Bringing Wind Power to Monmouth College

The Green Initiatives Class
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Over the past few decades, our society has become more conscious of its choices, as well as the impact that our choices have on the environment. Wind power has become a more prevalent means of providing electricity around the world because of our new consciousness. According to Nijhuis (2006), this consciousness has caused a fascination with wind power: “While wind currently provides less than one percent of the country’s total energy needs, states are looking to increase their supplies of renewable energy, helping to make wind the nation’s second fastest growing source of electricity” (p. 2) As communities, large corporations, colleges, counties, and states further their knowledge about wind power, they are finding that it is a valuable source of electricity.

The ongoing search for renewable energy sources stems from one of the most serious issues the world’s population faces. The burning of fossil fuels for energy is problematic for two main reasons. The first problem is that fossil fuels emit large amounts of pollutants into our atmosphere, and the second is that fossil fuels are a non-renewable source of energy. The energy that we use in our households comes primarily from coal, natural gas, gasoline, crude oil, E-85 gasoline, and diesel fuel. All of these non-renewable resources are contributing to air pollution, and according to the American Wind Energy Association (2007):

> In 1997, US power plants emitted 70% of the sulfur dioxide, 34% of carbon dioxide, 33% of nitrogen oxides, 28% of particulate matter, and 23% of toxic heavy metals released into our nation’s environment, mostly the air. These figures are currently increasing in spite of efforts to roll back air pollution through the federal Clean Air Act. (¶ 3)

In 1963, the United States Environmental Protection Agency (EPA) enacted the Clean Air Act. This law provides for the study and reduction of air pollution, as well as the setting and enforcing of air quality standards. Although the EPA enforces the Clean Air Act, air quality is not improving in certain areas. According to the National Emissions Inventory (2007) (See Figure 1), the emissions of carbon monoxide from burning coal and other fossil fuels to produce electricity has grown from 408 short tons in 1996 to 677 short tons in 2006. One short ton equals 6.55 barrels of crude oil. Having 677 short tons of carbon monoxide contributing to air pollution is equivalent to having 4,502.05 barrels of crude oil spilled into the environment. Carbon monoxide, sulfur dioxide, carbon dioxide, nitrogen oxides, toxic heavy metals, and various other pollutants are being put into our atmosphere. This can cause environmental issues such as acid rain, green house effect, and heath problems like cancer. While government agencies and groups have been working hard to reduce and eliminate the amounts of pollutants emitted into the environment, there are still many improvements to be made.

The government, however, is not the only group looking at the possibility of wind energy as a renewable source of energy. Students, grade school through college, have looked at the possibility of using wind energy to improve their communities. As a matter of a fact, several grade schools and high schools around the Monmouth, Illinois area have participated in a comprehensive study of wind powered turbines and their benefits for the schools. In 2004, a total of nine schools used a service called Virtual Towers by True Wind (Slaymaker, 2006). This study looked at the possibility of three different turbines: a 10 kilowatt, 600 kilowatt, and 900 kilowatt. The study of the turbines compared the monetary value saved by using wind power rather than other energy sources against the overall cost of the turbine factoring in insurance, tax, repairs, and debt payment for the turbine (See Table 1, Slaymaker, 2006). It is important to take into account that these values for savings and tax are extrapolated for twenty years. Several parameters were used to determine a total net cash amount per year. These parameters included the average energy cost per kilowatt hour, average wind, and purchase rate after selling to the grid, with other parameters also affecting the net cash amount. Out of these nine schools and towns, only three of the simulations were found to have positive average net cash. This net cash ranged from $9,000 to $27,000 a year. The other six towns had a negative net cash ranging from -$9,000 to -$50,000. The towns that experienced positive net cash were the communities that had larger wind speeds and larger cost for energy when compared to Monmouth.

The problem of rising energy costs is something that colleges have not been able to ignore, and these institutions have begun to turn to wind power as a solution. According to Blumenstyk (2006), colleges like the University of Maryland have now begun to require a surcharge from students to cover rising heating costs in the winter. In addition, Blumenstyk (2006) states that other colleges have begun to alter their academic year to have breaks during the coldest and warmest parts of the year to cut down on energy costs. Because of this adjustment, many colleges have begun production of their own wind turbines, or begun to purchase wind power from other local wind farms. As recorded by Cramer (2007), Grinnell College (Iowa) is in the process of purchasing three large wind turbines that will provide on average 44% of the college’s energy use with increased production during the winter months. The college tested the possibility of wind power with one small turbine off campus that powers a biology research building. As a result of this experiment, it was decided that it would be an excellent option for the rest of campus. The wind turbines will be built approximately 3 miles north of campus and Grinnell has made the decision that the power will be used only for their campus. They anticipate that the project will pay for itself in a total of fourteen years. Carlton College in Minnesota also has one large turbine used to power parts of their campus. According to Carlson (2004), the turbine was built just off campus and produces enough energy to power 400-800 homes. The turbine amounts to forty percent of the college's energy bill and is on track to paying for itself in ten years. The college is also pleased with the positive image of actively taking part and encouraging others to join in the renewable energy movement.

It is clear that local students and liberal art colleges have the capacity to address the problems that come with the burning of fossil fuels for energy. So what could we as seniors at Monmouth College do to address the issue? By further research of wind turbines, we agree that wind as a renewable source of clean energy is something that we must try to implement as a part of our own energy consumption. However, our path to realizing this goal would take intensive and in-depth research. In the end, we were able to come up with two distinct paths that would lead us to a "greener" campus. We believe that the two best ways for Monmouth College to implement wind energy as a part of our campus would be either to construct our own wind farm on privately owned property or to co-op with the Warren County wind farm that is currently underway.

