Electric Wind Shock

New Mexico
Supercomputing Challenge
Final Report
April 3, 2013

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Executive Summary

This project is about coming up with an alternative source of electricity for Edgewood when we have a power outage or blackout. We have decided to use wind power to use wind power as an alternative energy source. Electricity created by wind turbines is a cleaner energy. It is better for our environment and if the right conditions are present it is very reliable. We plan on solving this problem by demonstrating it in Star logo. To learn more about generating electricity with wind turbines, we have visited a windmill farm. We will need to convert the electricity produced by the wind turbine into usable electricity for our town. The energy from a wind turbine is too much for one home. We have determined that for our town of 1,153 houses we will need 4 wind turbines. We have many blackouts and power outages and if we have wind turbines we hope they would prevent the power outages from occurring so frequently.

Introduction

Imagine waking up two hours late and missing an important meeting, or even waking up to a refrigerator full of rotten food! When we get power outages, in Edgewood, we lose many services like: lighting, heating, cooling, and alarm clocks. On October 15th, 2012 we had a power outage over night that lasted through the next day, which left hundreds in the dark. Power outages are a huge issue that we hope to solve by the technology of wind power. This technology will make Edgewood a greener place to live. It is greener; they do not pollute the Earth because the wind turbines are using natural resources. This will benefit everyone by decreasing our electric bills and using a renewable energy source. Edgewood has a huge problem with power outages and we think we have the solution.

Problem

Can we successfully create a computer model to simulate a wind turbine(s) to be our alternative energy source when we have a power outage? How many wind turbines do we need to generate electricity for our town? These are our two primary questions that our project will address.

Our first version of the model will demonstrate how much electricity can be generated by one wind turbine. We will add turbines to each model until our whole town is supplied with electricity when we have a power outage. We want to have a town that will always have electricity. We used Star Logo to simulate our project.

Background

What Is the Wind?

Wind is a mixture of cold and hot air. Air is in constant motion. It is affected by changes in pressure and temperature. When one area heats up more than another area that it is next to, the difference in pressure creates wind. Wind is a rotation cycle of cool air and warm air. Edgewood is very windy. It gets very little precipitation.

How can wind be measured?

Wind is measured by its speed and direction. An anemometer is the tool used to measure wind speed. An anemometer works by using rotating cups to measure wind speed. When the wind catches the cups it causes them to spin and the amount of times the cups rotate completely around is the wind speed measured in rpms (revolutions per minute). The wind direction is measured with weather vanes. It is important to know the direction of the wind because then the wind turbine has an area to turn towards. After a year of measuring the wind it can be correlated to a reference point to calculate the mean of the wind. This information is needed to find the best area to create a wind turbine farm that will be the most efficient. Wind turbines should be placed according to where the wind is blowing the most for the majority of the year.

The exact way to know wind speed is to use a meter. Here’s a quick guide:

Regular Box Fan on HI (3) Setting:

Distance	Wind Speed (m/s)
1 Foot	4—5
2 Feet	2.5—3.5
3 Feet	1.5—2

Regular Box Fan on MED (2) Setting:

Distance	Wind Speed (m/s)
1 Foot	3—3.5
2 Feet	2—2.5
3 Feet	1—2

Figure 1 Wind Speed Determination

Wind Turbine

A wind turbine transforms the kinetic energy of the wind into electrical energy. Wind turbines are made up of a foundation (where the wind turbine sits on the ground), a tower (the part where the rotor sits on), and a rotor (how the wind turbine moves to locate the wind), see figure 1. The foundation prevents the turbine from falling over. The tower holds up the rotor. The rotor includes the blades and the hub, which holds them in position as they turn. Most wind turbines have three blades. The length of the blades can be more than 44 meters.

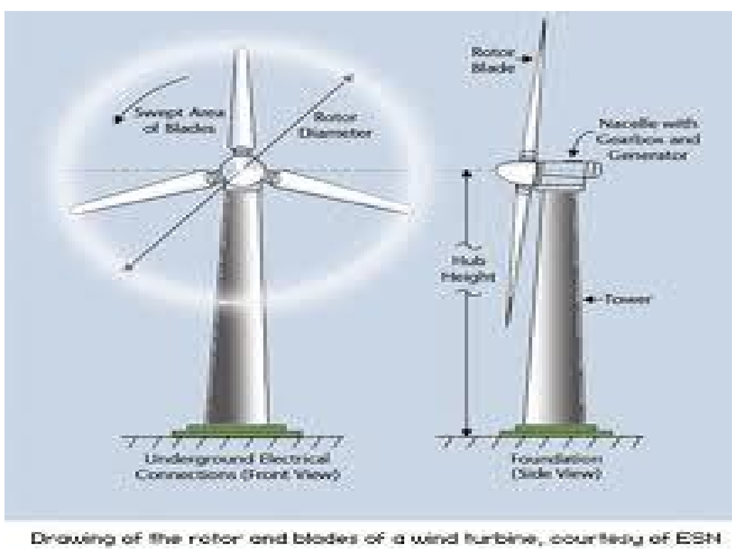


Figure 2 Diagram of a Wind Turbine http://blog.cafefoundation.org/?attachment_id=2742

