THE POWER OF WIND

Exhibit developed for SciTech Hands-On Museum
by Alessandra Conversi as part of the University of Chicago's
Center for the presentation of Science

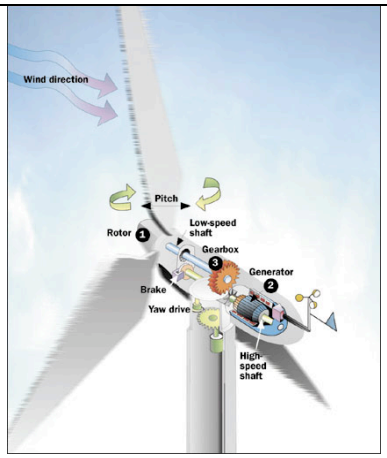
Introduction

This hands-on exhibit is meant to demonstrate how wind power, a source of renewable energy, can be used to generate energy, in this case electricity. Renewable energy is an energy resource such as wind power or solar energy that can keep producing indefinitely without being depleted. Renewable energy is also called "clean energy" or "green power" because it doesn't pollute the air or the water. Wind is the movement of atmospheric air on a planet. The wind is caused by the different temperatures, and therefore air pressure differences, around a planet, this is caused by the Sun. Since the earth's surface is made of very different types of land and water, it absorbs the sun's heat at different rates.

During the day, the air above the land heats up more quickly than the air over water. The warm air over the land expands and rises, and the heavier, cooler air rushes in to take its place, creating winds. Other causes of the wind are the temperature differential over the land and over seas, the topography of the land, hills, mountains, plains, etc., and the rotation of the Earth, which causes the Coriolis force. Air moves from areas of high pressure to areas of low pressure. Wind can be used to do work. The kinetic energy of the wind can be changed into other forms of energy, either mechanical energy or electrical energy. Using the wind to create electricity has been around for a long time. When the wind turns the blades of a windmill, it spins a turbine inside a small generator to produce electricity. Farmers have been using wind energy for many years to pump water from wells using windmills like the one on the right. In Holland, windmills have been used for centuries to pump water from low-lying areas.

Wind is also used to turn large grinding stones to grind wheat or corn, just like a water wheel is turned by water power. Today, the wind is also used to produce electricity.

Blowing wind spins the blades on wind turbines. This device is called a wind turbine and not a windmill. A windmill grinds or mills grain, or is used to pump water. The blades of the turbine are attached to a hub that is mounted on a turning shaft. The shaft goes through a gear transmission box where the turning speed is increased. The transmission is attached to a high speed shaft which turns a generator that makes electricity. In order for a wind turbine to work efficiently, wind speeds usually must be above 12 to 14 miles per hour. If the wind gets too high, the turbine has a brake that will keep the blades from turning too fast and being damaged. Wind has to be this speed to turn the turbines fast enough to generate electricity. The turbines usually produce about 50 to 300 kilowatts of electricity each. A kilowatt is 1,000 watts. You can light ten 100 watt light bulbs with 1,000 watts. So, a 300 kilowatt, 300,000 watts, wind turbine could light up 3,000 light bulbs that use 100 watts. Turbines vary in size from small 1 kW structures to large machines rated at 2 MW or more.

Project Description

This hands-on exhibit is meant to show children how wind power, a renewable natural resource (*wind will blow as long as the sun shines*), is a valuable source of electricity. They would observe how wind can be used to generate energy. The kinetic energy of the wind can be changed into other forms of energy, either mechanical energy or electrical energy, in this particular case it will be showed the production of electrical

energy. I am using two little motors with attached fans at their edges. The fans are facing each other. The first is connected to electricity and generates wind while spinning. The second one, which represents the wind turbine, is connected to two 2.5 watt light bulbs. When the wind blows over the turbine, it will spin generating enough energy to light up the bulbs. The wind generator is held by a movable arm. When the generator is moved closer / farther from the wind turbine it changes the strength of the wind received by the turbine affecting the amount of electricity generated. Distance affects the speed. When the two fans are at their closest distance the turbine will be spinning at its highest speed and will have enough energy to turn on the two light bulbs. As soon as the wind generator is moved backwards the lights will fade until they turn off.

