Agricultural Marketing Resource Center
Value-added Agriculture Profile
Iowa State University

November 2008

Small Farm Profitability Case Study: Is the Answer Blowing in the Wind?

By
Gary Brester[1], Professor
Department of Agricultural Economics and Economics, Montana State University

Joel Schumacher, Associate Extension Specialist
Department of Agricultural Economics and Economics, Montana State University

Cole Arthun, Graduate Research Assistant
Department of Agricultural Economics and Economics, Montana State University

Funding was provided by the Agricultural Marketing Resource Center.

[1]The authors prepared this case as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation. The cooperation and contributions made by Dr. Gordon Brittan are greatly appreciated.

Introduction

A small, 25-year old wind turbine stands as a sentinel on a windy ridge in Montana's Paradise Valley. The turbine is owned by Montana State University Philosophy Professor Gordon Brittan. Dr. Brittan has produced local, environmentally-friendly energy for decades. Yet, despite these attributes, few others have installed similar wind turbines in Montana. What prompted Gordon to purchase and install this 65-kilowatt wind turbine on his property near Livingston, Montana? His motivations included testing the idea that local residents and community-owned wind projects could not only be used to generate electricity for rural communities but also to provide a business model that would help sustain them. He also hoped his project would serve as a model for other locally-owned wind energy projects in rural parts of the state. After nearly 25 years, Gordon's experiences provide insights regarding the development of wind energy projects.

This case study examines the motivation and incentives that led Gordon to be on the cutting-edge of modern wind energy development in Montana. In addition, the economic factors surrounding small-scale wind energy production over the past 25 years are presented. Finally, this study examines decision processes for small-scale wind energy development under current economic and regulatory policies.

Wind Energy Terminology

The vernacular used in the wind energy industry is unfamiliar to many. A kilowatt (kW) is a quantity measure of electricity that is equal to 1,000 watts. A kilowatt hour (kWh) is the equivalent of 1,000 watts being used for one hour. To calculate kWh, the number of kilowatts consumed or produced is multiplied by the number of hours of service. For example, an 80-watt light bulb that is illuminated for 5 hours will consume 0.4 kWh of electricity (0.08 kW * 5 hours). The average residential customer uses about 920 kWh of electricity every month. A megawatt (mW) is equal to 1,000,000 watts. A wind turbine that produces 1 mW/year can supply the electrical needs of about 250 homes for an entire year.

Wind turbine projects are often categorized as grid connected, direct current, alternating current or net metering projects. The term “grid” refers to the electrical distribution system that physically connects electricity producers and consumers. To ensure electrical safety, reliability, and functionality, the electrical grid specifies equipment and usage rules for both producers and consumers. Grid-connected projects (most large wind projects are in this category) are required to follow certain standards, regulations, and rules before access to a grid is allowed. Off-grid projects are subject to fewer rules and regulations, and are often used to provide power at remote locations.

Electricity generated by off-grid projects can be used as either direct current or alternating current. Direct current technology was used and developed by the Edison Company in the early 1880s. Their Pearl Street generating plant in New York City was a very early example of direct current (DC) electricity generation. However, transmitting DC power over long distances is inefficient and expensive. These problems were overcome by George Westinghouse and Nikola Tesla in the late 1890s with the development of alternating current (AC) power generation. The technology to transmit AC power was much less expensive and more efficient for long distances. AC power allowed for the development of large centrally-located power plants with transmission lines connecting large numbers of consumers to relatively few power plants. This system became the standard for electric transmission in the United States. DC electrical generation must be converted to AC before entering the grid.

Wind projects produce energy that is sold to a buyer. However, small-scale projects often involve a system called net-metering. A net-metering project produces electricity for an owner's personal use. If an owner generates more electricity than is consumed, then extra electricity is transferred to the grid and is used by other electrical customers. However, if an owner produces less energy than is needed, then additional electricity is purchased from the grid. Special rules and regulations apply to net-metering projects that determine how often the account is "trued up" (i.e., the point in time when the difference between production and consumption of electricity is computed) and the price at which power will be purchased by a customer or sold to the utility company.