Wind turbines don't create greenhouse emission during its operation. It takes just three to six months to make up for the energy needed to make that wind turbine.

During a windmills lifetime it makes up eighty to one hundred times the amount of energy used during its production. Wind energy has the lowest life cycle emissions of all energy making technology. Wind energy doesn't let out any toxic substances such as Mercury and air pollutants like smog-creating nitrogen oxides, acid rain-forming sulphur dioxide and particulate deposits. These pollutants can trigger cancer, heart disease, asthma and other respiratory diseases, and can acidify terrestrial and aquatic ecosystems, and can also corrode buildings. Wind energy doesn't create any radioactive waste or water pollution.

How is Electricity Transported?

When a gadget is turned on, power is right away transmitted from a power plant to the appliance. Even though this seems to happen immediately there is a certain sequence of events that takes place to make sure the needed electricity is delivered. Electricity travels long distances to reach the place where it is needed. The sites where electricity is generated are often in less populated areas where there are a lot of cheap fuel resources. During the transportation process, part of the electricity is lost. To reduce the amount of electricity lost a transformer will convert the electricity from low to high voltage. This is the more efficient way to transport large amounts of electricity. Transmission lines then transport large supplies of power from generating sites to locations closer to people's homes. At these locations, other station transformers convert the high voltage electricity to lower voltage for distribution. Distribution lines carry low voltage electricity to communities who then access it through the power outlets in homes and offices (see figure 2). The distribution network has more power lines than the transmission network. This is because transmission lines can carry a large amount of power that will then require many distribution lines to take to the people.

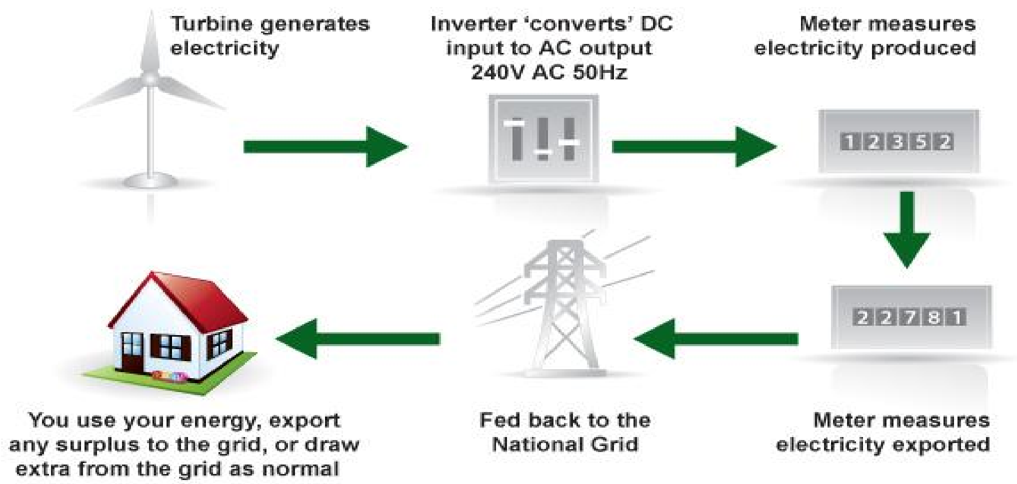


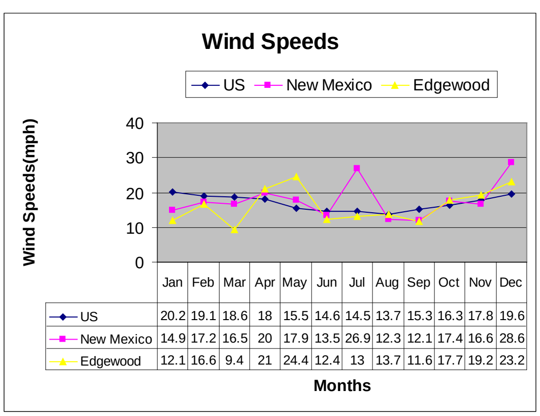
Figure 3 Wind Generating Diagram http://www.rotaryrenewables.co.uk/wind-turbines-for-home