There is hope in renewable resources, and wind farms have the capacity to power entire towns without sending pollutants into the environment. Wind power provides many solutions to several serious environmental issues. According to Figure 2, wind power usage has increased exponential and between 1995 and 2005 at an annual rate of roughly 18% (WorldWatch 2005). Wind power is incredibly effective, and because of its ability to provide power without damaging the environment, its use has continued to grow.

The cost of using fossil fuels and other finite resources has increased due to decreasing availability; therefore, the use of wind power as a primary energy source has steadily increased. There is some variation in data projecting the cost of energy for the next twenty to thirty years. According to Ramlow and Nusz (2006), the cost of natural gas has increased 7.54 percent over the past thirty years; since the supplies of our nonrenewable resources are decreasing the cost is continuing to increase faster. For this reason, natural gas is expected to increase by 15-20 percent over the next thirty years. Although the cost of coal is remaining relatively stable, it is expected to increase due to transportation cost and other factors. Therefore, according to the United Kingdom Dept. for Business, Enterprise and Regulatory Reform (BERR, 2007), the cost of electricity is expected to increase. Table 2 illustrates a low case of an 8% increase to a high case of a 26% increase between the years of 2005 to 2010. It is difficult to predict the cost of electricity for the next 30 years; however, Figure 3 shows that the energy costs overall are increasing each year (Energy Information Administration, 2000). According to the figure, the cost is increasing 0.5% annually. As researchers continue to explore more efficient and environmental friendly options for energy the cost of renewable energy decreases. According to Flavin and Lenssen (1991), wind energy is becoming more popular and its cost has decreased 75% over the past decade. Figure 4 illustrates this initial reduction and it is projected to continue decreasing, but at a slower rate (U.S. Dept. of Energy, 2005).

Wind turbines are instrumental in decreasing energy costs, and they accomplish this with a relatively simple process. Typical wind turbines consist of three blades resembling airplane wings arranged on a central hub sitting atop a tower. The hub turns a driveshaft which powers dynamo-housed nacelles. The nacelle is free to pivot about the tower, keeping the assembly aligned with the wind direction. According to Halliday, Resnick, and Walker (2005), rotation of the driveshaft creates a current which is altered by a transformer to be compatible for either the existing power grid or for direct use. It is important to note that while wind turbines are referred to with a certain wattage, such as 1.5 megawatts, that is not their expected output. Naming of wind turbines is based upon the maximum output of the dynamo; very rarely will the wind provide the necessary energy to allow the dynamo to produce at maximum capacity. Wind speed determines output for a given turbine. According to a 2001 Illinois Wind Resource map provided by the U.S. Department of Energy National Renewable Energy Laboratory, Monmouth's average wind speed is approximately 6m/s. This would produce approximately 3.5 million kilowatt-hours annually on a General Electric 2.5 MW turbine. A watt hour is a unit of energy relating wattage (power) with time. A watt hour is the amount of energy expended in an hour at a power output of one watt (joules/second). In the average household, a water heater uses 2,671 kilowatt-hours annually.

Wind power has the potential to produce enough energy to provide the majority of the country's electricity. The wind farms in the United States are potentially capable of producing enough energy to meet the demands of the nation. Pasqualetti (2000) states that "North Dakota alone has enough wind energy at class 4 and above (6m/sec) to supply 36 percent of the electricity used in the lower forty-eight states" (p. 387-388).

North Dakota's ability to produce wind powered energy is only a snapshot. It clearly illustrates that were more states to utilize wind farms, the amount of energy produced would decrease the need for fossil fuels and other finite resources.

Although wind turbines are an increasingly popular means of generating energy, there are some negative aspects to using them. These aspects include bird and bat deaths, construction costs, and changes in the landscape. Although, wind turbines are becoming a popular means of energy production, there are still some individuals and communities that believe them to be an eye sore. According to Pasqualetti (2000), "land-use competition is the core argument for those who consider wind power the rotten apple on the alternative energy tree" (p. 390). Pasqualetti points out that people are not aware that even though wind turbines are large structures, they do not require a large amount of space. In fact, wind turbines require approximately 380 square feet for the base of the structure. Pasqualetti (2000) further states that, "scaling that [380 square feet] up by 400,000 that just six square miles of land could house the bases for all the windmills needed to banish coal, oil, and gas from the U.S. electricity sector" (p. 87). Many people do believe that wind turbines are a cumbersome structure; however, the amount of land that is necessary for an individual wind turbine is negligible, thus disproving this argument.

Another concern in opposition to building wind farms is the welfare of birds, bats, and other winged animals. For example, Pasqualetti (2000) points out that "As many as 2,000 bats were hacked to death at one 44-turbine installation in West Virginia" (p. 88). However, there are solutions to this issue. One solution is using longer blades on the wind turbines. Longer blades turn at a slower rate; therefore killing fewer flying animals.

In the past, the base of the wind turbine was an open skeleton, or shell. The shell held the motor and other parts necessary to wind energy production; however, birds were often caught and trapped in the bases. More recent models have closed bases that do not have any openings allowing for winged animals to be caught, injured, or killed. Fatalities to birds and bats will continue to occur; however, these solutions will cause a decrease in this number. Another important piece of information to note when considering bird and bat mortality is that wind turbines account for less than one death per 10,000 deaths whereas skyscrapers account for roughly 5,500 of the 10,000 deaths (Skystream 2007, Figure 5).

