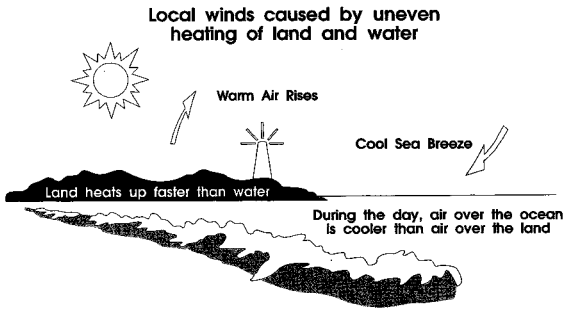
DEPARTMENT OF PLANNING AND NATURAL RESOURCES
VIRGIN ISLANDS ENERGY OFFICE
45 ESTATE MARS HILL
FREDERIKSTED, VIRGIN ISLANDS 00840
TELEPHONE 340 773-1082 STX * FAX 340 772-0063
340 774-3320 STT * FAX 340 714-9531
www.vienergy.org

WIND ENERGY

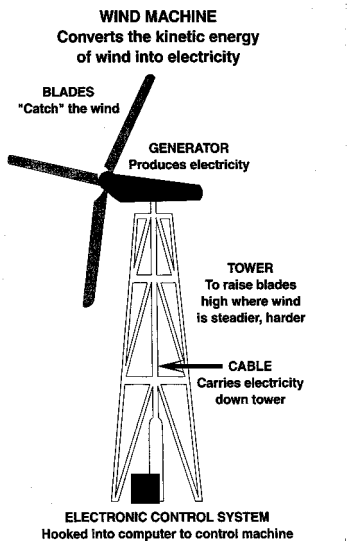
INTRODUCTION:

Wind is the natural movement of air across the land or sea. Wind is caused by uneven heating and cooling of the earth's surface and by the earth's rotation. Land and water areas absorb and release different amount of heat received from the sun. As warm air rises, cooler air rushes in to take its place, causing local winds. The rotation of the earth changes the direction of the flow of air. This produces prevailing winds, including the Caribbean's trade winds. Surface features such as mountains and valleys can change the direction and speed of prevailing winds. Wind energy uses the energy in the wind for practical purposes like generating electricity, charging batteries, pumping water, or grinding grain. Large, modern wind turbines operate together in wind farms to produce electricity for utilities. Homeowners and remote villages to help meet energy needs use small turbines.



Throughout history people have harnessed the wind. Over 5,000 years ago, the ancient Egyptians used wind power to sail the their ships on the Nile River.

American colonists used windmills to grind wheat and corn, pump water, and cut wood. When power lines began to transport electricity to rural areas in the 1930s, the electric windmills were used less and less. Then in the early 1970s, oil shortages created an environment eager for alternative energy sources, paving the way for the re-entry of the electric windmill on the American landscape.



WIND ENERGY BASICS

Wind turbines capture the wind's energy with two or three propeller-like blades, which are mounted on a rotor, to generate electricity. The turbines sit high atop towers, taking advantage of the stronger and less turbulent wind at 100 feet (30 meters) or more aboveground.

A blade acts much like an airplane wing. When the wind blows, a pocket of low-pressure air forms on the downwind side of the blade. The low-pressure air pocket then pulls the blade toward it, causing the rotor to turn. This is called *lift*. The force of the lift is actually much stronger than the wind's force against the front side of the blade, which is called *drag*. The combination of lift and drag causes the rotor to spin like a propeller, and the turning shaft spins a generator to make electricity.

Wind turbines can be used as stand-alone applications, or they can be connected to a utility power grid or even combined with a photovoltaic (solar cell) system. Stand-alone turbines are typically used for water pumping or communications. However, homeowners and farmers in windy areas can also use turbines to generate electricity. For utility-scale sources of wind energy, a large number of turbines are usually built close together to form a *wind farm*. Several electricity providers today use wind farms to supply power to their customers.

WIND ENERGY TECHNOLOGIES

Modern wind turbines are divided into two major categories: horizontal axis turbines and vertical axis turbines. Old-fashioned windmills are still seen in many rural areas.

Horizontal Axis Turbines (HAWT)

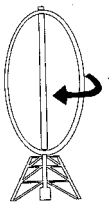
Horizontal axis turbines are the most common turbine configuration used today. They consist of a tall tower, atop which sits a fan-like rotor that faces into or away from the wind, the generator, the controller, and other components. Most horizontal axis turbines built today are two or three-bladed, although some have fewer or more blades.

Vertical Axis Turbines (VAWT)

Vertical axis turbines fall into two major categories: Savonius and Darrieus. Neither turbine type is in wide use today.

Darrieus Turbines

The Darrieus turbine was invented in France in the 1920s. Often described as looking like an eggbeater, this vertical axis turbine has vertical blades that rotate into and out of the wind. Using aerodynamic lift, these turbines can capture more energy than drag devices. The Giromill and cycloturbine are variants on the Darrieus turbine.



VERTICAL AXIS WIND MACHINE
Darrieus "egg beater" type

Savonius Turbines

First invented in Finland, the Savonius turbine is S-shaped if viewed from above. This drag-type VAWT turns relatively slowly, but yields a high torque. It is useful for grinding grain, pumping water, and many other tasks, but its slow rotational speeds are not good for generating electricity.

The amount of energy produced by a wind machine depends upon the wind speed and the size of the blades in the machine. In general, when the wind speed doubles, the power produced increases eight times. Larger blades capture more wind. As the diameter of the circle formed by the blades doubles, the power increases four times.

ADVANTAGES AND DISADVANTAGES OF WIND ENERGY

ADVANTAGES:

Wind is a renewable energy resource. Wind patterns in the Caribbean provide strong, steady trade winds in specific areas throughout most of the year.

Wind power can be used with battery storage or pumped hydro-energy storage systems to provide a steady flow of energy.

Used as a “fuel,” wind is free and non-polluting, producing no emissions or chemical wastes.

Use of wind power as a source of electricity will help reduce the Territory’s complete dependence on fossil fuels.

Wind farms can be combined with agricultural activities such as cattle grazing.

DISADVANTAGES:

Wind machines must be located where strong, dependable winds are available most of the time.

Because winds do not blow strongly enough to produce power all the time, energy from wind machines are considered “intermittent,” that is, it comes and goes. Therefore, electricity from wind machines must have a back-up supply from another source.

Wind towers and turbine blades are subject to damage from high winds and lightning. Rotating parts, which are located high off the ground, can be difficult and expensive to repair.

The environmental drawback may be a wind farm's effect on native bird populations, as well as its visual impact on the surrounding landscape. To some, the blades are an eyesore; to others, they're a beautiful alternative to conventional power plants.

ADDITIONAL RESOURCES

Wind Energy Program: www.eren.doe.gov/wind
The National Renewable Energy Laboratory's National Wind Technology Center: www.nrel.gov/wind/
Sandia National Laboratory: www.sandia.gov/wind/