FEASIBILITY ANALYSIS OF UTILITY SCALE WIND POWER GENERATION SYSTEMS

By

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To my family, who has always supported me in my endeavors; any success gained is a reflection of this fact.

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Over the past 20 years, renewable wind energy in North America has seen a growth in popularity and availability. Wind farms, which have been common for decades in Europe, have now become elements of the landscape of North America, providing cheap, clean, and renewable energy that has come to fulfill a much needed role in the make-up of the power generation in America. But the traditional idea of buying power from a utility provider that generates power in one area and transmits it great distances to the end user still prevails, using costly transition lines and a number of substations, losing energy as it moves over that long distance.

Our objective was to explore the concept and feasibility of on-site wind energy power generation. This will be done by examining the basic elements required to have a site suitable for renewable wind energy using different scale systems and looking at the different pay back periods for these projects, which are affected by those elements. Best practices shown to be successful in projects around the country will also be examined to determine how to address those elements that can increase or decrease the project pay back period. The result of this study will be able to present effective alternatives for those interested in considering on-site wind power generation.

CHAPTER 1
INTRODUCTION

It is a fact that the world is changing; in the past four years we have seen the elimination of our belief in an endless, inexpensive supply of fossil fuels, which as a nation we have used to heat our homes, power our vehicles, and light our streets. It was estimated that U.S. wind farms generated 48 billion Kilowatt-hours (kWh) of wind energy in 2008, but this only represented 1% of the total U.S. electricity supply. The more telling fact is that this level was achieved only with the contribution of 5,244 Megawatts (MW) of new wind generation installed in 2007 (U.S. Department of Energy, 2008).

The rest of the energy we use each year comes from coal, natural gas, nuclear, hydro, and petroleum, with the most significant of these sources being coal. Even with the variety of power generation sources used, all are operated much in the same way. Massive power generation facilities operate in select locales where the raw material needed for the generating process can easily be found or received in transport. After the electrical power is generated it travels over great distances to the different end users, losing power during the transmission process as it proceeds through the lines and substations.

Wind energy has been shown to be a proven technology, generating power in many different parts of the world on many different scales. Community scale power generation has not been considered a viable option for many years, as not every community can have a coal, natural gas, or hydro power plant located just outside of town. However many communities throughout North America have the necessary wind resource to have a community and utility scale wind energy project. While there are obviously costs involved in installation, maintenance and operation, this could result in the availability of more generated energy because, unlike

traditional power plants, the power does not need to be transmitted over a great distance resulting in a reduction of the energy loss during transmission.

Statement of Problem/Importance of Community Wind Energy Production

The United States has to rethink its energy mix and in doing so needs to develop a diverse source of clean, renewable energy. In 2006, then President Bush emphasized the nation's need for greater energy efficiency and a more diversified energy portfolio. The goal was to take action to move toward a scenario where the United States would derive 20% of its electrical energy from wind by 2030. At the time of this proposal the U.S. derived less than 1% of its power from wind generation (U.S. Department of Energy, 2008).

Within the next 20 years, the U.S. will have to reduce overall use of energy in every aspect of life. While becoming more energy efficient is only the first step, reduction in the overall energy demand gives us a greater chance of supplying an increasing percentage of those energy needs with renewable forms. Community based wind energy projects can help provide renewable energy in the places where it will be used, reducing the need to enlarge the power grid and reducing the demand on the power generation facilities that are supplying the current power needs.

Objective

The objective is to determine the feasibility of community and utility scale wind energy projects at the present time throughout the U.S. and to demonstrate that renewable wind energy technology as presently available is suitable for use in different community projects. Because there are a number of state and regional incentive programs that will affect different projects based on size, ownership, and locale, this project will look at the national incentive programs as they are applied to community wind energy programs throughout the nation. Life Cycle Assessment (LCA) will be used to evaluate the length of the pay back period. Projects can differ

greatly due to the fact that utility agreements ranging from all net metering to surplus power buy back and the base utility rate will vary, an average utility rate will be used with LCA run for a number of different scenarios to show at what point a project would become unfavorable. The issues of renewable energy certificates (REC) also know as Green Tags will be addressed as a second form of revenue, which would help to offset the cost of wind energy systems in an LCA.

Contribution to Renewable Energy

The contribution of this research is to develop a list of best practices and to determine the feasibility characteristics of different elements and strategies which should be considered when committing to a Community Wind Energy Project. Developers of Community Wind Energy Projects desiring to determine if a specific project is feasible will be able to look at this research and evaluate different options, identify which set of circumstances apply to them and decide if a different strategy might allow that project to become more feasible. In this way, Community Wind Energy Projects can be tailored to take advantage of the most economical practices for the given project type, area and size.

CHAPTER 2
LITERATURE REVIEW

Community Wind

Community wind projects are owned by farmers, school districts, colleges, tribal governments, municipal utilities, rural electric cooperatives, local businesses and others who come together to support this approach to on-site wind generated power. These projects can range in size from systems which are "commercial-scale," 2 to 50 Megawatts (MW) to systems that are designed to meet a need such as a small school district with a 50 Kilowatts (KW) system. The ability to scale these systems up and down corresponding to the need to the community truly allows them to be customized the meet the exact needs of these groups and is one of the key elements in the success of this approach to wind generated power. Steps can be taken during planning and construction of these projects to allow for the addition of turbines with relative ease to the system at a later date (Windustry, 2006).

Any wind energy project, whether a Community Wind Energy Project used for local distribution or a Wind Farm used to generate power of for transmission, is going to have substantial costs associated. These costs may be reduced but cannot be eliminated in any type of power generation project. But Community Wind Energy Projects do have a potential cost reduction element that other power generation projects do not; they use free abundant site resources in a nondestructive manner. Power generation at the community or private scale allows for the power needs of the community or site to be supplied by equipment at that location. This, in turn, allows individuals and communities to become self-sufficient rather than dependent on power, which is generated in a distant location, promoting stable energy prices and stable power supply free from outside tampering and manipulation.

Local power generation in any form also reduces the amount of energy loss caused by high-voltage electrical transmission, which travels great distances from the source of generation to the end user. The power grid of this nation has been pushed to its capacity. The blackouts and outages which hit California in 2001, and the Midwest, Northeast and Canada in 2003 are evidence that the power grid will not be able to keep up the growth in the demand of electrical power in the upcoming years. Community Wind Energy Projects will serve to delay the need to overhaul the power grid in some parts of the country.

There are a number of benefits that may be hard to quantify monetarily in the pricing of a system, as these benefits may not be evident when the power destitution gird is operating without interruption or if fossil fuels remain cheap and abundant. But in the uncertain future, these variables can have a drastic effect on the overall feasibility of a Community Wind Energy Project. During the blackout in California in the greater San Francisco Bay Area, the power outages caused an estimated $75 million in losses in the Silicon Valley because of the need for a reliable power supply of clean-room operations. One of the hardest and most important variables to consider in studying the feasibility of a system is future energy cost, and just because energy prices have stayed the same for a number of years does not mean that the same will happen in the years to come. Energy prices could increase in the years to come in the same way the gas prices have done just in the past few years.

Wind Turbine Basics

A wind turbine generator is a collection of different components assembled to generate electrical energy for use on-site or, more often, for use by consumers hundreds of miles away. The different components that make up the wind turbine generator, tower and base are listed below. In addition to these components, there are other elements necessary and important in the

evaluation of a wind generation energy system: electrical collation lines, electrical sub-station, and high-voltage transmission lines.

- Anemometer: Measures the wind speed and transmits wind speed data to the controller.
- Base: The base of most turbines is made up of steel and reinforced concrete, which allows the tower to be anchored to the surface; often there are electrical conduits which run electrical collation line out of the tower.
- Blades: Most turbines have either two or three blades. Wind blowing over the blades causes the blades to "lift" and rotate.
- Brake: A disc brake, which can be applied mechanically, electrically, or hydraulically to stop the rotor in emergencies.
- Controller: The controller starts up the machine at wind speeds of about 8 to 16 miles per hour (mph) and shuts off the machine at about 55 mph. Turbines do not operate at wind speeds above about 55 mph because they might be damaged by the high winds.
- Gear box: Gears connect the low-speed shaft to the high-speed shaft and increase the rotational speeds from about 30 to 60 rotations per minute (rpm) to about 1000 to 1800 rpm, the rotational speed required by most generators to produce electricity. The gear box is a costly (and heavy) part of the wind turbine and engineers are exploring "direct-drive" generators that operate at lower rotational speeds and don't need gear boxes.
- Generator: Usually an off-the-shelf induction generator that produces 60-cycle AC electricity.
- High-speed shaft: Drives the generator.
- Low-speed shaft: The rotor turns the low-speed shaft at about 30 to 60 rotations per minute.
- Nacelle: The nacelle sits atop the tower and contains the gear box, low- and high-speed shafts, generator, controller, and brake. Some nacelles are large enough for a helicopter to land on.
- Pitch: Blades are turned, or pitched, out of the wind to control the rotor speed and keep the rotor from turning in winds that are too high or too low to produce electricity.
- Rotor: The blades and the hub together are called the rotor.
- Tower: Towers are made from tubular steel, concrete, or steel lattice. Because wind speed increases with height, taller towers enable turbines to capture more energy and generate more electricity.

- Wind direction: This is an "upwind" turbine, so-called because it operates facing into the wind. Other turbines are designed to run "downwind," facing away from the wind.
- Wind vane: Measures wind direction and communicates with the yaw drive to orient the turbine properly with respect to the wind.
- Yaw drive: Upwind turbines face into the wind; the yaw drive is used to keep the rotor facing into the wind as the wind direction changes. Downwind turbines don't require a yaw drive, the wind blows the rotor downwind.
- Yaw motor: Powers the yaw drive.

(U.S. Department of Energy, 2006)

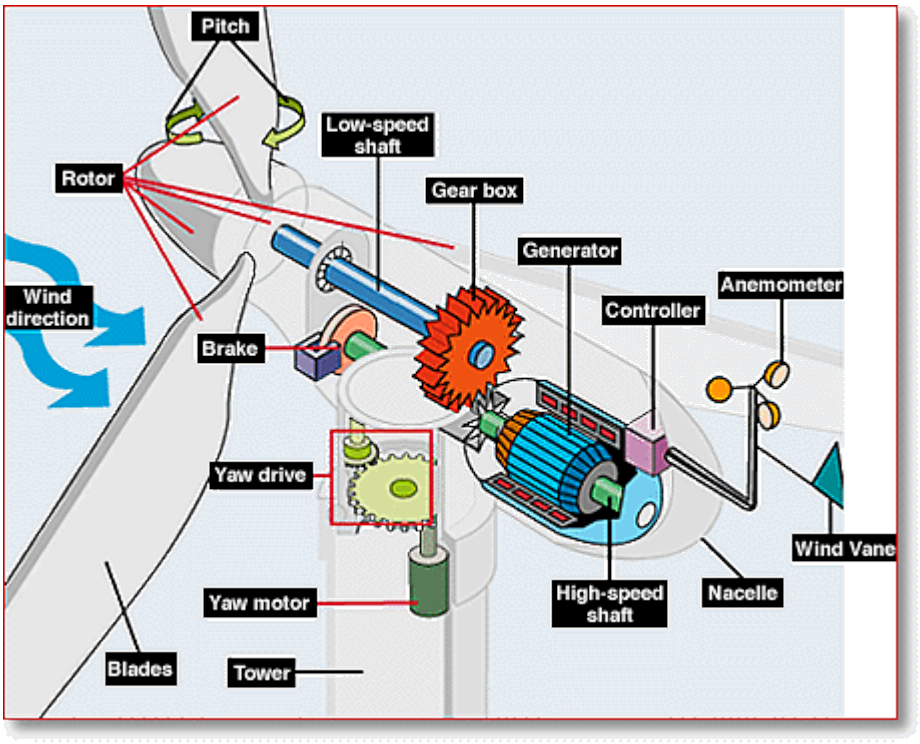

Figure 1-1. Basic elements of a wind turbine generator

Towers and Generators

The importance of the tower component of a wind energy system cannot be underestimated. There are a few different types of towers, but for a large utility scale system the only type that is usable is the tubular steel tower. These towers are made up of different sections with the base wider and the tower narrowing as the height increases. These towers can be built

in any height, but it is important that the turbines be placed as high as is economically feasible. With energy systems from 200 kilowatts kW to 2 megawatts MW the tower height will range from 30 meters to 110 meters. Wind turbine manufacturers will often offer only a few height configurations with different turbine models. It is important to note that the tower itself can be a significant portion of the cost a wind energy system (Danish Wind Industry Association, 2003).

The generators that are used in wind energy systems are somewhat different from those ordinarily found in the electrical power grid. Wind energy generators work with the forces that are supplied by the turbine rotor. On large wind turbine systems above 150 kilowatt kW the power is generated in 690 volt three-phase alternating current. This current is sent down the tower section to transformers next to the wind turbine, which raises the voltage somewhere between 10,000 and 30,000 volts, depending on the standard in the local electrical grid. Most generators have large fans for air cooling, but a few manufacturers use water cooled generators. Water cooled generators may be built more compactly, which also gives some electrical efficiency advantage, but they require a radiator in the nacelle to transfer the heat from the liquid cooling system. Starting and stopping the generator is done by "feathering" the blades, which is done by rotating the pitch so they do not incur as much drag in the wind. Then a system of a large disc brakes and locking pins are used to secure the turbine for any work needed (Danish Wind Industry Association, 2003).

Wind Energy Basic Math

An understanding of the fundamental math principles directly related to the energy production a given wind energy system is able to produce is needed to assess feasibility of specific systems in different settings. It will particularly support a better analysis of the efficiency of the systems under consideration.

Principles

Power in the Wind

The sweep area refers to the area of the circle created by the blades as they rotate through the air. This area can be found with the simple equation used for finding the area of the circle, (∏*r^2) with ∏= 3.14159 (pi), and r = the radius of the circle, which is equal to the length of one of the blades of the wind turbine. With the known area of the wind energy system, the calculation for the total power in the wind that is hitting the wind turbine can be found. The equation for the power in the wind is a follows, (P = ½ x p x A x V^3) , with P = Power (Watts), p = Air density at site, A = Swept Area of Blades, V = velocity of the wind. It is important to note that due to the fact that the wind velocity is raised to the third power in the equation, this means that an increase in wind velocity will have a greater impact in the total power available than would a increase in area or air density (American Wind Energy Association, 1998).

By doing this calculation, the total energy potential in the swept area of the turbine can be determined allowing for comparison of the actual amount of power being produced and the available power. With this basic understanding we know that an increase in the blade length, air speed or air density will all result in an increase in the production of power. This is important to understand when considering the efficiency of the turbine model which is being considered.

Wind Turbine Power

The amount of power that can be derived from any wind energy project is related to the site's resources, but also the efficiency of the equipment itself. The formula above deals with the maximum amount of energy that can be derived from the wind, while the formula below will deal with the production restraints of the equipment. It is important to note that all of the efficiency ratings of equipment will differ, not only between maker and model, but also from one turbine to another of the same model over different production runs.

Derived power is given through the equation (P = ½ x rho x A x Cp x V^3 x Ng x Nb). Where P = power in watts, rho = air density (about 1.225 kg/m^3 at sea level, decreasing with an increase in elevation), A = rotor swept area exposed to the wind (m^2), Cp = Coefficient of performance (.35 for a good design), V = wind speed (meters/sec), Ng = generator efficiency (80% when use of permanent magnet generator or grid-connected induction generator), Nb = gearbox/bearings efficiency with depends of model and design (as high as 95%). It should be noted that the efficiency ratings which are often given from the manufacturer will not always be accurate and this should be factored into any assessment (American Wind Energy Association, 1998).

