind farms. The largest sizes are MW scale and up to 300 ft. blade diameter. \$800 – 2000/ KW Capital cost range \$0.03 – 0.08/ kWh operating costs. In areas of excellent wind resources such as Texas and Oklahoma, the energy generated is competitive with the utility grid.



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