Gordon Brittan's Wind Project

In 1984, Gordon made the leap from being an observer and promoter of wind energy to an owner with a financial stake in wind energy production. He purchased a 65-kW, Windmatic 15c turbine manufactured by a Danish firm. The Windmatic turbine was purchased and installed on an 80-foot tower for $120,000 (an example of a 65 kW turbine is presented in Figure 1). This represents an initial investment of $1,850 per installed kW. He received a 25% (15% federal and 10% state) income tax credit in the year of installation. The tax credit was calculated as 25% of the income generated by the sale of the turbine's generated electricity. Over the years, Dr. Brittan has replaced one generator and several turbine brakes. Major repairs require the use of a crane and replacement parts which have to be ordered. Such work can require a month or more of downtime. Maintenance costs average approximately $1,200 per year.

This project required selecting an equipment manufacturer and also finding an electricity purchaser. Because Gordon was on the leading edge of the wind industry, many of the issues he faced were new to both himself and to utility companies. There was no how-to guide for wind energy installation and contract negotiations in 1984. Although identifying a buyer for wind energy was not difficult, the contractual details of a power purchase agreement involved risks for both parties. Gordon quickly identified the Montana Power Company (MPC) as a potential buyer because they owned a power line in close proximity to the site of his potential wind turbine. A power purchase contract identifies many possible outcomes and protects both buyers and sellers from actions of the other party. In addition, the contract establishes a sale/purchase price for electricity. MPC required that power produced by a wind turbine meet safety standards and an assurance that the equipment would remain operable for the life of the contract. The risks faced by both parties included not only whether or not the wind would blow, but also how well the equipment would perform over a 10-30 year time horizon. Questions such as "How often would the turbine require maintenance?", "How many hours, days or weeks would the turbine be out of service each year?", and "How much electricity would the equipment generate each day, week, month, and year?" were difficult to a priori assess. These risks required engaging in sensitivity analysis regarding potential benefits and costs of various possible outcomes. Due to the risky nature of wind energy and lack of experience in 1984, each of these cost-benefit estimates involved much more uncertainty than would a similar analysis today. MPC also needed to address these risks to protect the profitability of the company, the reliability of the power grid, and their customers. One method used to mitigate such risks was to withhold a percentage of electricity sale payments to Gordon and place them in

Figure 1. 65-kW Windmatic Turbine near Big Timber, MT (Source: NREL)

an escrow account. In the event of equipment failure, MPC could recover some of their costs from these funds. If no problems occurred, then the accumulated escrow balance (including interest) would be transferred to Gordon. Equipment durability concerned both parties. Consequently, MPC required Gordon to purchase casualty insurance for the Windmatic turbine. Insurance premiums for wind turbines were expensive in 1984 due to lack of data, quality of construction and design problems. Nonetheless, Gordon purchased insurance, which reduced the risk of the project.

Negotiations also addressed the value of electricity produced and the contract length. MPC offered several alternative contract terms to Gordon. One option included a 10-year contract that valued Gordon's wind-produced electricity at 5.76 cents/kWh. A second option was a 30-year contract that would pay 7.30 cents/kWh. Based on historical wind conditions, it was estimated that Gordon's 65 kW wind turbine would produce an average of 150,000 kWh/year. The annual average gross revenue would be $8,640 if the 10-year contract was selected and $10,950 if the 30-year contract was selected. If electricity rates trended upward over the next 30 years, then the 10-year contract probably provided the best option for capturing these future price increases. The risk of signing the 10-year contract was not only associated lower gross returns for the first 10-years, but also the risk that future contracts might be offered at even lower rates. Gordon decided to sign the 10-year contract based on an expectation that future power contracts would be offered at higher rates.

Gordon’s actual production has ranged from a high of 187,000 kWh/year to a low of 130,000 kWh/year. Unfortunately for Gordon, his prediction that future energy prices would rise by 1994 was incorrect. After the expiration of his 10- year contract in 1994, MPC offered a new contract for 2.25 cents/kWh (3.51 cents/ kWh less than the 1984 contract) which was 5.0 cents/kWh less than the 30-year contract he could have signed in 1984.

The History of Montana Wind Energy

Early Wind Development

For centuries, the dusty wind-blown plains of Montana went dark every evening unless light was provided by fire, candles or oil lamps. However, these light sources provided only limited light quantity and quality. Montana nights began to brighten with the discovery of electricity. Access to electricity promised modern conveniences such as lights, refrigerators, running water and automatic washing machines. These changes would alter life in rural Montana forever. Although electricity had been discovered for many years, it was difficult and expensive to access in many rural areas.