Methods and Materials

For our programming we used Star Logo. We wanted to simulate what four different windmills would have recorded, and how much electricity was produced when these tests run. We wanted to plot out the minimal amount of energy to run the town of Edgewood, so we placed windmills diagonally across space land. The windmills are represented by houses, and the wind is represented by the circles. To incorporate real world situations we modified the terrain to be hilly and made the wind scatter, because wind does not always go straight. When a wind agent hit the windmill agent we converted that to be 1 windmill turn and then that was converted to the amount of electricity that was produced by that 1 turn. The amount of electricity produced per revolution is around 1.5kw. When you change the speed of wind it will slow down the windmill, which causes less electricity to be produced per day.

When the program is running, it creates a graph that plots out the amount of revolutions, electricity, and days. When the amount of electricity produced reaches around the number 16kw it begins a new day, because that is what the average amount of electricity produced each day is with a 1.5 Kilowatt Windmill.

With the wind procedure, it tells the wind to wiggle by setting the heading of the object to random 360. Next it tells the wind to move forward by the number of the speed of Wind which is controlled by the slider. It then sets the size of the ball to be 1 to be more visible. With the setup procedure it says to clear the map, and then it says to create 4 windmills in an array diagonally across the screen. After that, it creates 100 wind characters, and then it scatters the wind. Then it resets the variables. With the collision procedure it makes it so that when wind collides with the windmills it places the wind randomly around the screen, this makes it so that there is constant amount of wind. Then it says if the wind is above 45 mph then it will not increase the amount of electricity, but if it's below 45 it registers as 1. To verify our program we compared the results of our program to graphs taken from the national wind surveys, and they were very close graphs in the amount of energy that was produced per day, and when we changed the variables.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
US	20.2	19.1	18.6	18	15.5	14.6	14.5	13.7	15.3	16.3	17.8	19.6
New Mexico	14.9	17.2	16.5	20	17.9	13.5	26.9	12.3	12.1	17.4	16.6	28.6
Edgewood	12.1	16.6	9.4	21	24.4	12.4	13	13.7	11.6	17.7	19.2	23.2

Figure 4 Edgewood average monthly wind speed

Figures 5,6,7,8 StarLogo Programming code and spaceland

Results

We will need four wind turbines to generate electricity to generate our town and we successfully created a computer model to simulate four wind turbines to be our energy source. However after doing research we found that energy created from wind turbines are transported to transfer stations and used immediately. Right now there is no technology to store the produced electricity. It is use it or lose it. Currently there are studies going on to create the technology to store the electricity created by wind turbines. So even though it is possible to power our town with the use of wind power it is not practical to be used as an alternative backup power source because the energy cannot be stored for later date.

Discussion

We have studied windmills because we have many power outages and we want that to change. Wind turbines turn to the direction of the wind. We have traveled to a wind turbine farm in New Mexico to study windmills and have gone on field trips to learn about different types of energy sources. One other energy source we have researched is solar energy. It is environmentally friendly. Individual people currently use solar energy to provide electricity for their home. With wind turbines you have to convert the energy before it goes to your home.

Conclusion

Our solution for Edgewood's power outages was to use a backup energy source created by wind turbines. We have learned that wind turbines are a big energy alternative for the world. Edgewood has enough sustainable wind for a wind farm, however right now there is no technology to actually store the power created. Wind turbines capture the winds power and immediately it is converted to electricity.   Wind energy is very useful because its eco-friendly. We have also learned that windmills are very expensive to install and repair at the commercial level, which is what would be needed to power an entire town. Wind Turbines are a greener way to produce electricity and Edgewood has enough sustainable wind to support a wind farm however until the technology is created to store the energy it would not be a reliable source of electricity for power outages in our town.

Future Plans

In the future we plan on finding the technology to store energy. Denmark is currently trying to create this kind of technology. When Denmark creates this technology we are going to evolve in our project. Denmark is creating the biggest wind turbine ever created. This wind turbine is going to be three times the size of the windmill that we saw. We are looking into adding solar panels to our project. They take up more space but they are more cost efficient.

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Acknowledgements

We would like to thank our mentors, Christopher Alme, Jennifer Cordova, Darren Duvall, and Casey Halloway. Christopher for helping us at the beginning of our project narrowing our idea down and getting us on the right track. Jennifer Cordova for helping us complete our project and sponsoring us. Darren Duvall and Casey Halloway from Aragonne Mesa Wind Farm for the tour of the wind farm, for all the good information, and for answering all our questions.