Wind Power Evolution

Wind has long been used as a beast of burden for humankind, from the first ships that sailed across the water to the simple windmills that were used for grain-grinding and water-pumping with a vertical axis system developed in Persia during 500-900 A.D. These simple systems added to the daily life of the people of those times. As the world growth of technology changed, these simple wind systems were transformed into the giant windmills that would dot the landscape of the different European counties during 1300-1875 A.D.

This first windmill, which would become widespread, was used for mechanical water pumping throughout the United States during the 19th century. These mills first used wooden blades with steel blades being developed in 1870 to be lighter and stronger than wood blades. Other improvements were the ability to change direction of the blades with changing wind direction and an automated speed braking system. Between 1850 and 1970, over six million wind machines were installed in the U.S., and in many parts of the country these wind systems still serve a useful role, mainly for farms and ranches.

The first use of large windmills to generate electricity was in Cleveland, Ohio, by Charles F. Brush in 1888. With a rotor 17 meters in diameter, this 12 Kilowatt (kW) system operated for 20 years and marked a important milestone as it was the first windmill to use a step-up gearbox, (50:1 ratio) which was able to step up the revolutions per minute (RPM) from the low-speed drive shaft to the high speed drive shaft that was then connected to the generator motor (Dodge, 2001).

After this point American research and development was aimed toward the Megawatt (MW) size turbines that could be connected to the electrical grid, as that was in place due to the Rural Electrification Administration, which had brought the electricity grid to much of rural America by the mid 20th century. The goals to create the Megawatt (MW) scale of turbines here often met with failure. A 1.25 Megawatt turbine, designed and built in southern Vermont in the 1940s, was the first of its kind, and in 1941 the turbine was in operation, feeding power into the Central Vermont Public Service Corporation. The turbine was only able to operate for two years when a main bearing failure shut the turbine down (Hills, 1996).

The next leap in Wind Energy development in America occurred during the 1970s, when, in response to the "Arab Oil Crisis" of 1973, the U.S. federal government's involvement in wind energy research increased. However, despite the amount of money and effort put into wind energy research at that time, a usable model was still far off in the future. Different designs came out of the federal research, most notably 13 different small wind turbine designs ranging in size from 1 Kilowatt (kW) to 40 Kilowatt (kW) and five large systems ranging from 100 kilowatt (kW) to 3.2 Megawatt (MW) in capacity (Righter, 1996).

These designs led to a number of turbines being installed by NASA in a few locations in the U.S. but none of the designs led to a usable production line Megawatt (MW) system. The

growth of what is considered America's first commercial wind turbine market took place in California during the 1980s. Incentives for these first wind farms were provided by extremely attractive federal and state credits. These included a federal energy credit of 15%, a 10% federal investment credit, and a 50% California state energy credit; these, along with attractive rates offered by utility companies for alternative energy, were mandated by state regulation and caused the uncontrolled growth of the wind market in California. Thousands of turbines were erected at the Altamont, Tehachapi and San Gorgino passes. When the incentives where rescinded in 1985 the rush ended and the domestic wind industry collapsed while the global industry went into a period of reorganization (Righter, 1996).

It is during this time that the modern wind turbine generator came into being. As development continued by manufacturers in Denmark and in other parts of Europe, Vestas developed blade pitch regulation technology, which provided protection for the machines from dangerous blade speeds. Sales throughout Germany, Denmark, and Spain stayed steady during the time leading up to the 1990s and by the later part of the 1990s Megawatt (MW) scale systems were available for utility-scale generation of electricity (Dodge, 1996).

Publicly-Owned Utilities

Publicly-Owned Utilities with community-based power generation is not a new concept in any terms, since the first public power system was created in 1880. Public power systems serve more than 45 million people each day through 2010 different public power systems in 49 states (American Public Power Association. 2007).

Publicly-Owned Utilities can achieve greater benefits over Privately-Owned Utilities for the community in which they operate. Publicly-Owned Utilities' end goal is to service their customers and not to service stockholders. They are able to measure their success by how much money stays within the community in which they operate, how low they are able to keep their

rates, and how much money is contributed to the city budget. This leaves money within the community and does not spread it across the country and around the world to stockholders (American Public Power Association. 2007).

When looking at electrical rates, customers of Privately-Owned Utilities pay 14 percent more for services then Publicly-Owned Utilities customers and the amount of money that is able to say in the community/state is increased by Publicly-Owned Utilities. Publicly-Owned Utilities leave 15 percent more funds in the community/state than Privately-Owned Utilities due to the tax payments and other contributions that are made (American Public Power Association, 2007).

Connections and Agreement with Local Utilities

Community Wind Energy Projects may be brought forth in part by the leaders of a local town or community who would also be the directors controlling power at the local municipal utility. This allows for more direct control of the energy rate, which is a strong element in the feasibility of a project since these municipal utilities have a vested interest in power which is produced locally.

When planning a Community Wind Energy Project, communication with the local utility provider must begin at least a year in advance of the start date of the project. The choices must be made to determine if the project's energy is going to be used for distribution, used on site or close to it, or used for transmission, where the electricity is wholesaled and is then transmitted into the grid to customers cross the state and region. It must also be determined what Federal Energy Regulatory Commission (FERC) rules will apply. Projects that are less then 2 Megawatt (MW) in size will fall under the Homeowner's Interconnection Procedures while projects between 2 and 20 Megawatts (MW) falling under the Small Generation Interconnection

Agreements. It is unlikely that a Community Wind Energy Project would be conceived having a size greater then 20 Megawatts (MW) (American Wind Energy Association, 2005).

It should be noted that many utilities are required to allow "net metering," a program that allows consumers to offset their energy consumption with excess power generated onsite. These net metering laws allow consumers to offset their entire bill at the end of each billing period. But it should also be noted that many of the utility companies are unaware of the law's requirement to pay full price for any excess power that is generated and passed back into the grid after the power needs of the consumer have been met (American Wind Energy Association, 2006).

For the vast number of Community Wind Energy Projects, there is going to be a large amount of energy surplus, where school districts, businesses, and other groups that intend on using the power that is produced by their wind project will sometimes find that surplus energy needs to be sold back to the local utility provider. For these groups, as well as those intending to sell all of the power generated to the local utility, the following steps will be the same. A power purchase agreement (PPA) is a contract to buy the electricity generated by a power plant. These agreements become a key part in securing a long-term stream of revenue throughout that life of the project and this can become the hardest elements of a wind project development (Windustry, 2006).

Because this agreement becomes one of the most important and lasting parts of a wind project, much care should be taken in its creation. The length of the PPA can range anywhere from 15-25 year, which for many projects can be the life of the turbine, and once the agreement is accepted by both parties it may not be a realistic possibility to go back and ask for better terms. It is at the time the sale and purchase price will be set that this becomes a very important element

for both parties. If the project has been developed for energy transmission, then the price will be slightly higher because the buyers understand that all energy produced will be sold to them. The seller must ensure the site data supports the resource and generation ability of the project to allow that purchaser to understand, to a degree of certainty, the amount of power they can then sell to their end customer. These prices can range from $0.04 to $0.064 per Kilowatt-hour ($/kWh). Projects that have been developed for community distribution as the first goal will have the sale price for energy lower because there is a lack of guarantee on the amount of power that will be supplied from time to time. In some cases, these prices have been as low as $0.015 per Kilowatt-hour ($/kWh) (Windustry, 2006).

Another area of tension for wind energy development are the issues that come with provision of transmission. The seller is often responsible for all the cost of transmission upgrades needed to allow the power to be fed into the transmission grid. The transmission authority, Federal Energy Regulatory Commission (FERC) or state laws will govern large generation projects. It becomes important to note that Community Wind Energy Projects that are being designed for power distribution in the area and within the community will not have to deal with these problems. They, in fact, will be able to save money because of the lack of infrastructure that is needed for mass power transmission project.

During the negotiating and securing of an acceptable PPA, it is important to have qualified personnel and experienced legal counsel. Many critical terms and conditions beyond price for the purchase of the wind-generated energy are important. Because of the length of time the PPA will be active and the effect that it will have on the feasibility of the overall project, no agreement should be entered into without counsel (Windustry, 2006).

Economic, Social, and Environmental Benefits of Community Wind Project

Economics

1. The economics of a community wind project have short-and long-term benefits to the community in which the project takes place, and that does not take into account the overall growth of the national economy.

2. Revitalizes Rural Economies: When a wind energy project is owned by the community in which it is placed, it serves to diversify the economy of that community, substantially broadening the tax base. The project will provide a new source of property taxes in rural areas which would be hard-pressed to attract other forms of industry (Windustry, 2006).

3. Stimulates the Local Economy: Community wind project will have a higher multiplier than other forms of business. A wind energy project will create new jobs, grow different business opportunities within the community, and bring new investment into the community by keeping all energy dollars local rather than having them sent out of the community (Windustry, 2006).

4. Stabilization of Energy Prices: There are only operation and maintenance costs ongoing throughout the life of the wind turbine because the fuel source is free. Other fuel sources for different forms of electrical generation need to be mined and transported, which are two very expensive and fluctuating aspects of a long-term energy project. Because of these facts, wind energy will not face the same fuel price spikes that other forms of energy generation have (Windustry, 2006).

5. Promotes Cost-Effective Generation: During the early 1980s the cost of wind generated electricity was nearly 40¢ per kWh but the latest generation of turbines has the figure dropping below $0.1 per kWh, and wind farms that are using technology developed in that past 20 years is generation power for $0.3 to $0.5 per kWh (Nancy Spring, 2008).

6. Creation of Jobs: Wind energy projects have the ability like many other energy projects to create both short and long term jobs. In the short term, meteorologists, surveyors, engineers, assembly workers, lawyers, bankers, and technicians will all have a place; in the longer term, those qualified to maintain and service the turbine will find jobs are created. According to a study by the New York State Energy Research and Development Authority, wind energy creates 27% more jobs than a coal plant and 66% more than a natural gas combined-cycle plant per unit of energy generated (Windustry, 2006).

Social

1. Promotes National Security and Energy Independence: Community wind projects diversify the nation's energy portfolio and reduce the country's dependence on imported fossil fuels. In addition, independent community energy resources allow for decentralization of the national electrical grid (Windustry, 2006).

2. Diversify Community Income: Wind energy gives a new source of revenue to farmers and rural landowners, serving to diversify their income streams. These projects are compatible

with agricultural of the land, because, although wind farms can cover large tracts of land, the physical footprint of each turbine is very small, having minimal affect on livestock and agricultural production (Windustry, 2006).

3. Local Ownership: When these wind energy projects are locally owned, they give to the community and increase local control of energy production, resulting in a significant contribution to the regional energy mix (Windustry, 2006).

4. Increase Support: When then local community is able to benefit from the project, it broadens support for the wind industry as a whole; this local support will decrease opposition to new wind farms and will cultivate local advocates (Windustry, 2006).

Environmental

1. Clean Electricity Production: Wind energy is a clean, renewable source of electricity, and every community wind project serves to addresses climate change by providing a non-polluting source of energy to reduce greenhouse gas emissions (Windustry, 2006).

2. Clean Water: Wind energy produces no particulate emission that would add mercury to lakes and streams, contaminating them. Wind energy also does not require the use of water during energy production as many other form of energy generation do (Windustry, 2006).

3. Protect Natural Resources: After construction the main resource needed is wind, which is occurs naturally and is located on the site selected. There is no need to use other natural resources and no need for destructive mining and transportation of the energy resource to a rocessing facility (Windustry, 2006).

4. Land Preservation: Because the actual footprint of each turbine is small and there is a requirement for turbines to be separated, a large geographic area land is preserved for use as farm land, grazing, or other low impact usages (Windustry, 2006).

Choosing a Turbine

When choosing a turbine for a given wind energy project, a clear understanding of its capability is needed. When energy generated can only be sold for $0.03 per Kilowatt-hour ($/kWh) to the local utility, it does not make sense to sell energy to them and then turn around and buy that energy back for a school, farm, or business for $0.08 to $0.1 a Kilowatt-hour ($/kWh). The better choice and real value comes when the group is able to reduce their electricity costs buy using only power that they have produced with their one wind energy generator. This is one of the key constructs of a Community Wind Energy Project. What does

this mean when sizing a turbine for your project? Understanding the amount of energy that is used on the site is the beginning. Many groups, such as schools and large manufacturing businesses, will have a number of buildings spread over a large area, so being able to tie together the energy use of these different buildings into one bill and then to offset that bill with the power generated in one locale is where true cost savings are achieved.

Knowing how much energy needs to be generated will allow the choice of a turbine that will generate all needed power, but will not greatly exceed the needed amount. This will allow for the best turbine or turbines to be chosen to suit the need at hand. By reducing the number or size of the turbines that are needed, up-front cost saving achieved and will allow for a project to become more feasible.

The end goal of the Community Wind Energy Project should be known at this time as well. If the turbine is to be connected to a distribution level voltage system that is used for the community or one site, then the size and type of a turbine might play a role, because certain models of turbine are better suited for this goal rather than for mass power generation. The wind resource of the site in consideration should also be taken into account when choosing a turbine model. Wind turbines are designed for specific wind resources, environmental criteria along with the quality of wind, turbulence or not. One choice is to look around the area to see if they are turbine models with a good track record working in site conditions that mimic your own.

One more recent option for consideration is the ability to purchase used wind turbines. These turbines have been decommissioned from older wind farms and have been reconditioned in order to be resold. These turbines may be less expensive up front but might be burdened with operational issues that can lead to problems during the second life. There can also be problems

in finding replacement parts if needed because sometimes the original maker has gone out of business or has stopped making the parts.

When turbine selection has been made it is important to look into any warranty that the manufacturer offers. The standard is 2-year parts and labor which might include a power curve and availability warranty. It is also common for turbine manufacturers to offer to extend the warranty up to 5 years with an additional cost. These warranties often cover manufacturing flaws and will provide for replacement part and labor (Windustry, 2006).

Federal and State Financial Support

Because of the high costs relative to large scale wind farms, state and federal grants and loan programs can play a significant role in improving the feasibility of Community Wind Energy Projects. Financial support can come in many different forms, such as low or no interest loans, renewable energy production credits and tax breaks. There are several USDA and Small Business Administration loans and grant programs that can be used by Community Wind Energy Projects.

USDA

Renewable Energy and Energy Efficiency Grants: Section 9006 of the 2002 Federal Farm Bill, the Renewable Energy System and Energy Efficiency Improvements Program. Set up to promote efficiency improvement on farms, ranches and small businesses, this program has been in place since 2003 and is administered by the USDA Rural Development. It is an important source of funding for Community Wind Energy Projects, because it is can provide a grant of $500,000, up to 25 percent of the total cost of the project. The funds can be used for both hard and soft costs for the project (Environmental Law and Policy Center, 2004).

Value-Added Agriculture Produce Grants: Section 6401 of the Federal Farm Bill. This program offers grants up to $500,000. In the past, these grants have gone to activities such as

business planning, feasibility studies, and working capital related to value–added agriculture activity, but new program rules have allowed wind projects to become eligible and over the past few years, small wind power projects have been able to receive grants.

There are a number of other grants and loan programs that the Rural Business Cooperative Service Program: USDA's Rural Business Cooperative Service can award. A summary of the different programs can be found in the Table 2-1 and that end of this chapter.

Other Sources of Federal Support:

U.S. Small Business Administration

504 Loan Program: The Certified Development Company provides growing businesses with long-term fixed-rate financing for major assets. A typical 504 project would include a loan from the Small Business Administration to support up to 40% of the cost of a project, with a maximum loan of $1.3 million.