Many rural Montana residents purchased wind generators to allow them to enjoy the comforts provided by electricity. These early wind generators produced direct current (DC) electricity that was often stored in batteries. A few Montanans did more than just buy these early turbines; they also designed and marketed them. Marcellus Jacobs was a particularly successful Montana wind turbine designer. He designed and marketed popular wind turbines and sold them under the Jacobs brand name. Early Jacobs wind generators were available in 1.8 kW, 2.5 kW and 3.0 kW models. The turbines allowed rural residents access to electrical technologies. Although this represented a great technological forward leap was for rural Montanans, the days of battery-based wind turbine systems were short-lived.

Electrical Co-Operatives and the Power Grid

A Presidential executive order in May 1935 was the first indication that the era of DC battery-based wind turbines in rural America was about to end. In 1936, the Rural Electrification Act (REA) cemented the path on which electrification in rural America was to follow. The Secretary of Agriculture authorized people, corporations, states, territories, agencies (municipalities, peoples’ utility districts and cooperative association and nonprofit associations) to participate in direct loans and loan guarantee programs to encourage the construction of rural electric distribution lines, transmission lines and electrical generation facilities. The Secretary's actions for any project involving the construction, operation or enlargement of an electrical generation plant were subject to the authority of state regulatory agencies.

Loans issued under this act by the Rural Electric Administration initially offered interest rates equal to the cost of money to the federal government. The rate fluctuated between 2% and 3% until 1944 when interest rates were fixed at 2%. The 2% rate remained in effect until the 1970s. The low-interest loans allowed energy development to boom. The percentage of farms with grid-connected electrical service increased from 11.6% in 1935 to 45.7% in 1945. The consistent power offered by an electrical grid connection dramatically reduced the demand for DC wind energy systems.

By 1970, over 98% of American farms had access to the power grid, meaning few DC power systems remained as the sole source of power for rural Americans. Residential electrical prices (adjusted for inflation) steadily declined from the end of World War II until the mid-1970s. This downward trend ended with the 1970s energy crisis.

Implications of the 1970s Energy Crisis

Until the mid-1970s, electricity produced from wind was more expensive than that generated from other sources. However, during the 1970s increases in the prices of coal, petroleum and natural gas improved the financial competitiveness of wind power. Several world events played a role in the 1970's U.S. energy market. The Organization of Petroleum Exporting Countries (OPEC), which had been formed during the Baghdad Conference in 1960, played an important role in the increase of the price of energy. OPEC contributed to the increase in the price of crude oil by ceasing exports of oil to the United States because of its support for Israel during the 1973 Yom Kippur War. At this time, the United States relied on significant amounts of foreign oil to supply domestic markets. The lack of imports from OPEC reduced the supply of oil and led to an increase in the prices of petroleum-based products. Increased gasoline and diesel fuel prices impacted the entire U.S. economy. In response, President Carter implemented price controls to halt price increases. Although price controls prevented retail gasoline prices from rising further, the policy created shortages of gasoline throughout the United States.

Prices for all types of energy increased during this period. The average household retail electricity price increased 25% from 2.5 cents/kWh in 1973, to 3.1 cents/kWh in 1974. Congress responded by creating policies designed to promote domestic energy production and reduce U.S. dependence on imported energy. The most sweeping of these policies was enacted when President Carter signed the National Energy Act (NEA) of 1978. The NEA focused on increasing domestic energy conservation and efficiency. Another important piece of legislation was the Public Utility Regulation Policy Act (PURPA), which focused on the development of facilities to generate electricity from renewable energy sources. These acts opened the door for wind energy development in the 1980s by providing a 15% federal income tax credit. Many states also offered incentives for wind energy development. In Montana, a 10% income tax credit was offered to wind energy producers. A few Montanans, including Gordon, took advantage of this new policy environment to invest in wind turbines. As the wind turbine market grew, researchers improved the technical aspects of wind energy production.

