

An Exploration of Wind Energy at Macalester College

ENVI133

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I. Introduction

Wind energy is a promising renewable resource. Because wind is generated by atmospheric circulation patterns caused by solar heating, it is a form of solar energy. Like hydropower, wind energy is generated by the turning of a turbine that in turn drives a generator that produces electricity (AWEA URL). Wind energy produces no hazardous wastes or emissions like nuclear power or fossil fuel power (Minnesotans for Sustainability URL), and does not have the ecological implications of hydropower (“Hydropower” URL). It is a clean, renewable form of energy, but it does not have the reliability or the energy capacity at the current amount of working turbines to stand on its own as an energy source. Used with other sources, however, wind energy is a step in the right direction of producing clean, renewable energy.

II. Goals and Objectives

The primary goal of this paper is to educate people about the benefits of wind energy as an alternative to traditional methods of energy production. In doing so, we tried to avoid portraying wind energy as a panacea, simply because a single solution to America’s energy problems does not exist. College campuses are often in the vanguard of social change in this country, so we explored the ways in which colleges and universities have moved toward wind power in the last few years. Schools both large and small have recognized wind energy as a viable alternative to conventional energy production involving fossil fuels. The fact that some schools have windmills on their campuses provides a nice segue into looking at Macalester’s wind turbine. We examined statistics regarding the windmill’s energy production and its value to the college. Furthermore, we explored the feasibility of installing another wind turbine on campus and the impact this would have on the amount of energy we purchase from Xcel Energy.

It was necessary for us to look at Xcel’s energy sources so that we could understand how the company uses wind power and how Macalester gets its energy. Once we had identified Macalester’s energy sources we were able to propose alternatives to fossil fuels. While wind power is an alternative, it has its disadvantages, which necessitate the use of other forms of renewable energy. One type of sustainable energy will not solve every problem, but wind power is a viable alternative that becomes stronger when used in conjunction with other forms. This may prove to be the best option for both Macalester College and the country as a whole.

III. Materials and Methods

In recent years, wind energy has become a viable alternative for colleges and universities looking to make a change in their energy sources. College students have long been recognized for their leadership in enacting social change and improving environmental policy (Colorado Green Power URL). Many colleges throughout the country have turned their attention toward wind turbines as an alternative to traditional sources of energy. Earlier this year, the University of Colorado at Boulder hosted a summit that brought together “faculty, staff and student representatives from all of Colorado’s campuses” to learn how they could work toward environmental sustainability (University of Colorado URL). This summit, the Colorado Sustainability Summit: Forging Solutions at Colleges and Universities, dealt with a variety of possible alternatives to traditional methods of energy production, including wind, and produced a hand book for students to use in encouraging the administration at their respective schools to look into alternative energy sources. The “Workbook for a Clean Energy Campus” contains case studies that students can use to strengthen their case. For example, in 2001 Penn State University signed a contract with a renewable energy marketing company to purchase 5 percent of the school’s electricity from wind energy (Workbook URL). Students at the University of Colorado voted in 2000 to purchase wind power from a Colorado wind farm (Workbook URL).

In Minnesota, Carleton College has explored the possibilities of using wind energy. The school is working with the Northfield school district and St. Olaf to find a suitable location for a windmill, which the school district had hoped to have in place by the beginning of this school year (Carleton College URL). A wind turbine was constructed on Long Island University’s Southampton College campus earlier this year. The college was chosen as a site for the windmill based on their “keen interest in incorporating renewable energy into their educational programs” (Long Island Power Authority URL). Donald A. Brown, the Director of the Pennsylvania Consortium for Interdisciplinary Environmental Policy, wrote a statement that can be found on Macalester’s Environmental Studies program webpage in which he reports that 25 Pennsylvania colleges and universities have committed to using renewable energy. For example, Dickinson College has agreed to purchase 9.2% wind energy, which Brown says is the “highest percentage of any school in the eastern U.S.” (Macalester College URL).

Macalester’s windmill is just one of many on college campuses across the United States. As students continue to encourage their administrations to consider wind power as a viable source of energy we can be assured of seeing many more windmills appearing in the not too distant future.

IV. Results

Macalester College officially began running the 10-kilowatt wind turbine that sits on the edge of the athletic fields on April 23, 2003. The wind turbine that sits on our campus is one of only a handful of urban turbines in America (Losure URL). The turbine is a 90-foot-tall symbol of Macalester’s commitment to using renewable energy sources.

In the early 1990’s, the Minnesota State Legislature required Xcel energy to donate more money to the research and development of sustainable energy sources as part of a bill that allowed the company to expand its nuclear storage facilities (Losure

URL). As a result, Xcel has been putting more effort into including sustainable energy sources, such as wind power, in their long-term energy plans. Laura McCarten, a representative from Xcel energy states, "I truly do not believe that this is a choice that if you want renewables, you have to shut the nuclear plants down...they co-exist, they should co-exist, they can co-exist" (Losure URL). As a result, Xcel energy decided to fund the cost of the windmill that has been placed on Macalester's campus.