The 7(a) Loan Guarantee Program: Private lenders can use the Small Business Administration 7(a) loan program to guarantee up to 75% of the value of a loan. There is an upfront guarantee fee (paid by the borrower) of 3.5 % of loans over $700,000 with the annual guarantee maintenance fee at 0.36% of the loan amount (Environmental Law and Policy Center, 2004).

State support

The level of state support for wind energy projects vary considerably for most states that have wind power potential. Some states offer financial incentives, including production incentives, direct grants, sales and property tax exemption, and low-interest financing. For states that have seen a great number of Community Wind Energy Projects, state support has been critical in their development. Beyond direct financial support, many states have taken steps to make Community Wind Energy Projects a more significant contributor to the energy mix of the

state by requiring local utilities to buy a percentage of their power from small Community Wind Energy Projects and setting the rate at which power will be purchased. The following table shows those states that take part in these programs. See Table 2-2 for State Incentive for Utility Scale Wind Power Development.

Federal Production Tax Credit and Favorable Depreciation:

These two different programs have the ability to play a key role in the economic feasibility of Community Wind Energy Projects. The Federal Production Tax Credit is worth $47,000 to $55,000 (after taxes) per year per installed Megawatt (MW). Under the present law, an income tax credit of 2.1¢ per Kilowatt-hour is allowed for the production of electricity from utility scale wind turbine generators. It was created under the Energy Policy Act of 1992, and had lapsed in the years since, but the American Recovery and Reinvestment Act (passed in February 2009) extended this credit another three years. In addition, wind project developers can choose to receive a 30% investment tax credit (ITC) in place of the production tax credit for facilities placed in service from 2009 to 2013 (American Wind Energy Association, 2009). Wind energy projects are also eligible for Modified Accelerated Cost Deprecation, which allows a project to be depreciated over 5 years for tax purposes instead of the 20 years of conventional depreciation (Environmental Law and Policy Center, 2004).

Energy Feed-In Tariffs

Feed-in tariffs have long been a standard in Europe, which has helped to lead the growth of renewable energy systems in those countries, but the same policies have not been as widely adopted in the United States. Though there are a number of different states looking at legislation to introduce feed-in tariff, those efforts are going slowly. Recently, the Gainesville Florida city-owned utility provider introduced feed-in tariffs for photovoltaic production of electricity. This tariff also set a fixed rate feed-in of 32¢ per kilowatt-hour (kWh) for the next 20 years. This

action has helped to jump-start the solar market in Gainesville. A number of different states are looking into feed-in tariffs applicable to wind energy, but the price paid for energy fed into the system would not be as high as the tariff in Gainesville. Proposed offerings would, however, be higher than the price that could presently be received from utility providers buying surplus power (Rickerson, Bennhold, Bradbury, 2008).

Electrical Power Grid

Since the early 1990s the need for a more reliable electrical power grid has been known. The rolling blackouts in different parts of the west have made it clear that the grid, which was first built under the Roosevelt Administration rural electrification projects, needs to be updated. Over the many decades since its first introduction, the power grid has undergone many changes, but the fact of the matter is that changes to the gird have not been able to keep up with the changes on the power generation side of the equation.

Updating and total grid redesign is planned, but both of these options will cost billions of dollars and take many years, and while it is true that this is needed, a reduction in the demand side of the equation is needed now. This can be done in many ways, such as having business and manufacturing companies switch from daytime to nighttime work hours when power demands are less and energy costs are cheaper. Increasing the efficiency of both homes and businesses will also reduce the need for power throughout the day, as will increasing the amount of on-site energy production, which will reduce the power generation and distribution pressures on the power infrastructure as it is now (Fairley, 2001).

Cost of Wind Energy

When looking at the cost of Community Wind Energy Projects, it is easiest to break down the cost of a project for planning purposes into the cost per Kilowatt (kW) of peak power installed. Since 1980 the cost of wind energy system has been coming down, due, in part, to the

larger number of different manufacturers now producing turbines as well as the increase in the generating capacity of the turbines (Windustry. 2007). In today's market the price range for wind energy installed is $1,000 to $1,750 per Kilowatt (kW) of peak power. Using this simple understanding, a project's total cost can be estimated. It should be noted that economies of scale come into play when considering a wind energy project as the total cost per Kilowatt (kW) installed will decrease with a large project (Danish Wind Industry Association, 2003).

Economies of Scale

When considering a move from a 150 kilowatt kW system to a 600 kilowatt kW system that price would roughly triple rather then quadruple and the reason for this is that many of the components that are used in the manufacturing of a 150 kilowatt kW system are not very different from what is required to build a 600 kilowatt kW, items such as safety features, man power to build these systems, and the amount of electronics required to run both system will be much the same. This can also be said when considering the cost of operating a wind farm rather then individual turbine (Danish Wind Industry Association, 2003). An important issue is that even if the prices are very similar in the range from 600 to 750 kilowatt kW system, there would not necessarily be an increase in the amount of power that could be generated if the750 kilowatt kW system had a relatively small rotor diameter but a larger generator then a 600 kilowatt kW machine and both are located in a low wind area then the 750 kilowatt kW system may generate less electricity (Danish Wind Industry Association, 2003).

Capacity Factor

In the early stages of planning a wind energy project, questions will be raised about the amount of energy that can be produced from the site when different models of equipment are used. An easy way to understand the amount of energy that can be produced from a given equipment configuration is to use capacity factor. Capacity factor is one element in measuring

the production of a power generating facility such as a wind turbine or turbines. It compares the actual production of the plant over a given period with the amount that plant should have produced if it had run at full capacity for that same period.

$$\text{Capacity Factor} = \frac{\text{Actual amount of power produced over time}}{\text{Power that would have been produced if the turbine operated at maximum output 100\% of that time}}$$

Power generation facilities that operate using other forms of fuels, such as natural gas and coal, would operate a capacity factor of 40% to 80%. But because a wind turbine uses the wind as a fuel source, the capacity factor will be less, because, though a utility scale wind turbine will operate 65% to 80% of the time, it will often run at less than full capacity due to the fact that it may operate in winds which are less then ideal. Because of this, a capacity factor of 25% to 40% is common, but with the ability to achieve higher capacity factor during a time of high winds. It should be noted that if the wind turbine only ran during optimal winds speeds, the capacity factor would be 60% to 80%, which is comparable to other forms of power generation (American Wind Energy Association, 2007).

Wind Resources / Site Selection

There is no more important element to a Community Wind Energy Project than the wind resources that will be available to the project. This is, after all, the element which will control the amount of energy that a project produces. Wind speed is a critical element in the project's turbine performance and a site's wind speed should be well measured and a thorough wind resource assessment should be completed prior to any construction. For small home wind energy systems, wind speeds of 4 m/s or 9 mph are required, but this is for a system that is smaller than 10 kilowatts (kW). For larger utility or community scale wind projects the wind speed minimum needs to be above 6 m/s or 13 mph, with high wind average wind speeds being preferable. The

wind also needs to be as turbulence free and unidirectional as is possible, elements that are effected by the site's topography (American Wind Energy Association, 2007).

The site where the wind energy project is placed is very important. Wind turbines need to be placed where they access steady high winds that are not broken up because of changes in the topography of the surrounding area, high trees, or buildings. One reason that large wind farms are placed where there is little else is because of this fact. Wind speed and wind consistency are both improved the farther above ground the wind turbines are placed. This base understanding is applied to any site, and when considering a site that is made up of a number of ridges and hill tops, the ideal place for wind turbine placement would be at the peak of the ridges or hill tops.

Wind Resources Maps

There are many sources of information that will allow for a better understand of wind resource of any site. These wind resource maps are for basic wind speed data for a site to be had, and many of the newer sources have interactive fetchers that allow someone to choose how high above the ground they want to receive date for. The U.S. Department of Energy has produced a wind resource map for all 50 states with data being gathered at 50 meters and this map shows the different parts of the country that could produced wind energy. When looking at any wind resource map areas that are shown to have wind speeds at excess of 13 mph will be able to support renewable wind energy (U.S. Department of Energy, 2008).

Ones of the great options for wind energy is in the form of off shore wind farms. Because of the increase in wind speeds, availably and quality of oceans wind they lend themselves perfectly to this concept and there are even areas of the Gulf of Mexico that would be suitable for off shore wind farms. Off shore wind farms do have an added cost in construction because of the difficulty and the operation and maintenances is also increased because of the

limited access to the turbine, but the energy that is generated can easily be used in the city that are along the coastline of America. With many off shore wind farms that are in operation in Europe being just a few miles out to sea, it is important that the water is not to deep because this will add to the cost of the foundation.

Other parts of the country that would be ideal for wind energy generation are located throughout the Mid-West and Great Plaines, since these areas are not has highly populated as the coast is, and there is a need for power generation that wind energy could easily fill. These areas of the country that are seeing the instillation of large wind farms that are used to generate power which is then transmitted off to cites hundreds of miles away. Because there is such a vast amount of wind energy in these rural parts of the country which could be used to generate power for far off cities, and increase in the importance of transition technology which could be used in the updating of the power grid, an increase in efficiency and capacity needs to be seen in the power grid before the mass wind resources of these area could truly be accessed (U.S. Department of Energy, 2008).

Because the average wind speed and the quality of the wind is of such importance, there should be wind resource studies done before the development of any wind energy project, utility scale or wind farm project. Wind resource studies will show the wind resources of the site, i.e. the average wind speed, direction of the wind, variation in either, alone with other weather related data. These studies used meteorological towers that allow for the gathering of this information at the proposed height of the wind turbines, these meteorological towers or MET towers for short, should be placed at the proposes location of the turbine so that the most realistic data can be gathered. The study period for should be one year, which would allow for a better

understanding of the site, and often, if the project is being financed by banks, this information can be used to show the investment as being valuable (Windustry, 2006).

Building Energy Use

When designing a renewable energy system, an understanding of the energy use of the building or site is necessary. This information can be gathered from many different sources; one, and the more reliable, being historical data from the building or site. If the project being considered is a new building for which there would be no historical data, then one of the best ways to understand the energy used would be to look historical data for buildings which are in the same climate as the one the is being proposed. This data can then be used to calculate the energy use per square foot and applied to the specifics of the building being proposed. The American annual energy consumption per square foot for a office building is typically 15.5 Kilowatt- hours (kWh/sf). The best way to understand the energy use of a building that has not been built yet is to have energy modeling completed for the building before the designs are finalized (U.S. Environmental Protection Agency, 2006).

Wind Energy System in School Districts

The first utility wind energy system to be installed at a community school in Iowa was at Spirit Lake Community School District in Dickinson County in September 1991. The project was conceived by two men, former Superintendent Harold Overmann, and then-Superintendent Tim Grieves during a student flag football game. The two men wondered if the wind which frequently gusts across the campus could power the school. They believed the wind energy could reduce the district's environmental impact and provide an economic boost for the school district (Galluzz and Osterbergy 2006).

When a local owner and founder of a wind energy consulting company was approached to assisted in the district planning of their wind energy system, the project began. A 250 kilowatt

kW turbine was selected, the tower height was 140 feet with the blade length being 45 feet, the turbine was located 800 feet behind the elementary school. The district created a contract with Alliant Energy Corporation to sell excess power from the turbine, and the length of this contract was 33 years. The turbine was connected directly to the elementary building and any excess power was then purchased from the school district for $0.0602 per kilowatt-hour kWh. The total cost of the project was $239,500, and for financing of this turbine the district received a $119,000 grant from the U.S. Department of Energy, while the remaining cost of the project, $120,500, was financed by a low-interest loan approved by the Department of Natural Resources' (DNR) Energy Bank Program. These turbines came online in July 1993. The cost of the project was paid for 5.5 years, and since 1998, the end of the pay back of the loan, the district has offset $23,124 annually in electric costs with the power produced by the wind energy system (Galluzz and Osterbergy, 2006).

Because the school district experienced such success with their first turbine, they decided to use a second wind energy system, and the turbine that was selected was a large 750 kilowatt kW system, the tower height was 180 feet with blade length being 77 feet, this turbine was also placed 800 feet behind the elementary school. This turbine was connected to the grid and it should be noted that all eight of the district buildings have net metering, which this turbine was to be used to off set. The district created a 20 year contract with Alliant Energy Corporation to sell excess power that is produced at $0.02 per kilowatt-hour kWh. The energy which was being offset would have normally been bought from Alliant Energy for $0.085 per kilowatt-hour kWh. For financing for this project, a $250,000 no-interest loan was provided from the Iowa Energy Center's (IEC) Alternate Energy Revolving Loan Program (AERLP) and a $530,000 loan from Energy Bank was financed at 5.1 percent. The second turbine came online in October 2001. A

total of $120,987 of energy cost is offset and $1,377 in revenue is generated each year, and in 2008, when there was no longer a loan to be paid back on either of the two turbines, the total saving will be over $144,100 annually (Galluzz and Osterbergy, 2006).

During the operation of both turbines, there were no significant problems, maintenance for the first 5 years of the second turbine was included in the cost, and insurance for both turbines is covered under the district's policy and is "not a significant cost." There is a warranty contract for the second turbine that cost $5,000 a year and is offered for the first five years. Neither of the two wind energy systems takes advantage of the sale of Green Tags, or the Federal Production Tax Credit (Galluzz and Osterbergy 2006).

It should be noted that the district has taken steps to reduce their overall energy use by converting its buildings to energy efficient lighting and using geothermal heating and cooling in the high school. Because of the offset in energy, the two wind energy systems at the district annually emit 3,032,000 fewer pounds of carbon dioxide, and 439,800 fewer pounds, of sulfur dioxide (Galluzz and Osterbergy, 2006).

Conclusion

Community Wind Energy Projects can serve a much needed role in rural communities throughout North America. Depending on the size of the project and the wind resource of the site, a wind energy project could possibly supply all of the electrical power needs of a large portion of the community in which it is placed. Often, distribution of the power generated within the community has the greatest economical benefit because you are able to subsidize the energy you would have been buying from a utility company at a much higher price than your production costs. Even though the planning and execution of Community Wind Energy Projects may be not be simple, the benefits which can be reaped will be long-lasting.