A small change to the landscape of our towns is a small price to pay, as we are consumers of energy, and therefore, we have a responsibility to the environment and the planet's other inhabitants. According to Pasqualetti (2000), the more steps there are between the production of the energy source and its destination, the consumer, the more detached people become. Because a large part of the population is unaware of where their energy comes from, the negative impact on the environment is not an issue to them. Unlike other forms of energy, Pasqualetti (2000) states that wind turbines:

> "Produce no global warming, flood no canyons, demand no water, do not contaminate soil, and leave no permanent and dangerous waste. They can be installed and removed quickly; they are well suited to isolated, off-grid locations; and the cost of the electricity they produce is now comparable with that from conventional sources." (p. 382)

The positive impact of wind power on the earth cannot be ignored. In comparison to other sources of electricity, Pasqualetti (2000) states that:

> "Approximately three-fourths of U.S. electricity is generated by burning coal, oil, or natural gas. Accordingly, switching that same portion of U.S. electricity generation to non polluting sources such as wind turbines, would eliminate 38% of the country's CO_2 emissions." (p. 87)

The most notable difference between conventional energy sources and wind energy is that energy created by wind turbines does not generate the pollutants that other sources of electricity produce. The toxic materials resulting from conventional energy sources play a significant role in concerns regarding global warming and other environmental issues.

Although some negative aspects exist when considering wind power, it also has many benefits. Because the benefits outweigh the disadvantages in our eyes, we believe that we need to take a course of action that will lead Monmouth College to utilizing the wind as a primary energy source. There are two main options for implementing the wind power project for Monmouth College. The first option is to use land that is owned by Monmouth College, and the alternative is to utilize the county farm co-op in progress by Warren County.

Our first option is to use the land owned by Monmouth College to construct and utilize a wind turbine to provide some or all of the power necessary to fulfill Monmouth College's individual needs. This land is located southwest of Monmouth College, approximately four miles west of the county farm and is approximately seven miles from Monmouth College. According to Don Gladfelter, Vice President for Finance and Business at Monmouth College, these plots of land are located in the same wind path (D. Gladfelter, personal communications, September 17 2007). The amount of wind that travels through the 490 acres owned by Monmouth College is comparable to the land owned by the Warren County farm.

In order to put a wind farm on Monmouth College property, the college would be responsible for several things: purchasing the turbine(s), paying the employees that maintain the turbines and the land, and for building the wind turbines. Using this site would provide several jobs in the area. According to Jolene Willis, the executive Director of Western Illinois Economic Development Partnership, there is one direct job (i.e. people who monitor and maintain the turbines) and one indirect job (i.e. people who had a temporary role in helping to build the turbines) for every megawatt in a turbine (J. Willis, personal communication, October 24, 2007). For example, a 2.5 mw turbine would provide for up to five jobs.

The land owned by Monmouth College has many zoning requirements (Willis, personal communication, October 24, 2007) to fulfill according to the requirements of Warren County before it can be used by wind turbines. To acquire turbines exclusively for Monmouth College, there are several issues that need to be considered. There are several companies that sell wind turbines; however, the company and brand the county will be using (the Clipper Liberty wind turbine) does prefer orders of 8 to 10 wind turbines. If the order is for less than eight wind turbines, the time it will take for the order to be filled will increase significantly. Currently, the time schools, companies, and communities must wait for an order for wind turbines is approximately three years. To utilize turbines on land owned by Monmouth College, employees will have to be hired to maintain and construct the turbines. This will create many jobs for Monmouth residents needing a job or extra money. Also, the college will have to supply the workers with the necessary machinery.

According to Warren County zoning requirements (Reichow 2006), Monmouth College will have to specifically space the turbines next to each other with 200 feet in between from tip to tip. Wind turbines must also be built outside of city limits, where there are no buildings, major roads, or power lines. Since Monmouth College would be doing this on its own, the grid that powers the school may have to be updated into its own individual grid so that the power from the turbines directly creates energy for the school. This is contingent on whether or not the grid is capable of transporting the amount of energy necessary to power Monmouth College. The alternative to installing lines directly to Monmouth College is to pipe the power through the nearest substation, which is near the county farm; in fact, the county's proposed wind farm will use that particular substation. It is also possible that no upgrades will have to be made to grids whatsoever, because they can already maintain the amount of power the college requires under the power company Monmouth College uses for their electricity. Because Monmouth College will not be relying on anyone else for their energy, a back up plan will be needed in the event that there are power outages. If this occurs, the school will receive power from the grid powered by Ameren or McDonough Power. Buying power from the power companies will be extremely expensive. This can be seen simply by noting the increase in power costs to 8 cents per kilowatt hour after the contract with the power companies expires.

Wind farms are a controversial undertaking, because the initial cost for building one is high. Rollins (2007) explains that "On average, wind power development costs around $1 million per megawatt of generating capacity installed" (p.43). Though costs can seem difficult to justify during the construction phase of wind farm development, the actual production of electricity incurs minimal costs. The construction of wind farms begins as a costly endeavor; however, the results in the long run have the potential to exceed the costs.

There are several organizations that allocate funds to individual groups or bodies to construct clean energy and energy efficient projects. One of these organizations is the Illinois Clean Energy Community Foundation. This organization exists primarily to "improve energy efficiency, advance the development of renewable energy resources and protect natural areas for people in communities all across Illinois" (Summary of Foundation Grants, 2006). Through July of 2006, the Illinois Clean Energy Community Foundation had allocated nearly $13,765,000 in grants for 121 renewable energy projects. Of the 121 grants, 27 were given for wind energy projects; the total grants allocated for wind energy was roughly $9,000,000 (Summary of Foundation Grants,2006). The size of the grants that are available from this organization varies by case, but by researching the grant history, it can be determined that the size of grants ranges from as little as $5,000 to as much as $2,000,000. As Monmouth College is an entity of Illinois that serves its citizens, it should be eligible for one of these grants.

The Internal Revenue Service announced (Envir. Law and Policy Center, 2006) that it would offer Clean Renewable Energy Bonds for "clean energy" projects. The Clean Renewable Energy Bonds are essentially interest free loans that would need to be paid back to the government and the size of these bonds range between $23,000 and

$3,200,000. If the college could secure one of these bonds, it would help to offset the cost of the project.