Wind-generated electrical capacity grew quickly in the early 1980s, and then slowed until the late 1990s. During this period, there were few major policy changes which impacted electrical markets. The next major policy change to impact the wind energy market was the decision in 1996 by the Federal Energy Regulatory Commission (FERC) to deregulate much of the energy market. Deregulation opened electric markets to competition and also coincided with a period of increased energy prices. Higher prices and competitive opportunities boosted wind projects across the country.

Deregulation in Montana

Deregulation had more serious ramifications in Montana than in many other parts of the country. The largest regulated utility in Montana was the Montana Power Company. The well-respected, nearly 100-year old firm was Montana's only Standard and Poor's 500 index company. MPC owned electrical generation facilities, transmission lines and electrical distribution assets. The Montana Public Service Commission regulated MPC's in-state activities. MPC also sold power to utilities outside of Montana. After deregulation, MPC decided to sell their power generation assets and buy power for their Montana customers. After selling their hydroelectric dams, coal mines and power plants to Pennsylvania Power and Light (PPL), MPC decided to sell their electricity and gas transmission and distribution system in an effort to focus their business strategy on the telecommunications sector. Northwestern Energy purchased transmission assets in 2002. By the end of 2003, both Northwestern Energy and Touch America (MPC's new name) filed for Federal bankruptcy protection. Decisions by MPC management in the years following the 1996 Act destroyed the company, increased electricity rates in Montana and caused huge equity losses for individuals and pension holders of MPC stock.

Montana Wind Energy

Commercial Wind Farms

Montana wind energy development continued in spite of MPC's demise. In 2002, Northwestern Energy requested construction bids for a 150-mW commercial wind farm in Montana. Bob Quinn, a farmer from Big Sandy, MT, led a group of investors who proposed to build a wind farm near Judith Gap, MT. This group later partnered with and eventually sold their interest to a Chicago-based company, Invenergy. Invenergy won the bid to build the wind farm. The Judith Gap location was chosen, in part, because of its proximity to transmission lines.

The Judith Gap project is quite different from Gordon Brittan's project. Each Judith Gap turbine is capable of producing 1.5 mW of electricity compared to Gordon's 65-kW turbine. The wind farm consists of 90 GE 1.5 mW wind turbines spread over 14,000 acres of land. Each turbine has 126-foot long blades mounted on towers that are approximately 260 feet tall (Figure 2). Each massive tower requires a seven-foot deep, 48-foot diameter concrete base (470 cubic yards of concrete). Invenergy studied the Judith Gap site for nearly five years. According to their on-site Energy Center Supervisor, John Bacon, the Judith Gap project has delivered acceptable returns on the investment.

In addition to being profitable, the project is relatively low risk because of the development of insurance markets for equipment failure. Insurance policies are offered by WindPro, and the policy has a 30-day deductable for a claim of losses. If a turbine experiences mechanical problems, the insurance will help reimburse the policy holder for lost revenue beyond 30-days of inoperability. Currently, the turbines are under a five-year warranty from GE. After this period, the insurance policy will cover the costs of some major parts. Mr. Bacon also stated that wind equipment insurance premiums are declining because of insurance company competition. Currently, there is only one Invenergy employee at Judith Gap and several GE employees. GE provided several years of service as part of the turbine warranty. After the warranty period, Invenergy will hire additional workers to operate and maintain the equipment.


Figure 2. Judith Gap wind farm.

In 2005, the Montana Public Service Commission approved Invenergy's request to sell power to Northwestern Energy. A 20-year contract values the energy at $31.75/mWh (or 3.175 cents/kWh). This project provides about 7% of the energy used by Northwestern's customers in Montana.

Siting a Wind Farm

Wind farms need to be close to transmission lines and located within a good wind resource to be successful. Wind quality is categorized into seven classes. Class 1 is the lowest level of wind and Class 7 the highest level. The electrical output of wind turbines is, within a certain range, cubic with respect to wind speed. That is, as wind speed doubles, electrical output increases eightfold. In general, Class 4 wind speeds (i.e., average wind speeds of 15.7 to 17.9 miles per hour) or higher are needed to support a commercial wind project[2]. Wind power density is usually determined by measurements occurring 50 meters above ground because wind speed increases with altitude. A wind turbine does not generate power at all wind speeds. Each turbine has a minimum speed at which it will begin to generate electricity and a maximum wind speed at which turbines stop generating electricity to prevent equipment damage. The minimum wind speed for the Judith Gap turbines is about 8 miles/hour and the maximum speed is about 55 miles/hour.