Table 2-1. USDA's Rural Business Cooperative Service Summary of Programs

Program	Eligibility	What Program Supports	Type of Support	2004 Funding Level
Renewable Energy and Energy Efficiency	Farms, Ranches, Rural Small Businesses, Cooperatives	Capital costs of renewable energy and energy efficiency equipment	Grants (loans and loan guarantees in future years)	$22.8 Million
Value-Added Producer Grants	Farms, Ranches, Cooperatives, Producer Groups	Planning, marketing and feasibility studies; working capital	Grants	$10.5 Million
Business/Industry Guaranteed Loan Program	Rural businesses	Guarantees for business loans made by rural lending institutions	Loan guarantees up to 80%	$840.0 Million
Rural Economic Development Loan and Grant Program	Rural Electric and Telephone Cooperatives	Low-interest/nointerest loans	Loans to Rural Businesses, Public Agencies, others	$18.9 Million
Rural Business Opportunity Grants	Local government, non-profit, tribes, cooperatives	Technical assistance and training supporting rural economic development	Direct grants to organizations	$3.0 Million
Intermediate Relending Program	Local government, non-profit, tribes, cooperatives	Revolving Loan Fund	Subsidized loans to intermediaries	$39.8 Million
Rural Business Enterprise Grants	Local government, non-profit, tribes, cooperatives	Loan funds or direct grants	Grants to intermediaries for use as seed grants or loans	$43.8 Million

Table 2-2. State Incentive for Utility Scale Wind Power Development

State	Property Tax Exemption	Sales Tax Exemption	Grants, Rebates	Loans	Production Incentives
Alabama					
Alaska				X	
Arizona		X			
Arkansas					
California			X	X	
Colorado					
Connecticut	X		X		
Delaware			X		
Florida					
Georgia					
Hawaii					
Idaho			X	X	
Illinois			X		X (large projects only)
Indiana					
Iowa	X	X		X	
Kansas	X				
Louisiana					
Maine			X		
Massachusetts	X	X	X		
Michigan	X				
Minnesota			X		X (< 2 MW)
Mississippi					
Missouri				X	
Montana			X		
Nebraska				X	
Nevada	X	X			
New Hampshire	X				
New Jersey		X	X	X	X
New Mexico					
New York	X		X	X	
North Carolina				X	
North Dakota	X	X			
Ohio	X	X	X	X	
Oklahoma					
Oregon	X		X	X	
Pennsylvania			X		
Rhode Island	X	X			X
South Carolina					
South Dakota	X				
Tennessee	X				
Texas	X				
Utah		X			
Vermont			X		
Virginia					
Washington		X	X		
West Virginia	X				

Table 2-2. Continued

Wisconsin	X		X
Wyoming		X	

(North Carolina Solar Center, 2009)

CHAPTER 3
METHODOLOGY

The goal of this thesis is to determine the overall feasibility of Community Wind Energy Projects, which are intended to offset the cost of power that is currently being purchased from a local utility company. These projects are being built by a group of private owners, a business or a school district. An understanding of the energy needs of a given site, building or group of buildings is needed when considering what size system is required. There must also be an understanding of intention, if the goal of the wind energy project is to offset a portion of the energy needs of a given site, produce all of the energy that is needed by the site, or to generate a surplus amount of energy that could then be sold back to the local utility provider. If the energy is not going to be used on the site and is intended to only be sold to the local utility, what are some the elements that would allow for this to be more feasible? The analysis will look at the project for a period of 20 years, which is based upon the stated life-span of wind power generators. The research will be shown through three cases.

Completion of this research required the development of a financial spreadsheet calculator which will be employed to demonstrate the financial feasibility of a particular renewable wind energy system for site power generation. The financial feasibility of a system will be judged by considering the upfront costs of the system as well as the Life Cycle Cost of the system. The calculator will include all necessary basic elements in its design, which will allow for it to be used by others evaluating the feasibility of different wind energy projects. A description of those elements in the different sheets within the calculator is provided below.

The sheet titled "Scenario Project Parameters" allows for the input of data that is specific to the individual scenario or project under consideration. This sheet is subdivided into four different categories to fully cover all project parameters as defined here:

Project Generation

This section gathers the data elements collected or calculated to assess the generating capacity of the projects. There are elements that are specific to the type of turbine being used and the amount of wind resource available on the site.

- Number of Turbines: The number of turbines being used in the project at the same time; understanding that Community Wind Energy Projects do not exceed 2 Megawatts MW in total generation capacity.
- Turbine Size: The size rating given to the turbine by the manufacturer that describes generation capacity of a single turbine given optimal conditions.
- Project Size: This is the total generation capacity of the project; calculated from the data inputted for the two previous elements.
- Net Capacity Factor: A measure of the production of the wind turbine, this figure compares the actual production of the plant over a given period with the amount that plant would produce if it was running at full capacity for that same period. For the purpose of this thesis, the Net Capacity Factor will be set at 25% which is at the bottom of the range for wind turbine generation.
- Annual Hours: The number of hours the wind turbine could operate during a year.
- Availability: An estimate of the percentage of time the wind turbine could operate during a given time span; the percentage will decrease over the life of the turbine due to wear and tear and the need to be taken offline for repairs and maintenance.

Project Cost

This section presents the cost of the project in terms of the cost paid for the wind energy system itself and the additional costs that are incurred because of loans that are needed to complete the project.

- Project Cost per kW: This is the cost of the equipment and the construction of the wind energy project on a per kilowatt basis, which was previously described in the literature review. For the purpose of this thesis, the cost is set at $1,250.
- Project Power, kW: This number is calculated from data entered in the Project Generation section.
- Total Cost: This amount is calculated from the entries for project size and cost per kW.

- Down Payment Percentage: This is the percentage of the Total Cost that is paid upfront and is used in the Life Cycle Cost analysis section of the spread sheet calculator.

- Loan Rate: This is the rate of interest for the principal of the loan, also used in the Life Cycle Cost analysis section to understand the total cost of the project.

- Analysis Period: This is the total time to be included in the analysis and is equal to the length of the loan; set to 20 years, which is expected life span of a wind energy system.

- Energy Inflation: This is the estimate of the annual increase in the cost of energy, which needs to be considered as an increase in expense of operation.

- Warranty Expense: This is a percent of the total cost of the project that is incurred during the first year of operation.

- Insurance Cost: This is a percent of the total cost of the project that is incurred every year of the analysis period.

- Operation and Maintenance Cost: This is an added cost of operation of the project taken as a percentage of the total first costs of the project; it is an escalating percentage over the life of the system because of the increasing need for repair as the system ages.

Energy Production/Use

This section is based on the total production of the wind energy system, which is automatically calculated from information already entered, including site specific information.

- Year Total kW: The amount of energy generated on this site by the renewable wind energy system is automatically calculated from information given in the Project Generation section.

- On-Site Usage kW/year: This site specific information is derived from historical site use; for this thesis, this value was set at 1,550,000 kilowatts per year (kW/year) to represent the energy use of two 50,000 square foot buildings.

- Surplus Energy: This is the difference between the total generation of energy on the site and the energy that is consumed on the site.

Revenue

This section deals will the elements affecting the revenue stream of the project. From the energy produced, there are many ways in which revenue can be generated and cost savings can be gained from a wind energy system.

- Power Purchase Agreement Rate ($/kWh): This amount will be governed by the agreement that is reached with the local utility company and the owner of the wind energy system. The price at which surplus energy is sold back to the utility company can play a very important role if there is a substantial or if there is a tariff in place for renewable wind energy that could influence the owner to sell all the energy to the utility company if the price that is being paid is higher than the cost of energy that is being purchased. There is an annual escalation percentage placed on this amount that represents the rising cost in energy.

- Cost of Energy Purchased ($/kWh): This cost is set by the local utility company and is important, because the higher this amount the greater the cost saving can be by offsetting energy purchased from the utility. This amount also is important when planning the wind energy systems; if the cost of energy being purchased is a great deal higher than the amount for which any surplus energy can be sold, then it makes sense to plan the generating capacity of the wind energy system as close as possible to the energy needs of the site and not to generate surplus energy. There is an annual escalation percentage placed on this amount that represents the rising cost in energy purchased.

- Green Tag Revenues ($/kWh): This source of revenue is gained by selling the environmental benefit of renewable energy separately from the energy itself. This practice is described in the previous literature review. This revenue stream, which has only recently been taken advantage of, is very important because it allows for the sale of an intangible product. There is an annual escalation percentage placed on this amount that represents the rising cost for which these credits are sold.

- Federal Production Tax Credit ($/kWh): This incentive is provided by the Federal Government with the intent of making wind energy competitive with other sources of energy generation. It is important to note that this incentive only adds to the competitiveness of wind energy and does not by itself make wind energy cost competitive. There is an annual escalation percentage placed on this amount as well.

Case 1

This case will consist of a project site that has two fictional existing office buildings of 50,000 square-feet each that exhibit the average annual energy used for office building of 15.5 Kilowatt- hours (kWh/sf) with a total energy use of both buildings at 1,550,000 kilowatt-hours (kWh) per year. The land surrounding both buildings is owned by the same owner, so there will not be any zoning or permitting issues that will have to be examined. The end goal of the wind energy project is to determine the different elements of the project that will change as the generating capacity of the project is sized to be 25%, 50% 100%, and 125% of the energy needed

of the buildings. A Life Cycle Cost analysis will be completed comparing the four different scenarios set against a base case, which will consist of the site operating without any onsite energy production system.

Case 2

This case will examine a project that has a renewable wind energy system with the ability to provide 100% or more of energy needs of the site and, after all energy needs of the site are met, the turbine is turned off. It will examine the different elements that could lead an owner of a renewable wind energy system to generate more energy than can be utilized on the site for the purpose of selling the surplus energy back to the local utility company. The element of change will be the price that is paid for the energy being sold back and the possibility of a tariff being paid for any renewable energy produced.

Case 3

This case will look at the overall constructability and logistic feasibility of installing a renewable wind energy system on the site in "Case 1;" the limitation and requirements of the site will be explored.

CHAPTER 4
RESULTS AND ANALYSIS

The findings of this study are presented below in three cases.

Case 1

Case one examined the economic feasibility of producing electrical energy through an on-site renewable wind energy system. The parameters set for this case are the following: 1) two 50,000 square-feet buildings that used a total of 1,550,000 kilowatt-hours (kWh) annually, 2) the surrounding land owned by the building's owner and granting no zoning and construction problems, 3) set energy costs of $0.105 ($/kWh) purchased from a local utility provider with an annual escalation of 2%, 4) sell back of surplus energy to the local utility at $0.02 ($/kWh) with an annual escalation of 2%, 5) Green Tag selling price of $0.025 ($/kWh) to a third party with an annual escalation of 2.8%, and 6) Federal Production Tax Credit of $0.021 ($/kWh) with annual an escalation of 2%. These remain the same parameters for the four different scenarios run for this case with all elements of the financing set as well. The only element changing among scenarios is the percent of total energy use to be offset with on-site wind energy. Those percentages will be 25%, 50% 100% and 125%, accordingly.

Figure 4-1 below displays the total cost of the loan and interest that is needed to finance the turbine used for the wind energy system. The annual revenue and savings come from the sale of the Green Tags, surplus energy (if any was produced) sold back to the utility company, the Federal Production Tax Credit, and the cost savings gained by off-setting the amount of energy that had to be purchased from the local utility, less than the operating and maintenance costs.

The Rate of Return (ROR) from the first three scenarios is the same at 2.08 because all of the energy being produced is used to offset the energy needs which would otherwise would need

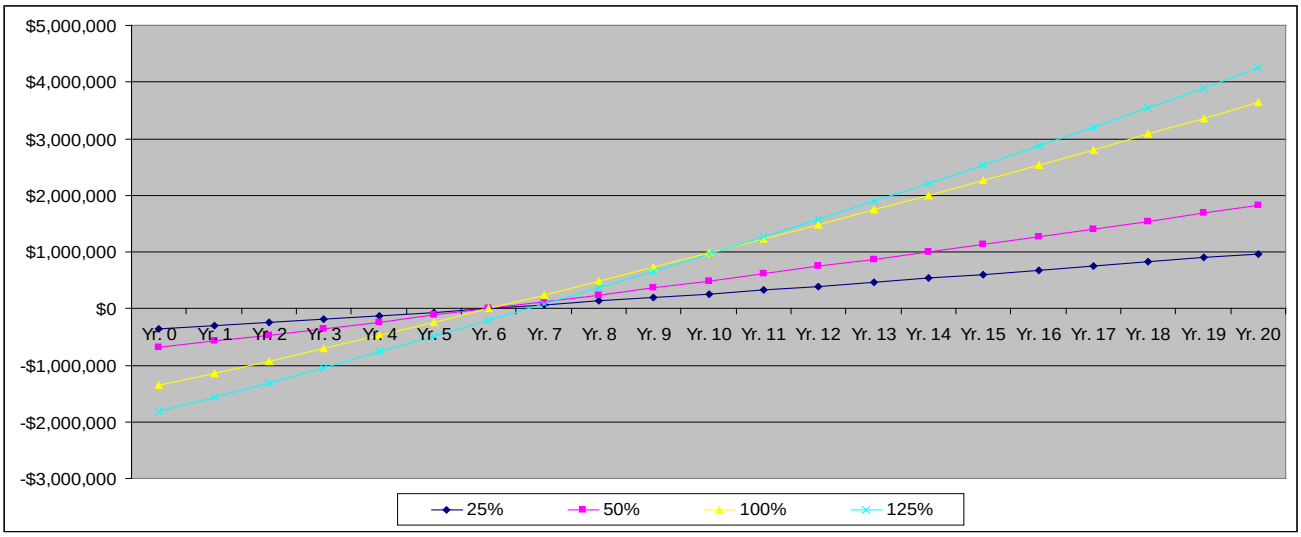

Figure 4-1. The LCC for the four different sized systems in Case 1

to be purchased from the local utility at a higher price. When the wind energy system production crosses the line between where the energy is only used on-site to the point where surpluses are sold to the local utility at a much lower rate, then it could be purchased for use by any end consumer. The ROR for the scenario set at 125% of site energy needs to drop to 1.82.

When considering the Life Cycle Cost of any of the systems that have been proposed, that total cost that would be incurred during the 20 year life span of the system needs to be viewed alongside the cost of having no system for those same 20 years, i.e. the best case of operating without an onsite energy production system is represented as 0%. This relationship can be seen by viewing the four different scenarios, 25%, 50%, 100%, and 125% of power needs, run in Case 1 for the four different levels of onsite power generation against the base scenario which does not have any on site power generation. By comparing these five scenarios, the true cost of the systems outlined in Case 1 can be understood.

The base scenario represents the cost of energy that would need to be purchased from the local utility in the 20-year analysis period because there is no other source for the energy on the site. But as Figure 4-2 shows, the different percentages of onsite power generation are viewed as

the true cost of a system, including the cost out of pocket for energy from the utility plus the cost of the loan, interest, insurance, maintenance and operation of the wind energy system minus any revenues generated and the savings from producing energy on site.

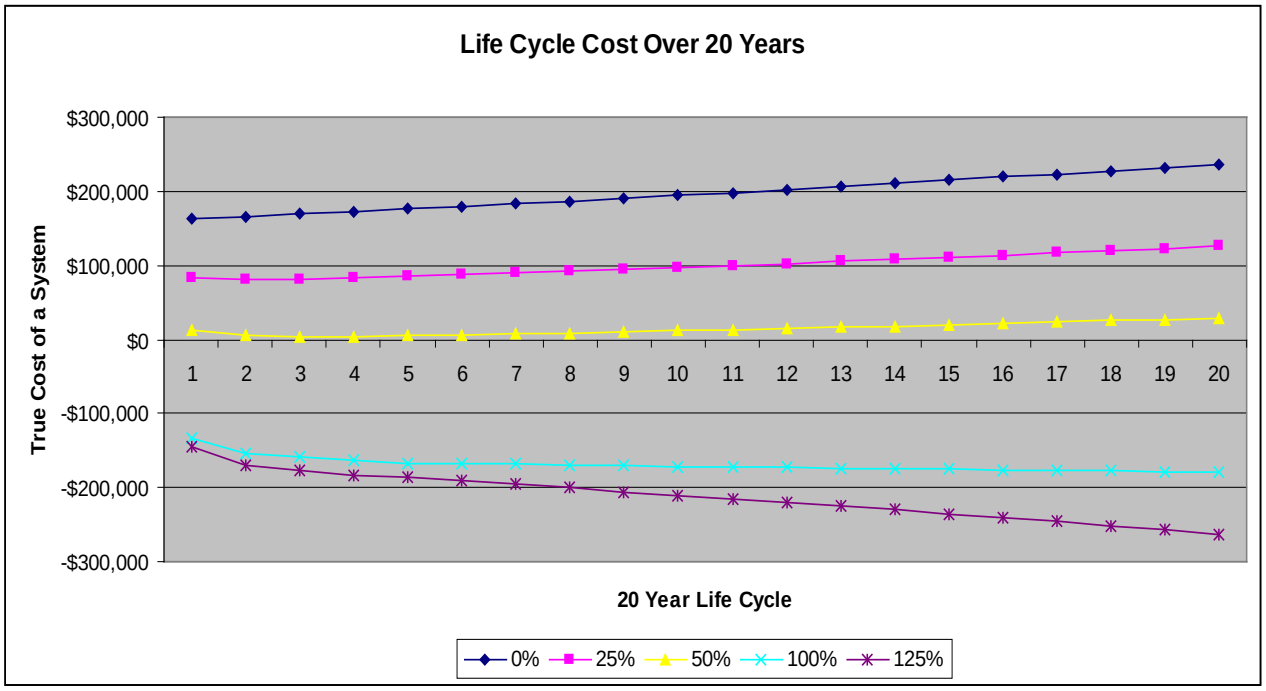

Figure 4-2. LCC relationship of the five different scenarios.