In general, the price for the turbine found in the studies (900 kilowatt) results in a purchasing price of about two million dollars. There are several fees such as operation and maintenance, insurance, property tax, and repairs that should be considered. Overall, these expenses are estimated to be approximately $37,000 (Lorax Energy Systems, 2006); however, this repair cost is does not take into account the need for major repairs. A smaller wind turbine of 20 kilowatts could be purchased for $100,000 (Jacobs Wind Energy). The amount of power produced, as well as the resulting costs would differ greatly due to the small size of the wind turbine.

There are many requirements for the zoning of a wind farm, according to Warren County ordinances. Zoning requirements include: all turbines must be 1,000 feet from any occupied building on any adjoining property and 1.1 times the total height of the wind turbine from its foot to the tip on the blade away from any occupied building on the subject or adjoining property (Reichow 2006). All wind energy systems must be separated one from the other by 200 feet when measured from the tip of the longest blade of each wind energy system to the other when said blades are at a right angle to the vertical and pointing at each other. There must be a minimum clearance distance of 25 feet from the tip of the longest blade when said blade is closest to the ground. Maximum total height of structure is 500 feet. A six-foot wire mesh security fence or locked barrier is required to surround the structure. The minimum lighting requirement that causes the least visual disturbance needs to be used. All wind energy systems must be of monopole, or freestanding, construction. Freestanding structures are supported by their base and pole. A wind energy system may be guyed if the proponent of the wind energy system is able to establish by a preponderance of the evidence that without guys, it is impracticable to construct the system. All electrical wires are to be underground unless necessary to connect a wind turbine to its base or to overhead collection lines unless a variance is granted at the same time the special use is granted. The exterior surface of any visible components of a wind energy system shall be a non-reflective and neutral color. Wind farm structures cannot be used for advertising, with the exception of the turbine's company brand and other warning signs. The owner of a wind energy system is required to provide the Zoning Administrator with a Written Notice of Termination of Operations if the operation of a wind energy system is halted for any reason.

Our second option for implementing wind power for Monmouth College is through the county farm co-op proposed by Warren County. According to our interview with Jolene Willis, there are no other investors involved in the wind farm for Warren County (J. Willis, personal communication, October 24 2007). The county farm is located south of Monmouth College on land owned by Warren County. The county farm consists of 186 acres. The County Farm is planning on placing three Clipper Liberty Turbines on the actual site of the County Farm. However, there will be a total of 8-10 turbines to power Warren County. The county plans on placing the other 6-7 turbines individually throughout the county, most likely on privately owned land (J. Willis, personal communication, October 24 2007). This is due to zoning regulations, which require certain amounts of space between turbines and other entities such as roads, buildings, power lines, and other turbines. The wind path of the Country Farm is directly in the path of a naturally occurring wind line, which would make this property a feasible site for wind turbines. The type of turbine to be used by County Farm is a product of the Clipper company called the Liberty. The Liberty is 440 feet tall and 2.5 megawatts (J. Willis, personal communication, October 24 2007).

As a whole, there are relatively few steps remaining in getting the Warren County wind farm up and operational. First, the developers pay the upfront costs associated with reviewing and upgrading the power grid; this step includes the costs incurred by the upgrades needed for the McDonough substation located on the county farm property. Simultaneously, Clean Energy Concepts will be monitoring wind speeds at the site in order to validate their wind speed estimates. As of October 20, 2007, a meteorological (met) tower was erected on location, and although developers usually allow for a year to validate wind speeds, Willis, personal communication, October 24, 2007 has reported that Clean Energy Concepts will be validating for even less time because of their confidence in the usefulness and value of the county farm location. Eventually the turbines themselves will arrive. After construction and initial setup, the turbines should be operational by January of 2010.

If Monmouth College teamed up with the county farm project, it would not be held responsible for any construction of the turbines being built (J. Willis, personal communication, October 24, 2007). With that said, the Liberty turbines are required to have monthly check-ups. In order to fix/check a turbine, up to three cranes along with a mechanical engineer for each crane are required. To maintain the entire wind farm, 20 full time jobs would be required to keep the wind farm up and running. Monmouth College would not be held responsible for any of these extra costs in maintaining a wind turbine. No initial investment would be required for Monmouth College; it would only be responsible for paying for power out of the grid (J. Willis, personal communication, October 24, 2007). According to Don Gladfelter, the County Farm team has offered Monmouth College a contract for paying through the grid for the next 20 years at a fixed rate of 5.5 cents per kilowatt hour.

When discussing the possibility of becoming part of the Warren County wind farm, there are several things to consider. First, the county wind project has been in progress since the spring of 2005 (J. Willis, personal communication, October 24 2007). This means that the turbines slated for construction on the county land have already been purchased and are scheduled to be delivered, constructed, and operational by January 2010. In this manner, it is easy to see that the waiting period (generally 3 years or longer) and the minimum order (at least 10 turbines) expected of new turbine orders could be avoided by collaborating with the county project that's already in motion (J. Willis, personal communication, October 24 2007).

In addition, if Monmouth College decided to cooperate with the Warren County wind initiative, it would eliminate the hassle of needing to hire construction crews to erect the turbines. According to Willis, this can be a great benefit in and of itself. She notes that a total of three different sizes of cranes are needed in the construction of new turbines. Since these machines are so vital to the erection of turbines, and since wind farm construction is in high demand, she claims that some crane operators can demand $50,000 per day for their services. Construction costs and liabilities would be the responsibility of the developers, not Monmouth College.