The turbine, tower and equipment necessary to allow the wind turbine to generate electricity cost \$40,000. Due to a generous grant of \$40,000 from Xcel energy that covers the cost of the actual turbine, Macalester only had to pay \$15,000, money that was used to pay for the installation fee. The wind turbine saves Macalester approximately \$1,000 a year by generating 18,000 kilowatt-hours of energy per year (Moring 2002). Since Macalester only paid the installation fee for the turbine, the apparatus will pay for itself in a very short period of time. It will take 15 years for Macalester to start profiting from the wind turbine.

According to Mark Dickinson, Director of the Physical Plant, it would take 300 wind turbines like the one currently on campus to generate the approximately 1.2 million KWH Macalester uses every month. Due to our urban location and spatial limits, this is obviously not feasible. However, we did explore the feasibility of placing one more wind turbine on the Macalester campus that would be identical to the 10-kilowatt turbine on the campus now. The factors that were considered when exploring this possibility were: the amount of money it would cost, the amount of electricity it would produce, and the amount of space it would take up. A place for another wind turbine could be arranged. However, the amount of energy that the current wind turbine produces is not significant to warrant the installation of a second turbine. In addition, it is doubtful that Xcel energy would donate an additional \$40,000 towards another wind turbine. Macalester does not have the funds to spend \$40,000, the amount that a new turbine would cost. Therefore, we concluded that installing an additional wind turbine on Macalester's campus in the near future is not feasible.

Though Macalester cannot directly generate its own wind power, the College could still support the use of wind energy in an alternative way by supporting offset windpower. In 2001, Minnesota State Legislature passed a law that required all electric companies who sell electricity to Minnesota customers to provide a "green energy" alternative at least once a year (Minnesota Statutes, Laws and Rules URL). "Green Energy" is defined as, "electricity generated from renewable, high efficiency, or low pollution energy sources" (Xcel URL). In order to comply with this law, Xcel energy set up a program called Windsource®. In this program, customers of Xcel are able to specify on their energy bill that they want some or all of their electricity to be generated by wind. Xcel buys this specified amount of wind energy from turbines and adds it to its electrical grid that includes energy generated from coal, natural gas and nuclear energy. As more wind energy is demanded, more is added to the grid. The electricity that Xcel customers receive comes directly from this grid (Xcel URL). Therefore, Xcel cannot guarantee that a specific customer is receiving wind energy. However, by using the Windsource® program, the customer is adding wind energy to the entire grid.

Due to the current participation of Minnesota customers in the Windsource® program, by the end of 2003, Xcel Energy will have 790 mega-watts of wind capacity (Xcel URL). Currently, Windsource® is being sold to customers. On top of their existing

energy bills, customers have to pay \$2.50 for every 100-kilowatt block of wind energy they desire (Xcel URL). Xcel states that because wind energy costs more to produce than coal or gas, the price of wind energy must be higher. However, it is unclear whether or not under this law Xcel has the right to pass this cost off onto the consumer. If the company had used equity as opposed to loans to fund the Windsource® program, they would not have had to do so. We believe Macalester should continue to monitor the progress of the Windsource® program. In the future, once the loans Xcel took out are paid off, the company claims that the price of wind energy will go down. If this does happen, this may be a good way for Macalester to support and possibly receive offset wind power.

V. Discussion

Macalester has very few alternatives to buying electricity from Xcel Energy of Minnesota. The windmill provides between \$1,000 and \$2,000 of electricity according to Mark Dickinson of the physical plant. However, if the college was trying to save more money they could invest in some photovoltaic cells. According to irishlassie.com, a typical installation to run a house would cost around \$18,000 and \$30,000. Photovoltaic cells charge a battery that the house can run off of when it is dark. A typical windmill costs around \$25,000 (JL Company URL). Xcel Energy, Macalester's energy provider, gets 50% of its energy from coal, 13% from nuclear power, 10% from gas and oil, 2% from renewable sources, 21% from a combination of sources, and 4% from Manitoba Hydro (Xcel).

Xcel Energy has a wide range of programs designed to help customers conserve energy. Reducing energy demand means less electricity has to be generated, which means less impact on the environment. The results from our energy conservation efforts make us a leader among utilities nationwide. In 2002, we helped customers across our service areas conserve 300 million kilowatt hours of electricity - the amount used by 40,000 homes in a year. That equates to a reduction in air emissions of: 2 million tons of CO₂, 5,210 tons of SO₂, 4,725 tons of NO_x (Xcel "2003 Environmental Report" URL).