Other Wind Projects in Montana

The Invenergy project at Judith Gap is not the only wind project operating in Montana. Other projects include the 19.5-mW Diamond Willow Wind Farm near Baker, MT owned by Montana Dakota Utility Company. The project investment totaled about $40 million dollars and consists of 13 turbines. In addition, the Horseshoe Bend wind farm near Great Falls, MT has a capacity of 9 mW and consists of six GE turbines.

---

[2] A Class 4 wind at 50 meters of elevation has a wind density between 400-500 watts per square meter with an average speed of 7.5 meters per second (16.8 mph). A Class 5 wind at 50 meters of elevation has a wind density between 500-600 watts per square meter with an average speed of 8 meters per second (17.9 mph).

The Two Dot Wind Company also owns approximately 3.5 mW of wind-generated electrical capacity in Montana. Their business plan is quite different from other large scale projects. Two Dot Wind purchases used turbines, refurbishes them and installs the newly refurbished turbines in small wind farms ranging from 1 to 11 turbines. Each turbine has a generating capacity of between 65 kW and 250 kW. Although the older equipment is less efficient than newer equipment, Two Dot Wind has been able to purchase these turbines at discounted prices. This allows these turbines to be financially feasible in certain circumstances. Some of the turbines owned by Two Dot Wind are the same model (65-kW Windmatic 15c) as Dr. Brittan installed in 1984.

Net Metering Projects

A much smaller scale of wind development is also occurring in Montana and is referred to as "net metering." Net metering refers to projects in which an electrical customer is also an electrical producer. A customer's electrical meter measures electricity usage each month. The amount of usage is offset by the amount of electricity produced by the customer. Such customers receive a monthly electrical bill only for the amount of net usage.

Northwestern Energy customers are allowed to install up to 50 kW of generating capacity for net metering projects. A special meter is installed that can measure electricity flows in both directions. It is important to note that if a net metering customer produces more electricity that is used during the true up period, the excess is simply given to Northwestern Energy. That is, net metering customers do not generate revenue from their wind projects. However, to the extent that net metering customers are able to replace purchased electricity, the amount replaced is valued at retail rates rather than wholesale rates.

Most of Montana's Rural Electric Cooperatives have adopted a uniform policy toward net metering. The policy limits net metering projects to a capacity of 10 kW and the true-up period is defined as a month. According to the Montana Green Power website, over 80 turbines, each with a capacity of less than 10 kW, are currently producing nearly 500 kW of electricity under net metering programs. The owners of these turbines include private citizens, municipalities, colleges, and non-profit organizations.

The Role of Government Policy

Government policies play an important role in the economics of alternative energy. State and federal programs offer many different tax incentives, grants and loans. The most important federal policy is the Renewable Electricity Production Tax credit. This program provides a 1.5 cents/kWh income tax credit for electricity generated from wind. In addition, Montana's Alternative Energy Investment Tax Credit and Residential Alternative Energy System Tax Credit are important state initiatives. The former provides a State income tax credit of up to 35% of the income generated by alternative energy investments. The latter allows a State income tax credit of up to $500 for the installation of a non-fossil fuel form of energy generation.

Utility companies also offer incentive programs. Northwestern Energy's Utility Grant Program provides grants of up to $2 per installed watt of wind capacity with grants limited to a maximum of $10,000. Many of the current net metering projects in Montana were partially funded through this program.

Although federal and state programs often provide a significant boost to investment in wind electricity generation, investors must evaluate the risks associated with changes in these policies.

The Future for Gordon and the Industry

Gordon Brittan's 65 kW wind turbine continues to produce electricity that is sold to the electrical grid. His buyer has changed from MPC to NWE, and contract terms have changed over the years. In 2005, Gordon signed a new contract that prices his electricity at about 4 cents/kWh. This price combined with the federal production incentive (REPI) of 1.5 cents/kWh generates 5.5 cents/kWh. This price is lower than that received in 1984 in nominal terms. Although his wind turbine has performed well over the past 20 years, the project has not been profitable to-date.

Opportunities in Today’s Market

Potential wind energy producers have several options in today's market. They can pursue a net metering project or a commercial wind energy project. Each type of project presents unique opportunities and challenges.