Perhaps one of the most crucial points to consider when understanding the Warren County wind farm project is that the land on which the turbines are to be placed is located in the exact site of the McDonough Power Cooperative's distribution grid. In fact, the McDonough Power substation, which will be receiving the power produced by the turbines and adjusting its voltage for insertion into the power grid, is actually located on the county farm. This means that getting power from the turbines into the power grid is a relatively simple process. According to Steve Epperson, President and CEO of the McDonough Power Cooperative, were the turbines a great distance from this substation (as would be the case with building upon Monmouth College's land southwest of the county wind farm), miles of special lines would have to be laid in order to connect the college's wind farm back to the substation. The substation on the county farm will need to be upgraded nearly 300%. This refers to the grid's ability to transport power. In other words, the wires and other materials must be updated to withstand the amount of power being transported. To operate with the new turbines in place, its location makes the county's wind farm site invaluable (J. Willis, personal communication, October 24 2007).

Global warming is a prominent issue in today's society. Combine the rising prices of energy consumption with the issue of global warming, and it is obvious that the way energy is produced and consumed needs to be addressed. Monmouth College consumes approximately 7.5 million kilowatt hours for its utilities, which is about 90 percent of Monmouth College's energy use (D. Gladfelter, personal communication, September 17, 2007). Monmouth College has transitioned from purchasing its utility energy from AmerenIP to purchasing its energy from Constellation. Although this has saved the college money, energy is still costing an average of six cents per kilowatt hour. The six cents is calculated by averaging our off peak hourly rate of 4.187 cents to the on peak hourly rate of 7.269 cents. Monmouth College has the highest demand for energy in

September and October; however, we can also see that June and July have our lowest energy demands. September demands about 6,500KW and October demands 6,636.89 KW while June demands 2223.4 KW and July demands 2128.3KW. There are also extra charges such as meter, delivery, transformation, and reactive charges. Some of these charges are fixed rates, while others can vary by up to$1,000. When our contract with our current energy supplier expires in December of 2008, these charges will increase. In an interview with Don Gladfelter, it was mentioned that he can foresee MC paying an average of 8 cents per kilowatt hour.

After accumulating information on wind energy, we were interested in finding out what other Monmouth College students knew about wind energy and how they would feel about our campus utilizing this renewable energy source. Two hundred and eighteen students were polled on their interest in bringing wind power to Monmouth College in light of the benefits and disadvantages. The participants were selected through the Integrated Studies classes to ensure certain numbers of freshmen (61), sophomores (60), juniors (52), and seniors (45), with permission from each professor.

Each participant was given a short eleven question survey handed out in class for them to complete on the topic of wind power. The survey contained questions on the participants prior knowledge, ranked on a scale from 1 *I know very Little* to 7 *I know very much* as the first part of the survey. There was then a short passage explaining wind power, and the remaining questions asked if they think wind power was a positive solution despite possible downfalls and benefits on the scale 1 *I strongly Agree* to 7 *I strongly Disagree.* (See Appendix)

The first question about the knowledge of wind power (*M* = 3.1, *SD* = 1.5), showing that students are not educated on wind power. Based on their current knowledge they viewed wind power positively and most did (*M* = 3.4, *SD* = 1.4). Weighing the pros and cons with students, they were generally neutral on having wind turbines on campus even if they presented a noise concern (*M* = 4.1, *SD* = 1.5). Having the turbines off campus generated the least amount of complaints (*M* = 2.8, *SD* = 1.5). If turbines were off campus but brought complaints from near by residents (*M* = 3.7, *SD* = 1.4), students seemed less concerned. Students were however more likely to disagree with wind power if the project would raise their tuition (*M* = 4.9, *SD* = 1.6), and slightly more neutral if the project would raise their tuition, but lower tuition for others in the future (*M* = 4.3, *SD* = 1.7). However, this question did have the highest standard deviation, showing that this was also the question students were most divided on (See Figure 7).

For the most part students did lean on the neutral side of the issue creating little significance for their feelings in either direction of the issue, except for believing that wind power was a positive thing when causing the least amount of complaints. This could be due to the fact that students are not educated on the subject and due to this do not know their true feelings on the matter. With more campus knowledge, the results to this survey would most likely change from being this neutral.

We feel that the lack of interest or knowledge of Monmouth College students about wind energy is alarming. The issues surrounding pollution from the burning of fossil fuels is a serious problem that the United States and the rest of the world faces. Our generation is going to make huge impacts on the future of our environment through our choices, which is why we feel that it is imperative that Monmouth College join up with the Warren County wind farm. We feel that building our own wind farm maybe something worth investing in at a later date, but for now joining the county's efforts will produce immediate results. Not only will this decision help the college save money on energy expenses, but it will also leave less of an impact on the environment. In addition, it will also help to inform the students that the energy problem is something that the college is willing to take a stand on and may even influence future Monmouth alumni to be more conscious about their energy consumption.

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Appendix

On the scale below, how much do you know about wind power, both about its pros and cons?

1	2	3	4	5	6	7
I know very Little						I know very much

With this information do you believe it is a positive solution to the current energy crisis?

1	2	3	4	5	6	7
Yes I do						No I don't

Wind power is becoming an increasingly popular method of energy production. Though there are a number of benefits to wind power, there are also negative implications, which must be considered when planning to construct a wind farm. Fortunately, wind turbines do not produce global warming, do not demand water, do not contaminate soil, are suitable for isolated locations, and the cost to operate turbines are comparable to conventional sources. However, wind turbines are seen by some individuals as an eye-sore and viewed as a nuisance because of the rapid winds they produce and because they take up a large amount of space as well. Consider these arguments when answering the following questions:

Gender: M F

Year in School: FR SO JR SR

Major:___________________

Please circle the number that corresponds to how you feel about the following questions based on whether you believe it would be a positive or negative thing for Monmouth College to switch to wind power.

I believe that it would be a positive thing for Monmouth College to switch to wind power, Even if the wind turbine site was on campus and raised a noise concern.