But the cost of wind energy cannot be measured in just the cost of erecting and maintaining the turbines. The potential environmental benefits and benefits to human health by the reduction of emissions of greenhouse gases and other pollutants from the reduction of fossil fuel burning must also be noted. The long term economic benefit to farmers who invest in wind turbines and place them amongst their crops or grazing lands must also be noted. Wind energy also produces more jobs per energy unit than other forms of electricity generation. Furthermore, the cost of decreased dependence on foreign fossil fuels and the reduced possibility of oil drilling in the Alaskan National Wildlife Refuge are priceless to many. The actual cost, however, depends on ownership. Public utility ownership would reduce the cost by 10-40%. Ryan Wiser and Edward Kahn of Lawrence Berkeley Laboratory's Energy and Environment Division note, "As wind turbine technology matures, resource evaluation becomes more accepted, and information becomes readily available to the financial community, debt and equity costs and terms may become less restrictive and costly for project-financed windpower facilities" (AWEA Cost FAQ URL).

When one considers the cost of producing power from wind energy, one must also remember to balance that perceived cost against the cost of alternatives. One alternative, frequently forgotten, is using less electricity. This can be done by implementing power

conservation measures, like installing more efficient light bulbs, using a timer-option on thermostats, or better insulating one's home and workplace. Also, one can make an effort to turn off appliances and lights when they are not being used.

Another alternative is producing energy by other methods, but many of these methods are detrimental to human and environmental health. There are important drawbacks to consider in producing electric power by any source. Most methods involve the use of a pressurized force running through and turning a turbine. The turbine is connected to a magnet that in turn revolves inside a wire coil. This alternating magnetic force pushes electrons through the wire, creating an electric current, or electricity.

There are several common pressure forces that are used for turning the turbines. For windmills, that pressure is wind. For hydroelectric dams on rivers, that pressure is a large mass of water under the effects of gravity. Turbines can also be turned by highly pressurized steam. Water is heated by the combustion of any number of organic and combustible substances, such as oil, natural gas, wood, peat, or coal. Certain of these substances are more efficient than others, but they all release some amount of pollution during combustion. Scrubbers on the tops of the facility smokestacks can decrease the amount released, but not capture all of the particulates and gasses. Also, the use of these resources to create electric power means that they become unavailable for other purposes. For example, wood has many other important applications, such as construction and paper, as does oil in such products as lubricants and plastics.

For those that live in the vicinity of power plants using combustion, health impacts can affect them as a result of this emitted particulate matter. Asthma is a common problem facing people in these areas. This can lead to children having to stay inside during school recess and high numbers of extra hospital check-ins.

Another way to heat the water and create steam is the use of nuclear fission. While not emitting harmful particulate and gaseous pollution into the air, this method produces nuclear waste and radiation, which causes cancer to humans as well as other organisms in the environment.

Solar panels produce electricity without emitting particulate or gaseous pollution, but they remain expensive for the energy that they produce.

VI. Conclusions/Recommendations

Wind power has been romanticized by many to be the wave of the future in terms of electricity generation, but some critics of wind energy reject this. In "Policy Comments on Point Petre Commercial Wind Turbine Generating Plant," issued by Prince Edward County, Ontario, the author states,

The development of commercial wind power that is currently fashionable is potentially misguided, ineffective and neither environmentally nor socially benign; but it is the right of citizens of rural areas to enjoy both clean and safe energy generation and an unspoiled countryside.

Wind energy has a role; rural communities are in constant evolution, however it may be argued that the environmental and social cost of the development of commercial wind energy is out of proportion to any benefit in the form of reduced emissions. The industrialisation of our least developed landscapes, irreversible ecological damage, loss of amenity and the social division of communities is too high a price for an insignificant and unreliable contribution to our energy supply and a small and uncertain saving of pollution (Prince Edward County URL).

Following this denunciation of wind power, the author states that for rural areas, wind power can be beneficial, given the distance from the grid. Furthermore, it is noted that

3.2-6.1 million tonnes of carbon emissions per year (between 0.006% and 0.011% of global emissions) can be prevented through wind farms (Prince Edward County URL). California's 13,000 wind turbines generated 3,604 million kilowatt-hours of electricity, equal to 1.27 percent of the state's total electricity. These figures seem to show that wind energy is not a very good source of energy, as it does not significantly reduce pollution nor does it significantly add much energy to the total produced. But despite these seemingly discouraging statistics, wind energy is a step in the right direction. Wind turbines are large, powerful reminders of a community's commitment to clean renewable energy. Combined with other forms of energy, wind energy is one way to reduce our dependence on fossil fuels. It cannot stand on its own as a sole source of energy, but every reduction in emissions from fossil fuels is beneficial.

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