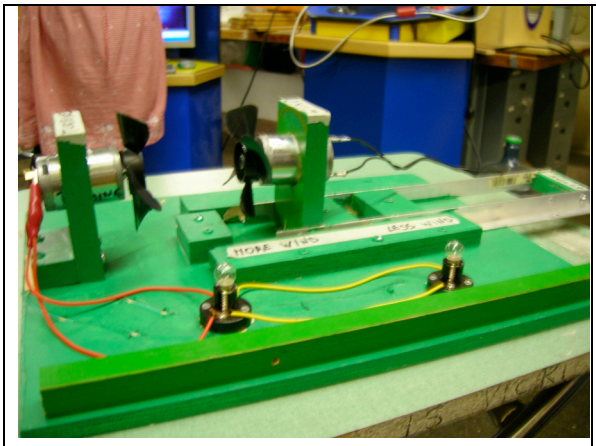
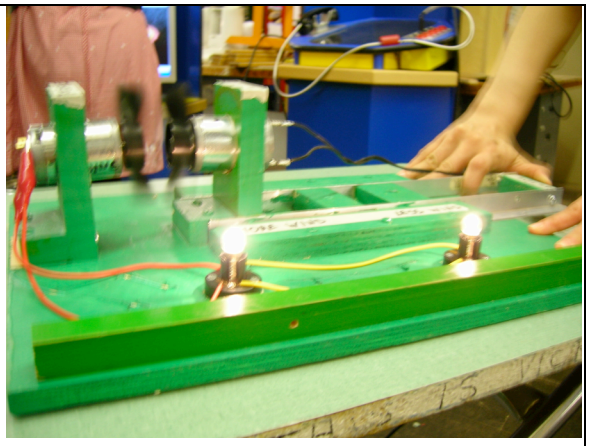
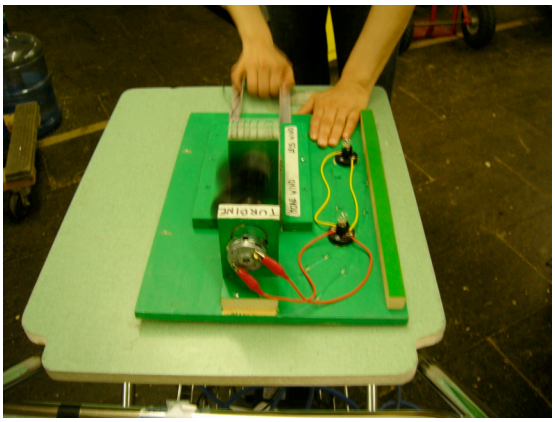
	

Exhibit at rest	**Exhibit at work**

Educational Standards



This hands-on exhibit complies with the National Science Standards. It covers “Unifying Concepts and Processes” (grades K to 12): "Models are tentative schemes or structures that correspond to real objects, events, or classes of events and that have explanatory power. Explain interaction of energy with matter including changes of state and conservation of mass and energy. Analyze reactions in natural and

man-made energy systems." It covers "Environmental Science aspects" (grades 9 to 13): "Identify renewable and nonrenewable natural resources. Identify and describe ways that science and technology affect people's everyday lives. Design and conduct an environmental impact study analyze findings and justify recommendation." It covers "Earth and Space Science" (grades 9 to 12): "Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere producing winds." It covers "Physical Science, Conservation of Energy" (grades 5 to 8): "identify and compare sources of energy. Use Kinetic theory, wave theory, quantum theory and the laws of thermodynamics to explain energy transformations."

Goal and Audience

My goal with this hands-on exhibit is to demonstrate how Nature, wind in this case, can be used to produce energy, without depleting natural resources. I would like children to observe that wind could be used to create work or energy. I believe that direct experience is very important for children and they need it in order to be able to make better and easier connection with theoretical concepts that they learn in class, and I think this exhibit has potential in that sense. This hands-on exhibit, in my opinion, has causes and effects easy to be observed and understood.

The target of my audience I would suggest is 1-8 grades, even though I believe that visitors in general, from younger children to adults, would enjoy it.

Evaluation of the project

I did my evaluation at SciTech Hands-On Museum in Aurora, IL. I was able to test the exhibit with at least 25 children between five and eleven years old and a couple of adults.

Evaluation at SciTech Hands-On Museum Aurora, IL.

First of all children love it. More the one would use the word 'cool' or 'sweet' referring to the exhibit, but it was also very fulfilling the fact that they would make

important observations. They were able to distinguish the fact that the first fan (wind generator) made the second one (the turbine) spin, and that moving the handle closer or farther would affect the spinning speed of the turbine. The closer the turbine was to the generator, the faster this spun and vice versa. The main concern was that since the two fans look alike, children would not notice the difference. Children also made the connection that the wind would spin the turbine and then the turbine would light the two bulbs.

During the evaluation I also figured out ways that would improve the exhibit. I noticed that children did not understand right the way what they were supposed to do with the handle.

It was build from scrap wood and metal, and for a child it does not resemble a handle. I would need to change it with a 'real' one, and also it should be smoother to move, in fact, as it is now it has to be pushed hard, and some children feeling how hard it was to move thought they were trying in the wrong way.

Carina Eizmendi a museum staff member evaluates visitors interacting with the exhibit.

Another thing that I noticed is that at first children would not notice the two bulbs, but their attention would be caught by the effect of the air causing the other fan to spin caught their interest, depending on how distant was the fan they were controlling. A possible change is to put the bulbs at a higher position, in the way of children's sight and to use some kind of material that would reflect and make the light brighter. Another problem that I had is that the transformer would warm up too much and would stop spinning the first fan, so I need to use a transformer with a lower voltage, since the first motor is 4.8 watts, and the transformer is 12 watts. At the end of the evaluation I was very pleased because children loved the exhibit and loved to interact with it, and also two or three adults were intrigued by it.