1	2	3	4	5	6	7
I strongly Agree						I strongly Disagree

I believe that it would be a positive thing for Monmouth College to switch to wind power, if the wind turbine site was off campus and caused the least amount of problems as possible.

1 2 3 4 5 6 7
I strongly Agree I strongly Disagree

I believe that it would be a positive thing for Monmouth College to switch to wind power, Even if the wind turbine site was off campus, but there were some complaints from the near by residents.

1 2 3 4 5 6 7
I strongly Agree I strongly Disagree

I believe that it would be a positive thing for Monmouth College to switch to wind power, Even if the project raised my tuition.

1 2 3 4 5 6 7
I strongly Agree I strongly Disagree

I believe that it would be a positive thing for Monmouth College to switch to wind power, Even if the project raised my tuition, but would lower tuition for future Monmouth College students.

1 2 3 4 5 6 7
I strongly Agree I strongly Disagree

How much would be too much for a raise in your tuition?

_____ 50 dollars

_____ 100 dollars

_____ 200 dollars

_____ 300 dollars

_____ 400 dollars

Table 1

Summary of Statistics from the 2004 Virtual Towers Survey

Town	**Energy cost (cents)**	**Average Wind speed (mph)**	**Best Turbine choice kW**	**Energy purchase rate ($/kWhr)**	**Cost of Turbine ($)**	**Average Net Cash ($)**
Roseville	**8.0**	**8.7**	**900**	**.055**	**1,795,500**	**8,863.90**
Macomb	**3.7**	**7.05**	**900**	**.048**	**1,795,500**	**-21,453.55**
Avon	*****	**7.09**	**900**	**.054**	**1,795,500**	**-9,269.40**
Cuba	*****	**7.07**	**900**	**.046**	**1,795,500**	**-25,608.90**
Galesburg	**6.08**	**7.08**	**900**	**.07**	**1,795,500**	**26,988.25**
West Central	*****	*****	**600**	**.052**	**1,496,000**	**-50,000**
Hamilton	**2.7**	**4.7**	**900**	**.044**	**1,795,500**	**-30,786.15**
Abingdon	*****	*****	**900**	**.086**	**1,795,500**	**23,324.10**
Nauvoo	**3.7**	**7.92**	**900**	**.053**	**1,795,500**	**-21,228.15**

*** These amounts were not disclosed**

Figure #: This figure is a Conclusion of specific values used in the calculation of the Average Net Cash found at the end of the year after changing to wind powered energy of the Virtual Towers survey of 9 schools around the Monmouth area.

Slaymaker (2006)

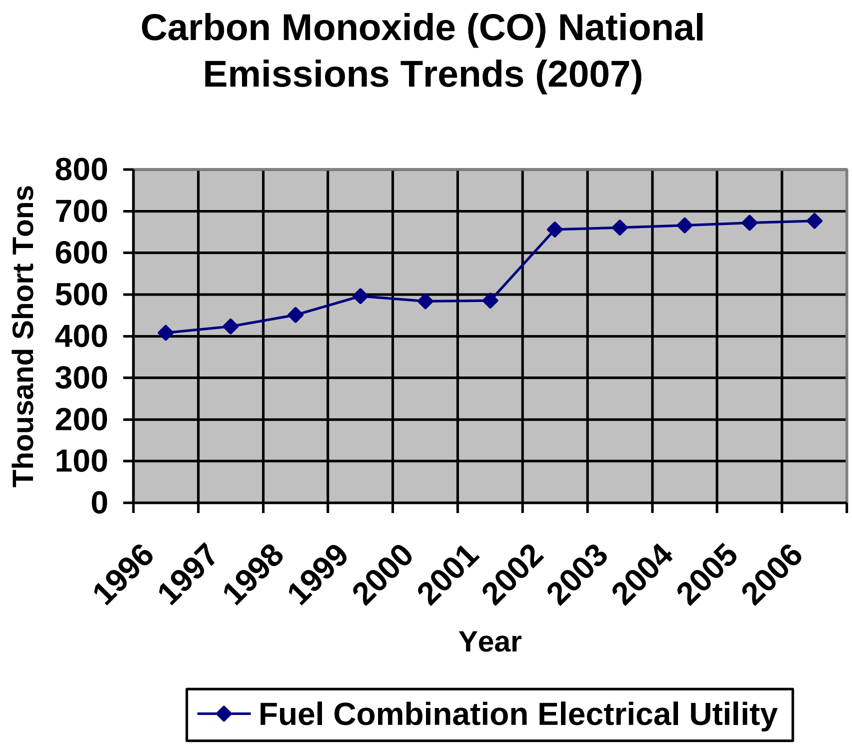
Table 2

Table 3 – Changes in electricity prices between 2003 and 2010, and 2005 and 2010

	Change between 2003 and 2010	Change between 2005 and 2010
Low case	+14%	+8%
Base case	+18%	+10%
High case	+36%	+26%

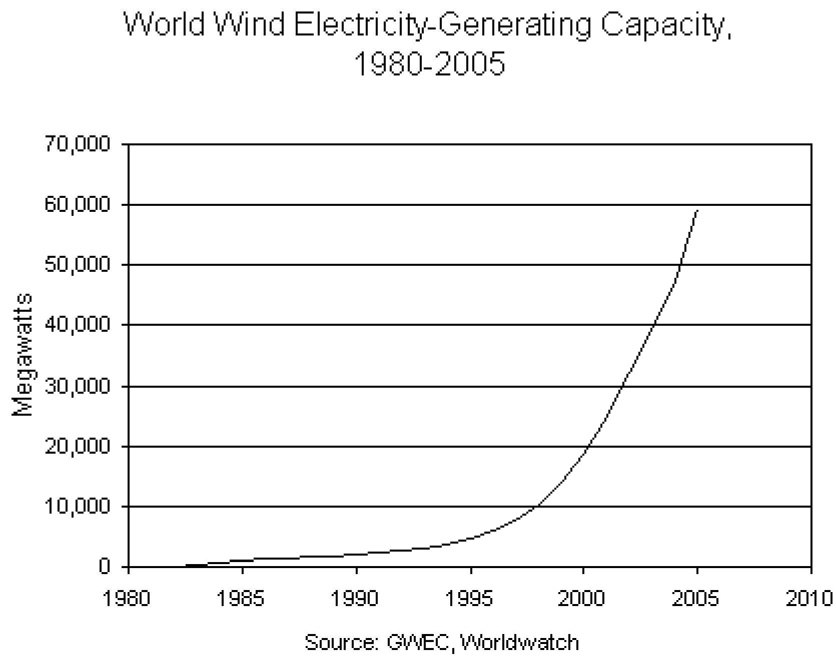
United Kingdom Department for Business, Enterprise and Regulatory Reform (2007)