Because the annual energy demands of Case 1 are as low as they are the power generation needs of the site could be fulfilled by one turbine for all four scenarios. The size rating for the turbine would be different, but the overall footprint would not change a great deal. The project parameters, expenses and revenues for a 20-year analysis and life cycle analysis for Case 1 can be found in Tables 4-1 through 4-20 in Appendix A.

Case 2

Case 2 examined the feasibly and benefits of having an over-sized wind energy system that was able to provide more than 100% of the annual needs of the site. Using information gained from the first case, the scenarios run for this case indicate a clear drop off in economical advantage seen when surplus energy is sold back to the local utility. In this case the different

scenarios show the change in the payback period and rate of return when the price for surplus energy sold back is changed. A total of 12 scenarios were completed, four of the scenarios examined the project feasibility when turbine sizing was set to meet 100% of the site needs only with the sale price for surplus energy being $0.02 ($/kWh), $0.055 ($/kWh), $0.105 ($/kWh) to represent net metering or $0.3 ($/kWh) which would represent a price that could be achieved if a renewable energy tariff was in place. The next four scenarios that were run changed the production size of the turbine to 125% of the site's energy needs and then had the same four changes in the price of energy being sold. The last four scenarios that were run had the turbine size at 200% of the site's energy needs with the same four changes in energy sale prices. With the sale price for surplus energy altered in the different scenarios, the economic impact is easily understood in that a high sales price will improve the payback of a wind energy system when it produces surplus energy, but the effect of having a feed-in tariff would truly tilt the scale to economic feasibility.

Scenarios 1-4

Scenarios 1-4 used a system sizing to meet 100% of the site's energy needs , meaning that little, if any, surplus energy would be produced. A lack of surplus energy sold back will reduce the over-all payback period of the system. The graphic below displays the payback period of a base system, which is meant to offset the energy use of the site. That information can be compared to systems that have a high up-front cost but also have a higher revenue stream due to the fact that surplus energy is being sold back at different prices through the four different scenarios. The project parameters, expenses and revenues for the 20-year analysis and life cycle analysis for scenarios 1-4 can be found in Tables 4-21 through 4-40 in Appendix B.

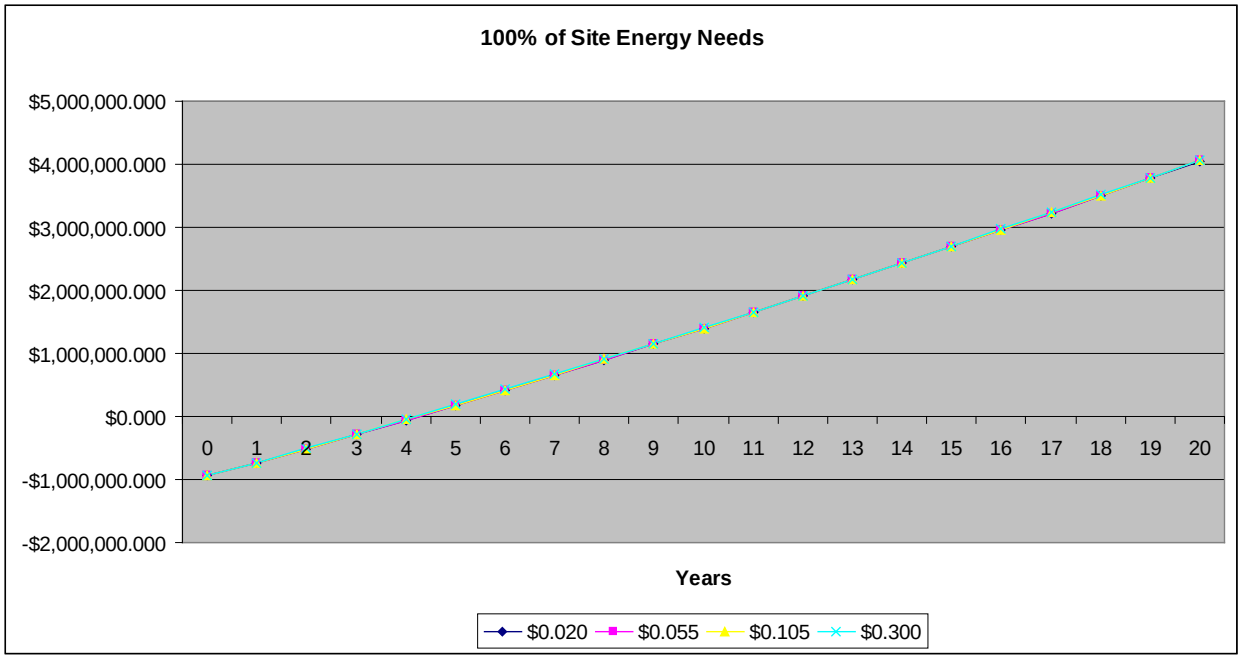

Figure 4-3. LCA for scenarios 1-4

Scenarios 5-8

Scenarios 5-8 used system sizing to meet 125% of the site's energy needs, producing surplus energy that is than sold back to the local utility provider. The four different scenarios use a surplus energy sales price from $0.02 ($/kWh), $0.055 ($/kWh), $0.105 ($/kWh) which represents net metering and $0.3 ($/kWh) representing a feed-in tariff. Because of the change in the sale price for energy, there is a corresponding change in the payback period for each of the scenarios. The systems in each of the scenarios are the same and the only element changed is the energy purchased, with a decrease in the payback period seen as the price increases. There is a marked increase in the length of the payback period from the system used in Scenarios 1-4 compared to the system used for Scenarios 5-8. Even though there is a surplus of energy sold, it is not until the price being paid for the surplus energy passes the purchase price for energy originally brought from the utility provider that it becomes economically beneficial to have a larger system with a greater cost up-front. There is a marked increase to the total Net Savings in

the two different scenarios over the 20-year life of the wind energy system, with a positive increase seen at all four different purchase prices of surplus energy, $562,893.00 at the sale price of $0.02 ($/kWh), $887,887.00 at $0.055 ($/kWh), $1,352,431.00 at $0.105 ($/kWh), and $3,163,725.00 at $0.3 ($/kWh). The project parameters, expenses and revenues for the 20-year analysis and pay back periods for scenarios 5-8 can be found in tables 4-41 through 4-60 in Appendix B.

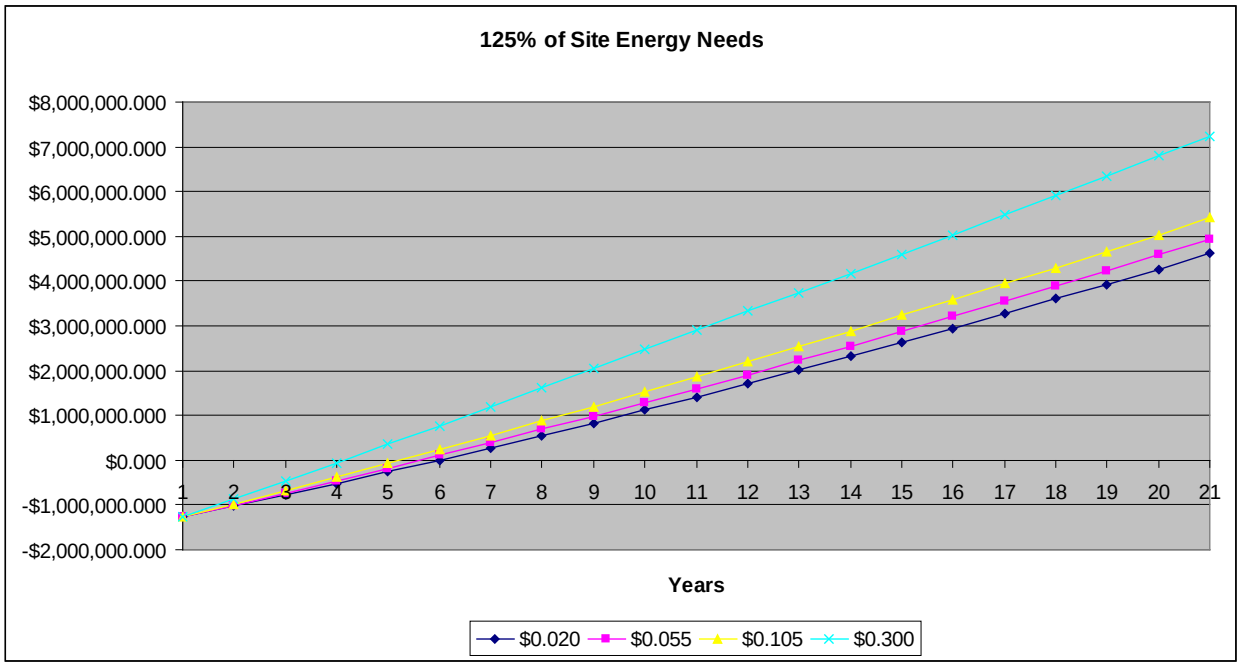

Figure 4-4. Pay back period analysis for scenarios 5-8

Scenarios 9-12

The last four scenarios evaluated showed an increase in the amount of surplus energy produced. These scenarios used a system designed to meet 200% of the site's energy needs. Because of this over-sizing there is an increase in the initial cost, but also a later increase in revenue generated. When comparing Scenarios 9-12 to Scenarios 5-8 there is an increase in the payback period from this large system when the surplus energy is sold for $0.02 or $0.055 ($/kWh), no increase in length of payback for the system when energy is sold at $0.105 ($/kWh)

and a decrease in the length of the payback when energy is sold at $0.3 ($/kWh). There is a marked increase in the amount of Net Savings that can been seen at the end of the 20-year life span. Over a 20 year life of the wind energy system, a positive increase can be seen in all four of the different scenarios representing the different purchase price of surplus energy, $707,686.00 at the sale price of $0.02 ($/kWh), $1,530,053.00 at $0.055 ($/kWh), $2,704,862.00 at $0.105 ($/kWh), and $7,286,619.00 at $0.3 ($/kWh). These amounts represent a large increase in Net Savings over the different scenarios with payback period changing relatively little in two scenarios, not at all in one and changing for the positive by decreasing in the last one. The project parameters, expenses and revenues 20-year pay back period for Scenarios 9-12 can be found in Tables 4-61 through 4-80 in Appendix B.

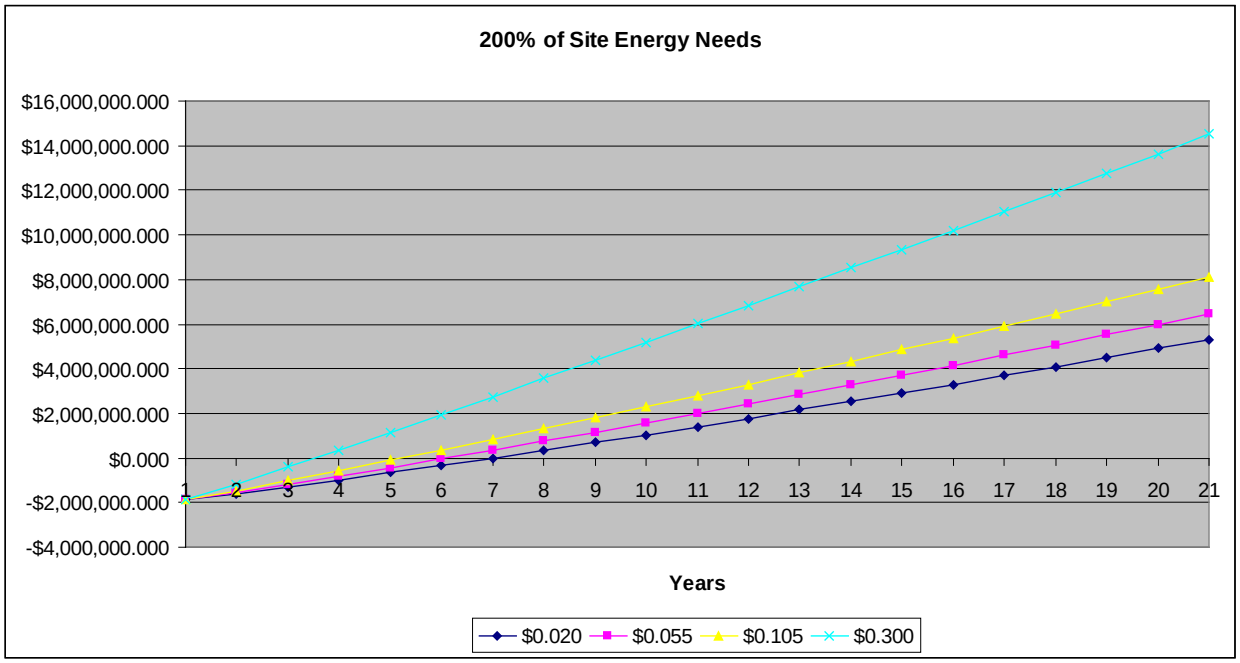

Figure 4-5. Pay back period analysis for scenarios 9-12

Case 3

Case 3 examined the constructability of the four different size systems in Case 1. The site in Case 1 consisted of two buildings at 50,000 square-feet each with a total annual energy

use of 1,550,000 kilowatt-hours (kWh). The site was deemed to have the needed wind resource to support a wind energy project. The owner of the two buildings also owned the surrounding land, allowing for placement of the wind energy system on the site without any zoning or permitting problems. To offset a certain percentage of the site's total energy needs, four scenarios were chosen; 25%, 50%, 100% and 125% of the total energy needs of the site. For these four different scenarios, the size of the systems needed to meet the production needs of the site were found to be 200 kilowatt (kW), 375 kilowatt (kW), 750 kilowatt (kW), and 1 megawatt (MW) systems. Because the first three scenarios could be run with the installation of only one turbine on the site, the first three constructability analyses were done together. The last scenario could be completed with either a single 1 megawatt (MW) turbine placed on the site or with two 750 kilowatt (kW) turbines; the last analysis will look at both cases that could be used on the one site.

Analysis 1

When looking at the first three scenarios of Case 1, the power generation needs of the site could be fulfilled with the installation of a single turbine on site. As the turbine's rated size increases the overall size of all of the components increases as well, but the construction of each turbine is much the same and the equipment used will be similar; the only element of the equipment that will change will be the size. When selecting the site for a turbine, the wind resource plays the most important role, as wind often comes into a site from one general direction. It is important that no large obstacles, such as buildings, trees and other turbines be located between the incoming wind and the turbine. The turbines also need to be placed away from structures and people with these setbacks often 1.1 times the total height of the wind energy system, which is the tower height plus the length of the blade in the vertical position. This distance allows for a catastrophic failure of the system without putting other objects or persons in

danger. This clear space around the turbine site also allows for easy access for construction and assembly of all of the turbine components.