Net Metering

Small wind turbines with capacities for 1.5, 3 and 5 kW can be purchased for approximately $1,500 to $3,000/kW. Based on wholesale electricity prices and current subsidies, such turbines are not likely to be financially successful unless subsidized beyond the 1.5 cent REPI. Based on conservative estimates of wind speed and turbine efficiency, each kW of capacity generates between $50 and $150 of revenue per year. Using current wholesale prices, the future of small-scale wind power generation is not bright. However, small-scale, net metering projects generally offset retail electricity prices which averaged nearly 9 cents/kWh in 2007. In these cases, it is possible for such projects to have payback periods that are much shorter than those based on wholesale prices.

Commercial Wind Farms

The current outlook for commercial wind farms is bright. These projects involve substantial initial investments, and are often erected on land leased from federal, state and private land owners. Land owners receive rental payments in exchange for the loss of land use. However, land owners generally have few, if any, out-of-pocket costs associated with such projects. In many cases, the opportunity cost of the land used for such projects is quite low.

Several factors are slowing the development of commercial wind projects. Although Montana has some of the best wind resources in the country, its small population and lack of industrial activity combine to make the state a small electrical energy consumer (Figure 3). Thus, much of the electricity generated in Montana must be shipped through transmission lines to other electrical markets. Transmission capacities are limited, and expansion of such lines is costly and time consuming.

The large number of wind projects that are in various stages of development in Montana has slowed regulatory evaluations. In addition, the supply of new turbines and equipment is relatively low. Thus, equipment manufacturers have increased prices as customer demand has increased.

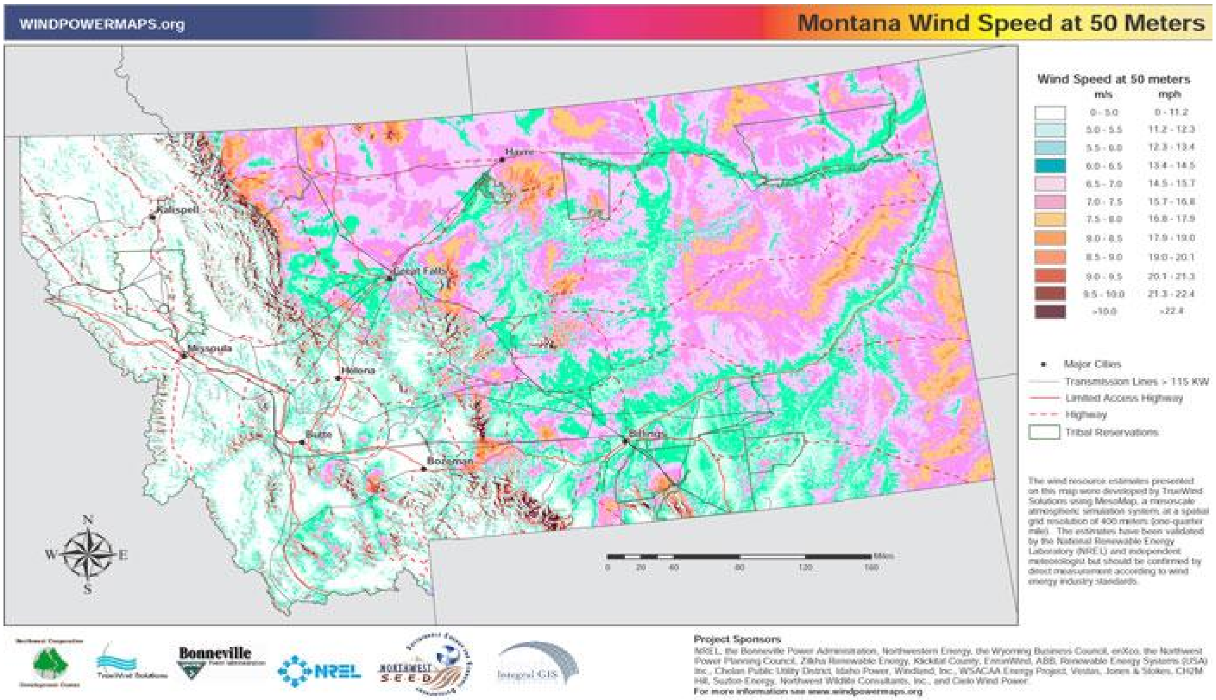

Figure 3. Montana Wind Map.