Figure 1



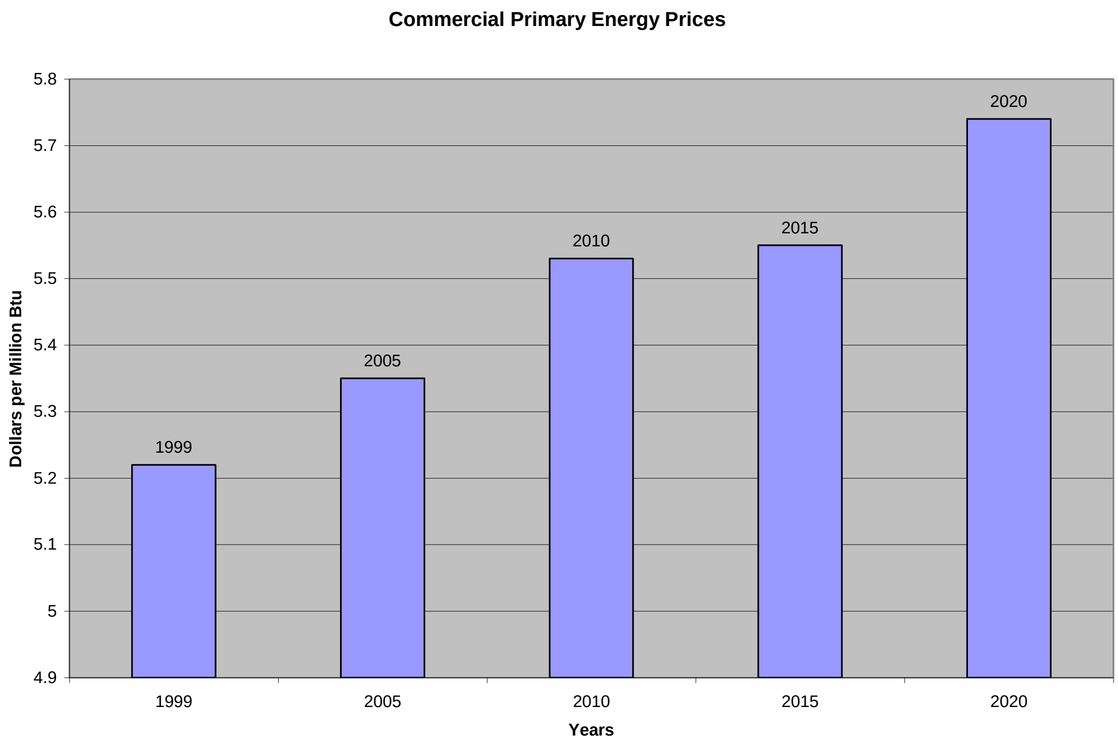
National Emissions Inventory (2007)

Figure 2



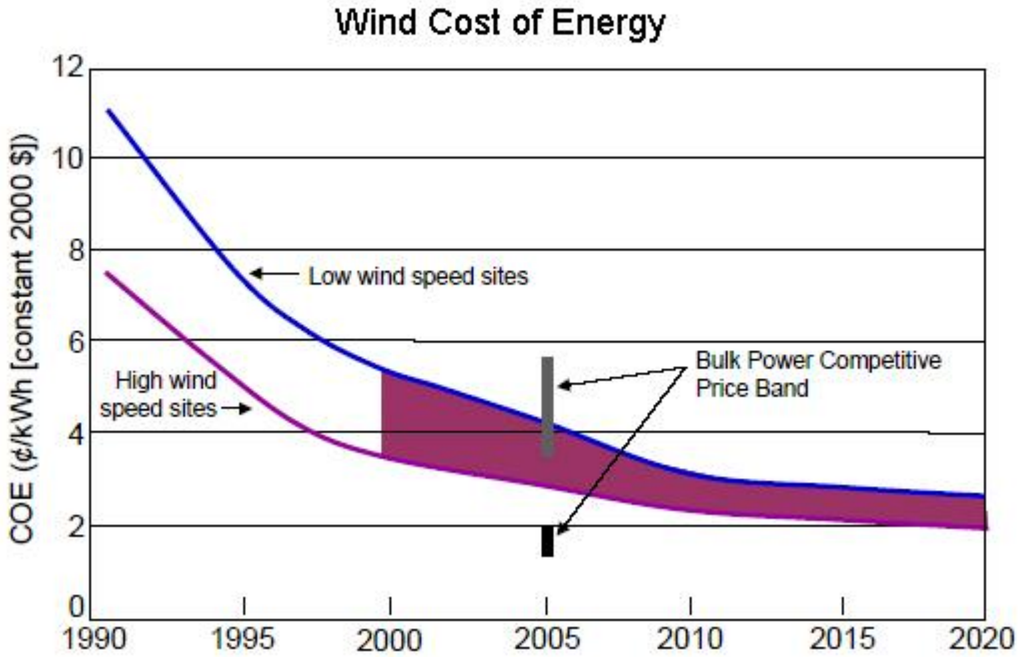
WorldWatch Institute (2005)