During construction, the turbine site and the area around it will needs to be cleared; this area is often slightly larger than the area a fully assembled blade section would occupy. But after construction, the surrounding site can be returned to the previous use such as farm land or grazing because the footprint of the turbine extends just a few feet from the base. The collection lines (electrical lines that transfer the power generated to the end use) are buried underground for safety. The energy that is generated is three-phase electricity sent to a transformer which, depending the site and the end use, can be stepped up or down in voltage and then transmitted for use.

Analysis 2

For this analysis the site energy production needs can be met with the installation of either one or two turbines on the site. At this point, it becomes a choice for the owner of the site; there would be an increase in the cost of construction if more than one turbine is to be installed because the amount of work and the length of time would be increased, but the size of the equipment needed for handle the turbine components would not change. A major issue to be addressed is the placement of the two turbines on the site. All elements of the first analysis would still hold true for this analysis but with an added concern. Because the wind turbine takes energy out of the wind, the wind behind the turbine is often very turbulent and less productive than it was before it passed over the blades. This means turbines placed directly in line with each other and the prevailing winds need to have a greater spacing than turbines that are placed in a direction perpendicular to the prevailing winds.

CHAPTER 5
CONSLUSIONS AND RECOMMENDATIONS

This thesis has demonstrated the feasibility of on-site renewable wind energy for power generation. The feasibility of any wind energy system is dictated by the site's wind resources, the different federal and state incentive programs available, and the prices paid not only for energy purchased but also for energy sold. The ability to offset the on-site energy cost comes with a wind energy system that will produce a large portion, if not all, of the energy needs of the site at a fixed price. Selling surplus energy to a local utility company can be feasible, but it is important to secure purchasing agreements that will allow a maximum profit.

Conclusions

The electrical needs of a site which consumes 1,550,000 kilowatt-hours (kWh) annually represent the uses of two 50,000 square-feet office buildings in the United States. With wind resources on the site reaching a 6 m/s or 13 mph average wind speed, renewable wind energy systems are able to offset a portion of the electrical needs of the site. Because the electrical energy that is needed for that site has to be bought from the local utility company that sets a price for that energy, there will always be a recurring annual cost, but a wind energy system can allow the owner to offset that cost for the life of the wind energy system. In areas of the country where energy prices are high and wind resources are good, a wind turbine generator allows for production of electrical energy at a much lower cost. In the scenarios run for this thesis, data was drawn from real projects and used to simulate project payback periods for wind energy systems of different sizes. When the wind energy system is designed to merely meet the energy needs of the site, payback periods were a mere four years; after this point, energy used on the site could be considered free because it is being generated with equipment that has been paid for with funds that would have been destined to go to the local utility company. The pay back for

systems that are sized to meet and then exceed the energy needs of the given site have longer payback periods, but also have high Net Savings over the life of the system. The payback periods will decrease with any increase in the cost of energy and the Net Savings will increase will any increase in incentives or actions where renewable wind energy becomes valued at a premium. At present the economical feasibility for systems designed to produce a surplus of energy beyond the needs of the site are risky because of the uncertainty in energy prices, but systems sized to meet the needs of a site show high economical feasibility and relatively short payback periods.

Recommendations

The future of this research should be geared toward the evolution of renewable wind energy incentives and their effect on economic feasibility. The results obtained in this thesis are highly dependent on the incentives available for wind energy projects. A decrease in these incentives would decrease the overall feasibility of these projects. With the development of larger and more efficient wind energy generators, the overall production of energy will increase with a relatively low increase in the cost of the systems, and production of these systems will increase in the United States as lower prices and greater availability is seen. A study of other forms of energy generation and the incentives that are used with them would prove interesting in terms of the true cost of a energy unit.

APPENDIX A
CASE 1 SIMULATION

Table A-1. Case-1 25% scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	200				
Project Size (kW)	200				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	200				
Total Cost	$ 250,000				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	416,100	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	0				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.0400	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

Table A-2. Case-1 25% scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$250,000						
Expenses							
Loan (Principal)		-$6,805	-$7,145	-$7,502	-$7,877	-$8,271	-$8,685
Loan (Interest)		-$11,250	-$10,910	-$10,553	-$10,177	-$9,784	-$9,370
Warranty Expense		-$3,750	$0	$0	$0	$0	$0
Insurance Cost		-$3,750	-$3,750	-$3,750	-$3,750	-$3,750	-$3,750
Operation and Maintenance Cost		-$1,250	-$1,263	-$1,275	-$1,288	-$1,301	-$1,314
Total Expenses Less Loan Principal and Interest		-$8,750	-$5,013	-$5,025	-$5,038	-$5,051	-$5,064
Total Expenses Cost		**-$26,805**	**-$23,067**	**-$23,080**	**-$23,092**	**-$23,105**	**-$23,118**
Revenues							
Total Energy Generated kWh/yr		416,100	416,100	416,100	416,100	411,939	407,820
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)		0.0400	$0.0408	$0.0416	$0.0424	$0.0433	$0.0442
Electricity Sales Revenue per Power Purchase Agreement		$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$43,691	$44,564	$45,456	$46,365	$46,819	$47,278
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$10,403	$10,694	$10,993	$11,301	$11,501	$11,705
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$8,738	$8,913	$9,091	$9,273	$9,364	$9,456
Total Annual Revenues		**$19,141**	**$19,607**	**$20,084**	**$20,574**	**$20,865**	**$21,161**
Total Energy Cost Saving		**$43,691**	**$44,564**	**$45,456**	**$46,365**	**$46,819**	**$47,278**
Total Annual Savings		**$62,831**	**$64,171**	**$65,540**	**$66,939**	**$67,684**	**$68,439**

Table A-3. Case-1 25% scenarios expenses and revenues

Year	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$9,119	-$9,575	-$10,053	-$10,556	-$11,084	-$11,638	-$12,220
Loan (Interest)	-$8,936	-$8,480	-$8,001	-$7,498	-$6,971	-$6,416	-$5,835
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$3,750	-$3,750	-$3,750	-$3,750	-$3,750	-$3,750	-$3,750
Operation and Maintenance Cost	-$1,327	-$1,340	-$1,354	-$1,367	-$1,381	-$1,395	-$1,409
Total Expenses Less Loan Principal and Interest	-$5,077	-$5,090	-$5,104	-$5,117	-$5,131	-$5,145	-$5,159
Total Expenses Cost	**-$23,131**	**-$23,145**	**-$23,158**	**-$23,172**	**-$23,185**	**-$23,199**	**-$23,213**
Revenues							
Total Energy Generated kWh/yr	403,741	399,704	395,707	391,750	387,832	383,954	380,115
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	0	0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)	$0.0450	$0.0459	$0.0469	$0.0478	$0.0488	$0.0497	$0.0507
Electricity Sales Revenue per Power Purchase Agreement	$0	$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$47,741	$48,209	$48,682	$49,159	$49,640	$50,127	$50,618
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$11,912	$12,124	$12,338	$12,557	$12,780	$13,006	$13,236
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$9,548	$9,642	$9,736	$9,832	$9,928	$10,025	$10,124
Total Annual Revenues	**$21,461**	**$21,765**	**$22,075**	**$22,389**	**$22,708**	**$23,031**	**$23,360**
Total Energy Cost Saving	**$47,741**	**$48,209**	**$48,682**	**$49,159**	**$49,640**	**$50,127**	**$50,618**
Total Annual Savings	**$69,202**	**$69,974**	**$70,756**	**$71,547**	**$72,348**	**$73,158**	**$73,978**

Table A-4. Case-1 25% scenarios expenses and revenues

Year	14	15	16	17	18	19	20
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$12,831	-$13,473	-$14,146	-$14,854	-$15,596	-$16,376	-$17,195
Loan (Interest)	-$5,224	-$4,582	-$3,908	-$3,201	-$2,458	-$1,679	-$860
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$3,750	-$3,750	-$3,750	-$3,750	-$3,750	-$3,750	-$3,750
Operation and Maintenance Cost	-$1,423	-$1,437	-$1,451	-$1,466	-$1,480	-$1,495	-$1,510
Total Expenses Less Loan Principal and Interest	-$5,173	-$5,187	-$5,201	-$5,216	-$5,230	-$5,245	-$5,260
Total Expenses Cost	**-$23,227**	**-$23,241**	**-$23,256**	**-$23,270**	**-$23,285**	**-$23,300**	**-$23,315**
Revenues							
Total Energy Generated kWh/yr	376,313	372,550	368,825	365,136	361,485	357,870	354,292
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	0	0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)	$0.0517	$0.0528	$0.0538	$0.0549	$0.0560	$0.0571	$0.0583
Electricity Sales Revenue per Power Purchase Agreement	$0	$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Saving from Off-Setting Energy Purchasing	$51,114	$51,615	$52,121	$52,632	$53,147	$53,668	$54,194
Green Tag Rate ($/kWh)	$0.0358	$0.0368	$0.0378	$0.0389	$0.0400	$0.0411	$0.0422
Green Tag Sales Revenue	$13,471	$13,710	$13,953	$14,200	$14,452	$14,708	$14,968
Federal Production Tax Credit	$0.0272	$0.0277	$0.0283	$0.0288	$0.0294	$0.0300	$0.0306
Federal Production Tax Credit Revenue	$10,223	$10,323	$10,424	$10,526	$10,629	$10,734	$10,839
Total Annual Revenues	**$23,694**	**$24,033**	**$24,377**	**$24,726**	**$25,081**	**$25,441**	**$25,807**
Total Energy Cost Saving	**$51,114**	**$51,615**	**$52,121**	**$52,632**	**$53,147**	**$53,668**	**$54,194**
Total Annual Savings	**$74,808**	**$75,648**	**$76,498**	**$77,358**	**$78,228**	**$79,110**	**$80,001**

Table A-5. Case-1 25% life cycle cost analysis

Power Cost Data			Financial Data		
kWh/year	1,550,000		Loan Amount	$250,000.00	
Electricity Cost	$0.1050	/kWh	Loan Rate	5.0%	
Avg Yearly Cost	$162,750		Down Payment	10%	
			Discount Rate	5%	
			General Inflation	3%	
			Fuel Inflation	2%	
			Analysis Period	20	years
			1st year I and M	5%	

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
0				$225,000.00						
1	-$18,054.58	-$11,250.00	-$6,804.58	$218,195.42	-$8,750	$43,691	$19,141	$62,831	$36,027	$34,311
2	-$18,054.58	-$10,909.77	-$7,144.81	$211,050.61	-$5,013	$44,564	$19,607	$64,171	$41,104	$37,282
3	-$18,054.58	-$10,552.53	-$7,502.05	$203,548.55	-$5,025	$45,456	$20,084	$65,540	$42,460	$36,679
4	-$18,054.58	-$10,177.43	-$7,877.15	$195,671.40	-$5,038	$46,365	$20,574	$66,939	$43,846	$36,072
5	-$18,054.58	-$9,783.57	-$8,271.01	$187,400.39	-$5,051	$46,819	$20,865	$67,684	$44,579	$34,929
6	-$18,054.58	-$9,370.02	-$8,684.56	$178,715.83	-$5,064	$47,278	$21,161	$68,439	$45,320	$33,819
7	-$18,054.58	-$8,935.79	-$9,118.79	$169,597.03	-$5,077	$47,741	$21,461	$69,202	$46,070	$32,741
8	-$18,054.58	-$8,479.85	-$9,574.73	$160,022.30	-$5,090	$48,209	$21,765	$69,974	$46,830	$31,696
9	-$18,054.58	-$8,001.12	-$10,053.47	$149,968.84	-$5,104	$48,682	$22,075	$70,756	$47,598	$30,682
10	-$18,054.58	-$7,498.44	-$10,556.14	$139,412.70	-$5,117	$49,159	$22,389	$71,547	$48,376	$29,698
11	-$18,054.58	-$6,970.63	-$11,083.95	$128,328.75	-$5,131	$49,640	$22,708	$72,348	$49,163	$28,744
12	-$18,054.58	-$6,416.44	-$11,638.14	$116,690.61	-$5,145	$50,127	$23,031	$75,934	$52,735	$29,365
13	-$18,054.58	-$5,834.53	-$12,220.05	$104,470.55	-$5,159	$50,618	$23,360	$73,649	$50,436	$26,747
14	-$18,054.58	-$5,223.53	-$12,831.05	$91,639.50	-$5,173	$51,114	$23,694	$74,474	$51,247	$25,883
15	-$18,054.58	-$4,581.97	-$13,472.61	$78,166.89	-$5,187	$51,615	$24,033	$75,309	$52,067	$25,045
16	-$18,054.58	-$3,908.34	-$14,146.24	$64,020.65	-$5,201	$52,121	$24,377	$76,154	$52,898	$24,233
17	-$18,054.58	-$3,201.03	-$14,853.55	$49,167.11	-$5,216	$52,632	$24,726	$77,009	$53,738	$23,446
18	-$18,054.58	-$2,458.36	-$15,596.23	$33,570.88	-$5,230	$53,147	$25,081	$77,874	$54,589	$22,683
19	-$18,054.58	-$1,678.54	-$16,376.04	$17,194.84	-$5,245	$53,668	$25,441	$78,749	$55,450	$21,943
20	-$18,054.58	-$859.74	-$17,194.84	$0.00	-$5,260	$54,194	$25,807	$79,636	$56,321	$21,227
Totals	-$361,091.64	-$136,091.64	-$225,000.00			$986,839.83	$451,378.81	$1,438,218.65	$970,853.25	$587,226.84

Table A-6. Case-1 50% scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	375				
Project Size (kW)	375				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	375				
Total Cost	$ 468,750				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	780,188	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	0				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.0400	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

Table A-7. Case-1 50% scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$468,750						
Expenses							
Loan (Principal)		-$12,759	-$13,397	-$14,066	-$14,770	-$15,508	-$16,284
Loan (Interest)		-$21,094	-$20,456	-$19,786	-$19,083	-$18,344	-$17,569
Warranty Expense		-$7,031	$0	$0	$0	$0	$0
Insurance Cost		-$7,031	-$7,031	-$7,031	-$7,031	-$7,031	-$7,031
Operation and Maintenance Cost		-$2,344	-$2,367	-$2,391	-$2,415	-$2,439	-$2,463
Total Expenses Less Loan Principal and Interest		-$16,406	-$9,398	-$9,422	-$9,446	-$9,470	-$9,495
Total Expenses Cost		**-$50,259**	**-$43,251**	**-$43,274**	**-$43,298**	**-$43,323**	**-$43,347**
Revenues							
Total Energy Generated kWh/yr		780,188	780,188	780,188	780,188	772,386	764,662
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)		0.0400	$0.0408	$0.0416	$0.0424	$0.0433	$0.0442
Electricity Sales Revenue per Power Purchase Agreement		$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$81,920	$83,558	$85,229	$86,934	$87,786	$88,646
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$19,505	$20,051	$20,612	$21,189	$21,565	$21,947
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$16,384	$16,712	$17,046	$17,387	$17,557	$17,729
Total Annual Revenues		**$35,889**	**$36,762**	**$37,658**	**$38,576**	**$39,122**	**$39,676**
Total Energy Cost Saving		**$81,920**	**$83,558**	**$85,229**	**$86,934**	**$87,786**	**$88,646**
Total Annual Savings		**$117,808**	**$120,321**	**$122,887**	**$125,510**	**$126,908**	**$128,322**