Summary

Gordon looks up from reviewing this case and glances around his cramped university office. If one were looking for a stereotypical professors office with the usual montage of books, papers and research material strewn about, one needs to look no further than Dr. Brittan's office. He grins at how his office mirrors the clutter involved with small-scale wind energy development.

His thoughts turn to his decisions regarding wind power over the years. He was able to select equipment that stood the test of time and today, over two decades after the turbine was installed, the reasons to develop wind power are even stronger than in the 1980s. Concerns about energy prices, energy security and rural economies are still relevant. A new concern, atmospheric greenhouse gases, has recently strengthened wind power discussions. Uncertainty about the future seems to remain as a constant reminder that many things change, while others do not.

His focus then turns to gathering papers to be read and edited over the weekend. His 40-minute commute to the Paradise Valley will undoubtedly give him the opportunity to further reflect on the past and ponder the future of wind energy in rural Montana.

References

Energy Information Administration (1996). "The Changing Structure of the Electrical Power Industry: An Update." Available at http://tonto.eia.doe.gov/FTPROOT/electricity/056296.pdf; Accessed June 9, 2008

IEEE Virtual Museum (2007). "AC vs. DC: The Struggle for Power" Available at: http://ieee-virtual-museum.org/collection/event.php?id=3456872$lid=1; Accessed June 9, 2008

United State Department of Agriculture (1982). "A Brief History of the Rural Electric and Telephone Programs." Available at: http://www.rurdev.usda.gov/rd/70th/rea-history.pdf; Accessed June 9, 2008.

Montana Department of Natural Resources and Conservation (2008). "Montana's Gap" in wind production." Available at: http://dnrc.mt.gov/trust/wind/judith_gap.asp; Accessed June 9, 2008.

Montana Green Power (2008). "Montana Wind Installations Near 900 Kilowatts." Available at: http://www.montanagreenpower.com/wind/mtinstallations.html; Accessed June 9, 2008.

Leonard, Paul A.; Paul Miesing, and Ray Van Ness (2004) "Montana Power Company – When Power Begets Power." Available at: http://www.albany.edu/~pm157/research/Montana%20Power.pdf; Accessed June 9, 2008.

Energy Information Administration (2008). "History of PURPA and Nonutilities." Available at: http://www.eia.doe.gov/cneaf/solar.renewables/rea_issues/html/history.html; Accessed April 1, 2008.

Rural Electrification Act of 1936; Available at: http://www.usda.gov/rus/regs/info/100-1/title_i.htm; Accessed June 9, 2008.

Zucchet, Michael J. (2002). "Renewable Resource Electricity in the Changing Regulatory Environment." Available at: http://www.eia.doe.gov/cneaf/pubs_html/rea/feature2.html; Accessed June 9, 2008.

Energy Information Administration (2008). "Energy Perspectives." Available at: http://www.eia.doe.gov/emeu/aer/ep/ep_frame.html; Accessed June 9, 2008.

NorthWestern Energy (2008). "Net Metering." Available at: http://www.northwesternenergy.com/display.aspx?Page=Net_Metering&Item=103; Accessed June 9, 2008.

Personal Communication with John Bacon, Invenergy Operations Manager, March 27, 2008.

Personal Communication with John Campbell, NorthWestern Energy Utility Engineer, March 6, 2008.

Personal Communication with Dana Dogterom, General Partner, Two Dot Wind, LLC., May 2, 2008.

Illustrated History of Wind Power Development (2006). "Part 2 – 20th Century Developments." Available at: http://www.telosnet.com/wind/20th.html; Accessed June 9, 2008.

Wind Turbine Industries Corporation (2008). "History." Available at: http://www.windturbine.net/history.htm; Accessed June 9, 2008

MDU Resources Group, Inc. (2008). "2007 Annual Report." Available at: http://www.mdu.com/proxymaterials/2007_ANNUAL.pdf; Accessed June 9, 2008.

National Renewable Energy Laboratory (2008). "Wind Research." Available at: http://www.nrel.gov/wind/; Accessed June 9, 2008.

Database of State Incentives for Renewables & Efficiency (2008). Available at: http://www.dsireusa.org/; Accessed June 9, 2008.