Figure 3



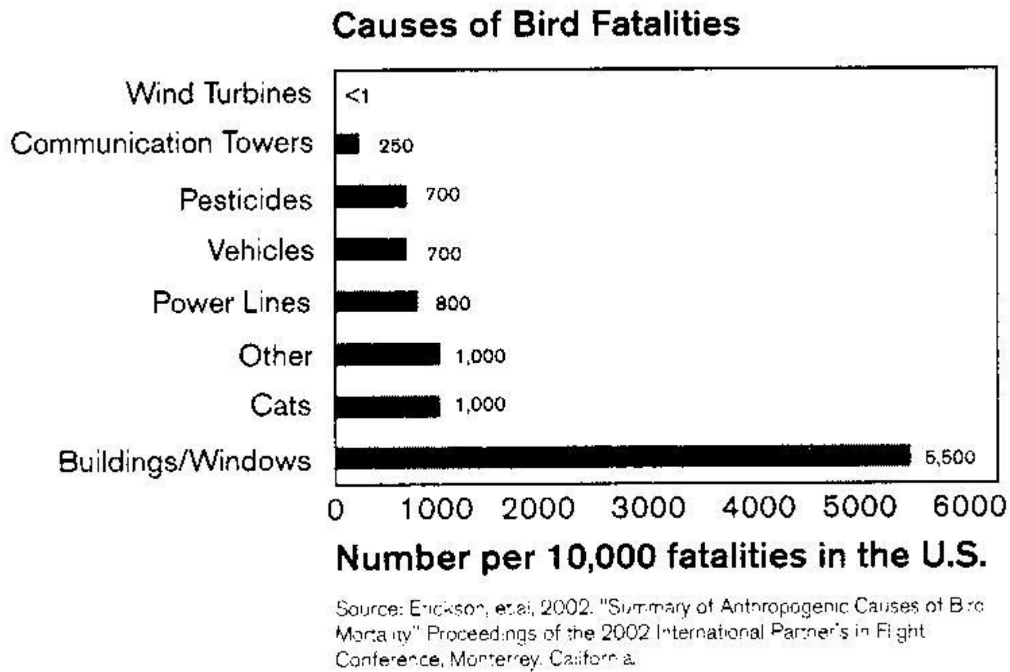
Energy Information Administration (2000)

Figure 4



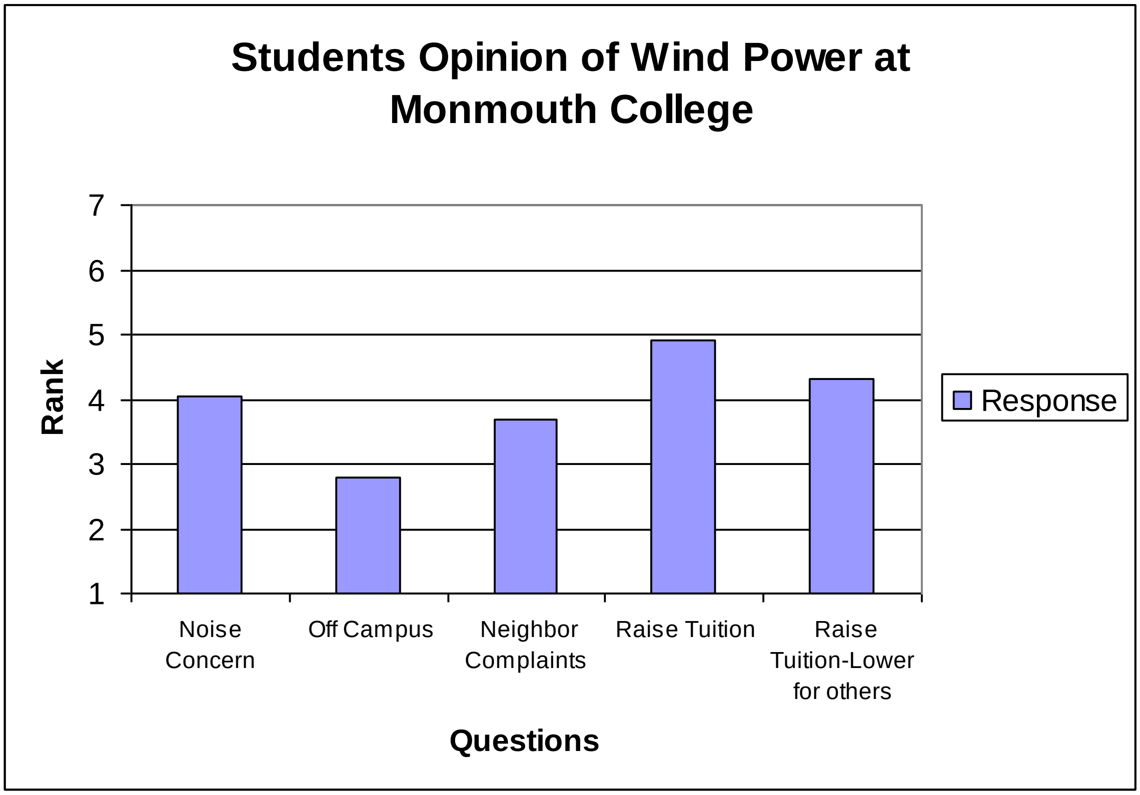
U.S. Dept. of Energy (2005)

Figure 5



Skystream (2002)

Figure 6


Students Opinion of Wind Power at Monmouth College
Rank
7
6
5
4
3
2
1
Noise Concern
Off Campus
Neighbor Complaints
Raise Tuition
Raise Tuition-Lower for others
Questions
Response