Table A-8. Case-1 50% scenarios expenses and revenues

Year	7	8	9	10	11	12	13
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$17,098	-$17,953	-$18,850	-$19,793	-$20,782	-$21,822	-$22,913
Loan (Interest)	-$16,755	-$15,900	-$15,002	-$14,060	-$13,070	-$12,031	-$10,940
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$7,031	-$7,031	-$7,031	-$7,031	-$7,031	-$7,031	-$7,031
Operation and Maintenance Cost	-$2,488	-$2,513	-$2,538	-$2,563	-$2,589	-$2,615	-$2,641
Total Expenses Less Loan Principal and Interest	-$9,519	-$9,544	-$9,569	-$9,595	-$9,620	-$9,646	-$9,672
Total Expenses Cost	**-$43,372**	**-$43,396**	**-$43,422**	**-$43,447**	**-$43,473**	**-$43,498**	**-$43,525**
Revenues							
Total Energy Generated kWh/yr	757,015	749,445	741,951	734,531	727,186	719,914	712,715
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	0	0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)	$0.0450	$0.0459	$0.0469	$0.0478	$0.0488	$0.0497	$0.0507
Electricity Sales Revenue per Power Purchase Agreement	$0	$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$89,515	$90,392	$91,278	$92,172	$93,076	$93,988	$94,909
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$22,336	$22,732	$23,134	$23,544	$23,962	$24,386	$24,818
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$17,903	$18,078	$18,256	$18,434	$18,615	$18,798	$18,982
Total Annual Revenues	**$40,239**	**$40,810**	**$41,390**	**$41,979**	**$42,577**	**$43,184**	**$43,800**
Total Energy Cost Saving	**$89,515**	**$90,392**	**$91,278**	**$92,172**	**$93,076**	**$93,988**	**$94,909**
Total Annual Savings	**$129,754**	**$131,202**	**$132,668**	**$134,151**	**$135,652**	**$137,172**	**$138,709**

Table A-9. Case-1 50% scenarios expenses and revenues

Year	14	15	16	17	18	19	20
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$24,058	-$25,261	-$26,524	-$27,850	-$29,243	-$30,705	-$32,240
Loan (Interest)	-$9,794	-$8,591	-$7,328	-$6,002	-$4,609	-$3,147	-$1,612
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$7,031	-$7,031	-$7,031	-$7,031	-$7,031	-$7,031	-$7,031
Operation and Maintenance Cost	-$2,667	-$2,694	-$2,721	-$2,748	-$2,776	-$2,803	-$2,832
Total Expenses Less Loan Principal and Interest	-$9,699	-$9,725	-$9,752	-$9,779	-$9,807	-$9,835	-$9,863
Total Expenses Cost	**-$43,551**	**-$43,578**	**-$43,605**	**-$43,632**	**-$43,659**	**-$43,687**	**-$43,715**
Revenues							
Total Energy Generated kWh/yr	705,588	698,532	691,546	684,631	677,785	671,007	664,297
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	0	0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)	$0.0517	$0.0528	$0.0538	$0.0549	$0.0560	$0.0571	$0.0583
Electricity Sales Revenue per Power Purchase Agreement	$0	$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Saving from Off-Setting Energy Purchasing	$95,839	$96,778	$97,727	$98,684	$99,652	$100,628	$101,614
Green Tag Rate ($/kWh)	$0.0358	$0.0368	$0.0378	$0.0389	$0.0400	$0.0411	$0.0422
Green Tag Sales Revenue	$25,258	$25,706	$26,161	$26,625	$27,097	$27,577	$28,065
Federal Production Tax Credit	$0.0272	$0.0277	$0.0283	$0.0288	$0.0294	$0.0300	$0.0306
Federal Production Tax Credit Revenue	$19,168	$19,356	$19,545	$19,737	$19,930	$20,126	$20,323
Total Annual Revenues	**$44,426**	**$45,061**	**$45,707**	**$46,362**	**$47,027**	**$47,702**	**$48,388**
Total Energy Cost Saving	**$95,839**	**$96,778**	**$97,727**	**$98,684**	**$99,652**	**$100,628**	**$101,614**
Total Annual Savings	**$140,265**	**$141,840**	**$143,433**	**$145,046**	**$146,678**	**$148,330**	**$150,003**

Table A-10. Case-1 50% life cycle cost analysis

Power Cost Data		Financial Data	
kWh/year	1,550,000	Loan Amount	$468,750.00
Electricity Cost	$0.1050 /kWh	Loan Rate	5.0%
Avg Yearly Cost	$162,750	Down Payment	10%
		Discount Rate	5%
		General Inflation	3%
		Fuel Inflation	2%
		Analysis Period	20 years
		1st year I and M	5%

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
0				$421,875.00						
1	-$33,852.34	-$21,093.75	-$12,758.59	$409,116.41	-$16,406	$81,920	$35,889	$117,808	$67,550	$64,333
2	-$33,852.34	-$20,455.82	-$13,396.52	$395,719.89	-$9,398	$83,558	$36,762	$120,321	$77,070	$69,905
3	-$33,852.34	-$19,785.99	-$14,066.35	$381,653.54	-$9,422	$85,229	$37,658	$122,887	$79,613	$68,773
4	-$33,852.34	-$19,082.68	-$14,769.66	$366,883.88	-$9,446	$86,934	$38,576	$125,510	$82,212	$67,636
5	-$33,852.34	-$18,344.19	-$15,508.15	$351,375.73	-$9,470	$87,786	$39,122	$126,908	$83,585	$65,491
6	-$33,852.34	-$17,568.79	-$16,283.56	$335,092.17	-$9,495	$88,646	$39,676	$128,322	$84,975	$63,410
7	-$33,852.34	-$16,754.61	-$17,097.73	$317,994.44	-$9,519	$89,515	$40,239	$129,754	$86,382	$61,390
8	-$33,852.34	-$15,899.72	-$17,952.62	$300,041.82	-$9,544	$90,392	$40,810	$131,202	$87,806	$59,430
9	-$33,852.34	-$15,002.09	-$18,850.25	$281,191.57	-$9,569	$91,278	$41,390	$132,668	$89,246	$57,529
10	-$33,852.34	-$14,059.58	-$19,792.76	$261,398.81	-$9,595	$92,172	$41,979	$134,151	$90,704	$55,685
11	-$33,852.34	-$13,069.94	-$20,782.40	$240,616.41	-$9,620	$93,076	$42,577	$135,652	$92,180	$53,896
12	-$33,852.34	-$12,030.82	-$21,821.52	$218,794.89	-$9,646	$93,988	$43,184	$142,376	$98,878	$55,059
13	-$33,852.34	-$10,939.74	-$22,912.60	$195,882.29	-$9,672	$94,909	$43,800	$138,093	$94,568	$50,152
14	-$33,852.34	-$9,794.11	-$24,058.23	$171,824.06	-$9,699	$95,839	$44,426	$139,639	$96,088	$48,531
15	-$33,852.34	-$8,591.20	-$25,261.14	$146,562.92	-$9,725	$96,778	$45,061	$141,204	$97,627	$46,960
16	-$33,852.34	-$7,328.15	-$26,524.20	$120,038.73	-$9,752	$97,727	$45,707	$142,788	$99,183	$45,437
17	-$33,852.34	-$6,001.94	-$27,850.41	$92,188.32	-$9,779	$98,684	$46,362	$144,391	$100,759	$43,961
18	-$33,852.34	-$4,609.42	-$29,242.93	$62,945.40	-$9,807	$99,652	$47,027	$146,013	$102,354	$42,530
19	-$33,852.34	-$3,147.27	-$30,705.07	$32,240.33	-$9,835	$100,628	$47,702	$147,655	$103,968	$41,144
20	-$33,852.34	-$1,612.02	-$32,240.33	$0.00	-$9,863	$101,614	$48,388	$149,317	$105,602	$39,800
Totals	-$677,046.83	-$255,171.83	-$421,875.00			$1,850,324.69	$846,335.28	$2,696,659.96	$1,820,349.84	$1,101,050.32

Table A-11. Case-1 100% scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	750				
Project Size (kW)	750				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	750				
Total Cost	$ 937,500				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	1,560,375	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	10,375				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.0400	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

Table A-12. Case-1 100% scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$937,500						
Expenses							
Loan (Principal)		-$25,517	-$26,793	-$28,133	-$29,539	-$31,016	-$32,567
Loan (Interest)		-$42,188	-$40,912	-$39,572	-$38,165	-$36,688	-$35,138
Warranty Expense		-$14,063	$0	$0	$0	$0	$0
Insurance Cost		-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063
Operation and Maintenance Cost		-$4,688	-$4,734	-$4,782	-$4,830	-$4,878	-$4,927
Total Expenses Less Loan Principal and Interest		-$32,813	-$18,797	-$18,844	-$18,892	-$18,940	-$18,989
Total Expenses Cost		**-$100,517**	**-$86,502**	**-$86,549**	**-$86,597**	**-$86,645**	**-$86,694**
Revenues							
Total Energy Generated kWh/yr		1,560,375	1,560,375	1,560,375	1,560,375	1,544,771	1,529,324
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		10,375	10,375	10,375	10,375	0	0
Power Purchase Agreement Rate ($/kWh)		0.0400	$0.0408	$0.0416	$0.0424	$0.0433	$0.0442
Electricity Sales Revenue per Power Purchase Agreement		$415	$423	$432	$440	$0	$0
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$162,750	$166,005	$169,325	$172,712	$175,572	$177,292
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$39,009	$40,102	$41,224	$42,379	$43,130	$43,894
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$32,768	$33,423	$34,092	$34,774	$35,114	$35,458
Total Annual Revenues		**$72,192**	**$73,948**	**$75,748**	**$77,593**	**$78,244**	**$79,352**
Total Energy Cost Saving		**$162,750**	**$166,005**	**$169,325**	**$172,712**	**$175,572**	**$177,292**
Total Annual Savings		**$234,942**	**$239,953**	**$245,073**	**$250,304**	**$253,816**	**$256,645**

Table A-13. Case-1 100% scenarios expenses and revenues

Year	7	8	9	10	11	12	13
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$34,195	-$35,905	-$37,701	-$39,586	-$41,565	-$43,643	-$45,825
Loan (Interest)	-$33,509	-$31,799	-$30,004	-$28,119	-$26,140	-$24,062	-$21,879
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063
Operation and Maintenance Cost	-$4,976	-$5,026	-$5,076	-$5,127	-$5,178	-$5,230	-$5,282
Total Expenses Less Loan Principal and Interest	-$19,038	-$19,088	-$19,138	-$19,189	-$19,240	-$19,292	-$19,344
Total Expenses Cost	**-$86,743**	**-$86,793**	**-$86,843**	**-$86,894**	**-$86,945**	**-$86,997**	**-$87,049**
Revenues							
Total Energy Generated kWh/yr	1,514,030	1,498,890	1,483,901	1,469,062	1,454,371	1,439,828	1,425,429
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	0	0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)	$0.0450	$0.0459	$0.0469	$0.0478	$0.0488	$0.0497	$0.0507
Electricity Sales Revenue per Power Purchase Agreement	$0	$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$179,030	$180,784	$182,556	$184,345	$186,151	$187,976	$189,818
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$44,672	$45,463	$46,269	$47,089	$47,923	$48,772	$49,637
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$35,806	$36,157	$36,511	$36,869	$37,230	$37,595	$37,964
Total Annual Revenues	**$80,478**	**$81,620**	**$82,780**	**$83,958**	**$85,154**	**$86,368**	**$87,600**
Total Energy Cost Saving	**$179,030**	**$180,784**	**$182,556**	**$184,345**	**$186,151**	**$187,976**	**$189,818**
Total Annual Savings	**$259,507**	**$262,404**	**$265,336**	**$268,303**	**$271,305**	**$274,343**	**$277,418**

Table A-14. Case-1 100% scenarios expenses and revenues

Year	14	15	16	17	18	19	20
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$48,116	-$50,522	-$53,048	-$55,701	-$58,486	-$61,410	-$64,481
Loan (Interest)	-$19,588	-$17,182	-$14,656	-$12,004	-$9,219	-$6,295	-$3,224
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063
Operation and Maintenance Cost	-$5,335	-$5,388	-$5,442	-$5,496	-$5,551	-$5,607	-$5,663
Total Expenses Less Loan Principal and Interest	-$19,397	-$19,451	-$19,505	-$19,559	-$19,614	-$19,669	-$19,726
Total Expenses Cost	**-$87,102**	**-$87,155**	**-$87,209**	**-$87,264**	**-$87,319**	**-$87,374**	**-$87,430**
Revenues							
Total Energy Generated kWh/yr	1,411,175	1,397,063	1,383,093	1,369,262	1,355,569	1,342,014	1,328,593
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	0	0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)	$0.0517	$0.0528	$0.0538	$0.0549	$0.0560	$0.0571	$0.0583
Electricity Sales Revenue per Power Purchase Agreement	$0	$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Saving from Off-Setting Energy Purchasing	$191,678	$193,557	$195,453	$197,369	$199,303	$201,256	$203,229
Green Tag Rate ($/kWh)	$0.0358	$0.0368	$0.0378	$0.0389	$0.0400	$0.0411	$0.0422
Green Tag Sales Revenue	$50,516	$51,411	$52,322	$53,250	$54,193	$55,153	$56,131
Federal Production Tax Credit	$0.0272	$0.0277	$0.0283	$0.0288	$0.0294	$0.0300	$0.0306
Federal Production Tax Credit Revenue	$38,336	$38,711	$39,091	$39,474	$39,861	$40,251	$40,646
Total Annual Revenues	**$88,852**	**$90,123**	**$91,413**	**$92,723**	**$94,054**	**$95,405**	**$96,777**
Total Energy Cost Saving	**$191,678**	**$193,557**	**$195,453**	**$197,369**	**$199,303**	**$201,256**	**$203,229**
Total Annual Savings	**$280,530**	**$283,679**	**$286,867**	**$290,092**	**$293,357**	**$296,661**	**$300,005**

Table A-15. Case-1 100% life cycle cost analysis

Power Cost Data		Financial Data	
kWh/year	1,550,000	Loan Amount	$937,500.00
Electricity Cost	$0.1050 /kWh	Loan Rate	5.0%
Avg Yearly Cost	$162,750	Down Payment	10%
		Discount Rate	5%
		General Inflation	3%
		Fuel Inflation	2%
		Analysis Period	20 years
		1st year I and M	5%

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
0				$843,750.00						
1	-$67,704.68	-$42,187.50	-$25,517.18	$818,232.82	-$32,813	$162,750	$72,192	$234,942	$134,425	$128,024
2	-$67,704.68	-$40,911.64	-$26,793.04	$791,439.77	-$18,797	$166,005	$73,948	$239,953	$153,452	$139,185
3	-$67,704.68	-$39,571.99	-$28,132.69	$763,307.08	-$18,844	$169,325	$75,748	$245,073	$158,524	$136,939
4	-$67,704.68	-$38,165.35	-$29,539.33	$733,767.75	-$18,892	$172,712	$77,593	$250,304	$163,708	$134,683
5	-$67,704.68	-$36,688.39	-$31,016.30	$702,751.46	-$18,940	$175,572	$78,244	$253,816	$167,171	$130,983
6	-$67,704.68	-$35,137.57	-$32,567.11	$670,184.35	-$18,989	$177,292	$79,352	$256,645	$169,951	$126,820
7	-$67,704.68	-$33,509.22	-$34,195.47	$635,988.88	-$19,038	$179,030	$80,478	$259,507	$172,764	$122,780
8	-$67,704.68	-$31,799.44	-$35,905.24	$600,083.64	-$19,088	$180,784	$81,620	$262,404	$175,611	$118,861
9	-$67,704.68	-$30,004.18	-$37,700.50	$562,383.14	-$19,138	$182,556	$82,780	$265,336	$178,493	$115,058
10	-$67,704.68	-$28,119.16	-$39,585.53	$522,797.62	-$19,189	$184,345	$83,958	$268,303	$181,409	$111,369
11	-$67,704.68	-$26,139.88	-$41,564.80	$481,232.81	-$19,240	$186,151	$85,154	$271,305	$184,360	$107,791
12	-$67,704.68	-$24,061.64	-$43,643.04	$437,589.77	-$19,292	$187,976	$86,368	$284,752	$197,755	$110,118
13	-$67,704.68	-$21,879.49	-$45,825.19	$391,764.58	-$19,344	$189,818	$87,600	$276,185	$189,136	$100,303
14	-$67,704.68	-$19,588.23	-$48,116.45	$343,648.12	-$19,397	$191,678	$88,852	$279,278	$192,176	$97,062
15	-$67,704.68	-$17,182.41	-$50,522.28	$293,125.85	-$19,451	$193,557	$90,123	$282,408	$195,253	$93,920
16	-$67,704.68	-$14,656.29	-$53,048.39	$240,077.45	-$19,505	$195,453	$91,413	$285,576	$198,367	$90,874
17	-$67,704.68	-$12,003.87	-$55,700.81	$184,376.64	-$19,559	$197,369	$92,723	$288,782	$201,518	$87,922
18	-$67,704.68	-$9,218.83	-$58,485.85	$125,890.79	-$19,614	$199,303	$94,054	$292,026	$204,708	$85,060
19	-$67,704.68	-$6,294.54	-$61,410.14	$64,480.65	-$19,669	$201,256	$95,405	$295,310	$207,936	$82,287
20	-$67,704.68	-$3,224.03	-$64,480.65	$0.00	-$19,726	$203,229	$96,777	$298,633	$211,203	$79,600
Totals	-$1,354,093.66	-$510,343.66	-$843,750.00			$3,696,159.40	$1,694,381.02	$5,390,540.42	$3,637,920.18	$2,199,639.62

Table A-16. Case-1 125% scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	1000				
Project Size (kW)	1000				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	1000				
Total Cost	$ 1,250,000				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	2,080,500	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	530,500				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.0400	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

Table A-17. Case-1 125% scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$1,250,000						
Expenses							
Loan (Principal)		-$34,023	-$35,724	-$37,510	-$39,386	-$41,355	-$43,423
Loan (Interest)		-$56,250	-$54,549	-$52,763	-$50,887	-$48,918	-$46,850
Warranty Expense		-$18,750	$0	$0	$0	$0	$0
Insurance Cost		-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750
Operation and Maintenance Cost		-$6,250	-$6,313	-$6,376	-$6,439	-$6,504	-$6,569
Total Expenses Less Loan Principal and Interest		-$43,750	-$25,063	-$25,126	-$25,189	-$25,254	-$25,319
Total Expenses Cost		**-$134,023**	**-$115,335**	**-$115,399**	**-$115,462**	**-$115,527**	**-$115,592**
Revenues							
Total Energy Generated kWh/yr		2,080,500	2,080,500	2,080,500	2,080,500	2,059,695	2,039,098
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		530,500	530,500	530,500	530,500	509,695	489,098
Power Purchase Agreement Rate ($/kWh)		0.0400	$0.0408	$0.0416	$0.0424	$0.0433	$0.0442
Electricity Sales Revenue per Power Purchase Agreement		$21,220	$21,644	$22,077	$22,519	$22,068	$21,600
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$162,750	$166,005	$169,325	$172,712	$176,166	$179,689
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$52,013	$53,469	$54,966	$56,505	$57,506	$58,525
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$43,691	$44,564	$45,456	$46,365	$46,819	$47,278
Total Annual Revenues		**$116,923**	**$119,678**	**$122,499**	**$125,389**	**$126,394**	**$127,403**
Total Energy Cost Saving		**$162,750**	**$166,005**	**$169,325**	**$172,712**	**$176,166**	**$179,689**
Total Annual Savings		**$279,673**	**$285,683**	**$291,824**	**$298,100**	**$302,560**	**$307,093**

Table A-18. Case-1 125% scenarios expenses and revenues

Year	7	8	9	10	11	12	13
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$45,594	-$47,874	-$50,267	-$52,781	-$55,420	-$58,191	-$61,100
Loan (Interest)	-$44,679	-$42,399	-$40,006	-$37,492	-$34,853	-$32,082	-$29,173
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750
Operation and Maintenance Cost	-$6,635	-$6,701	-$6,768	-$6,836	-$6,904	-$6,973	-$7,043
Total Expenses Less Loan Principal and Interest	-$25,385	-$25,451	-$25,518	-$25,586	-$25,654	-$25,723	-$25,793
Total Expenses Cost	**-$115,657**	**-$115,724**	**-$115,791**	**-$115,858**	**-$115,927**	**-$115,996**	**-$116,066**
Revenues							
Total Energy Generated kWh/yr	2,018,707	1,998,520	1,978,535	1,958,749	1,939,162	1,919,770	1,900,573
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	468,707	448,520	428,535	408,749	389,162	369,770	350,573
Power Purchase Agreement Rate ($/kWh)	$0.0450	$0.0459	$0.0469	$0.0478	$0.0488	$0.0497	$0.0507
Electricity Sales Revenue per Power Purchase Agreement	$21,114	$20,608	$20,084	$19,540	$18,975	$18,391	$17,784
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$183,283	$186,949	$190,688	$194,501	$198,391	$202,359	$206,406
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$59,562	$60,618	$61,692	$62,785	$63,898	$65,030	$66,182
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$47,741	$48,209	$48,682	$49,159	$49,640	$50,127	$50,618
Total Annual Revenues	**$128,417**	**$129,435**	**$130,457**	**$131,484**	**$132,514**	**$133,547**	**$134,585**
Total Energy Cost Saving	**$183,283**	**$186,949**	**$190,688**	**$194,501**	**$198,391**	**$202,359**	**$206,406**
Total Annual Savings	**$311,700**	**$316,384**	**$321,145**	**$325,985**	**$330,905**	**$335,907**	**$340,991**

Table A-19. Case-1 125% scenarios expenses and revenues

Year	14	15	16	17	18	19	20
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$64,155	-$67,363	-$70,731	-$74,268	-$77,981	-$81,880	-$85,974
Loan (Interest)	-$26,118	-$22,910	-$19,542	-$16,005	-$12,292	-$8,393	-$4,299
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750
Operation and Maintenance Cost	-$7,113	-$7,184	-$7,256	-$7,329	-$7,402	-$7,476	-$7,551
Total Expenses Less Loan Principal and Interest	-$25,863	-$25,934	-$26,006	-$26,079	-$26,152	-$26,226	-$26,301
Total Expenses Cost	**-$116,136**	**-$116,207**	**-$116,279**	**-$116,352**	**-$116,425**	**-$116,499**	**-$116,574**
Revenues							
Total Energy Generated kWh/yr	1,881,567	1,862,751	1,844,124	1,825,682	1,807,426	1,789,351	1,771,458
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	331,567	312,751	294,124	275,682	257,426	239,351	221,458
Power Purchase Agreement Rate ($/kWh)	$0.0517	$0.0528	$0.0538	$0.0549	$0.0560	$0.0571	$0.0583
Electricity Sales Revenue per Power Purchase Agreement	$17,157	$16,507	$15,834	$15,138	$14,418	$13,674	$12,905
Cost of Energy if Purchased	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Saving from Off-Setting Energy Purchasing	$210,534	$214,745	$219,040	$223,421	$227,889	$232,447	$237,096
Green Tag Rate ($/kWh)	$0.0358	$0.0368	$0.0378	$0.0389	$0.0400	$0.0411	$0.0422
Green Tag Sales Revenue	$67,355	$68,549	$69,763	$70,999	$72,258	$73,538	$74,841
Federal Production Tax Credit	$0.0272	$0.0277	$0.0283	$0.0288	$0.0294	$0.0300	$0.0306
Federal Production Tax Credit Revenue	$51,114	$51,615	$52,121	$52,632	$53,147	$53,668	$54,194
Total Annual Revenues	**$135,626**	**$136,670**	**$137,718**	**$138,769**	**$139,823**	**$140,880**	**$141,940**
Total Energy Cost Saving	**$210,534**	**$214,745**	**$219,040**	**$223,421**	**$227,889**	**$232,447**	**$237,096**
Total Annual Savings	**$346,160**	**$351,416**	**$356,758**	**$362,190**	**$367,713**	**$373,327**	**$379,036**

Table A-20. Case-1 125% life cycle cost analysis

Power Cost Data			Financial Data		
kWh/year	1,550,000		Loan Amount	$1,250,000	
Electricity Cost	$0.1050	/kWh	Loan Rate	5.0%	
Avg Yearly Cost	$162,750		Down Payment	10%	
			Discount Rate	5%	
			General Inflation	3%	
			Fuel Inflation	2%	
			Analysis Period	20	years
			1st year I and M	5%	

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
0				$1,125,000						
1	-$90,273	-$56,250	-$34,023	$1,090,977	-$43,750	$162,750	$116,923	$279,673	$145,650	$138,714
2	-$90,273	-$54,549	-$35,724	$1,055,253	-$25,063	$166,005	$119,678	$285,683	$170,347	$154,510
3	-$90,273	-$52,763	-$37,510	$1,017,743	-$25,126	$169,325	$122,499	$291,824	$176,425	$152,403
4	-$90,273	-$50,887	-$39,386	$978,357	-$25,189	$172,712	$125,389	$298,100	$182,638	$150,257
5	-$90,273	-$48,918	-$41,355	$937,002	-$25,254	$176,166	$126,394	$302,560	$187,033	$146,545
6	-$90,273	-$46,850	-$43,423	$893,579	-$25,319	$179,689	$127,403	$307,093	$191,501	$142,901
7	-$90,273	-$44,679	-$45,594	$847,985	-$25,385	$183,283	$128,417	$311,700	$196,043	$139,324
8	-$90,273	-$42,399	-$47,874	$800,112	-$25,451	$186,949	$129,435	$316,384	$200,660	$135,815
9	-$90,273	-$40,006	-$50,267	$749,844	-$25,518	$190,688	$130,457	$321,145	$205,354	$132,373
10	-$90,273	-$37,492	-$52,781	$697,063	-$25,586	$194,501	$131,484	$325,985	$210,126	$128,999
11	-$90,273	-$34,853	-$55,420	$641,644	-$25,654	$198,391	$132,514	$330,905	$214,978	$125,693
12	-$90,273	-$32,082	-$58,191	$583,453	-$25,723	$202,359	$133,547	$344,299	$228,304	$127,128
13	-$90,273	-$29,173	-$61,100	$522,353	-$25,793	$206,406	$134,585	$339,954	$223,888	$118,733
14	-$90,273	-$26,118	-$64,155	$458,197	-$25,863	$210,534	$135,626	$345,119	$228,983	$115,652
15	-$90,273	-$22,910	-$67,363	$390,834	-$25,934	$214,745	$136,670	$350,371	$234,164	$112,637
16	-$90,273	-$19,542	-$70,731	$320,103	-$26,006	$219,040	$137,718	$355,710	$239,432	$109,686
17	-$90,273	-$16,005	-$74,268	$245,836	-$26,079	$223,421	$138,769	$361,139	$244,788	$106,800
18	-$90,273	-$12,292	-$77,981	$167,854	-$26,152	$227,889	$139,823	$366,659	$250,234	$103,977
19	-$90,273	-$8,393	-$81,880	$85,974	-$26,226	$232,447	$140,880	$372,270	$255,772	$101,218
20	-$90,273	-$4,299	-$85,974	$0	-$26,301	$237,096	$141,940	$377,976	$261,403	$98,520
Totals	-$1,805,458	-$680,458	-$1,125,000			$3,954,397	$2,630,152	$6,584,549	$4,247,722	$2,541,885

Table A-21. Case-2 100% power purchase agreement rate $0.02/kWh scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	750				
Project Size (kW)	750				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	750				
Total Cost	$ 937,500				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	1,560,375	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	10,375				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.0200	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

APPENDIX B
CASE 2 SIMULATIONS

Table B-22. Case-2 100% power purchase agreement rate $0.02/kWh scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$937,500						
Expenses							
Loan (Principal)		-$25,517	-$26,793	-$28,133	-$29,539	-$31,016	-$32,567
Loan (Interest)		-$42,188	-$40,912	-$39,572	-$38,165	-$36,688	-$35,138
Warranty Expense		-$14,063	$0	$0	$0	$0	$0
Insurance Cost		-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063
Operation and Maintenance Cost		-$4,688	-$4,734	-$4,782	-$4,830	-$4,878	-$4,927
Total Expenses Less Loan Principal and Interest		-$32,813	-$18,797	-$18,844	-$18,892	-$18,940	-$18,989
Total Expenses Cost		**-$100,517**	**-$86,502**	**-$86,549**	**-$86,597**	**-$86,645**	**-$86,694**
Revenues							
Total Energy Generated kWh/yr		1,560,375	1,560,375	1,560,375	1,560,375	1,544,771	1,529,324
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		10,375	10,375	10,375	10,375	0	0
Power Purchase Agreement Rate ($/kWh)		0.0200	$0.0204	$0.0208	$0.0212	$0.0216	$0.0221
Electricity Sales Revenue per Power Purchase Agreement		$208	$212	$216	$220	$0	$0
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$162,750	$166,005	$169,325	$172,712	$175,572	$177,292
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$39,009	$40,102	$41,224	$42,379	$43,130	$43,894
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$32,768	$33,423	$34,092	$34,774	$35,114	$35,458
Total Annual Revenues		**$71,985**	**$73,737**	**$75,532**	**$77,373**	**$78,244**	**$79,352**
Total Energy Cost Saving		**$162,750**	**$166,005**	**$169,325**	**$172,712**	**$175,572**	**$177,292**
Total Annual Savings		**$234,735**	**$239,742**	**$244,857**	**$250,084**	**$253,816**	**$256,645**

Table B-23. Case-2 100% power purchase agreement rate $0.02/kWh scenarios expenses and revenues

Year	7	8	9	10	11	12	13
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$34,195	-$35,905	-$37,701	-$39,586	-$41,565	-$43,643	-$45,825
Loan (Interest)	-$33,509	-$31,799	-$30,004	-$28,119	-$26,140	-$24,062	-$21,879
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063
Operation and Maintenance Cost	-$4,976	-$5,026	-$5,076	-$5,127	-$5,178	-$5,230	-$5,282
Total Expenses Less Loan Principal and Interest	-$19,038	-$19,088	-$19,138	-$19,189	-$19,240	-$19,292	-$19,344
Total Expenses Cost	**-$86,743**	**-$86,793**	**-$86,843**	**-$86,894**	**-$86,945**	**-$86,997**	**-$87,049**
Revenues							
Total Energy Generated kWh/yr	1,514,030	1,498,890	1,483,901	1,469,062	1,454,371	1,439,828	1,425,429
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	0	0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)	$0.0225	$0.0230	$0.0234	$0.0239	$0.0244	$0.0249	$0.0254
Electricity Sales Revenue per Power Purchase Agreement	$0	$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$179,030	$180,784	$182,556	$184,345	$186,151	$187,976	$189,818
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$44,672	$45,463	$46,269	$47,089	$47,923	$48,772	$49,637
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$35,806	$36,157	$36,511	$36,869	$37,230	$37,595	$37,964
Total Annual Revenues	**$80,478**	**$81,620**	**$82,780**	**$83,958**	**$85,154**	**$86,368**	**$87,600**
Total Energy Cost Saving	**$179,030**	**$180,784**	**$182,556**	**$184,345**	**$186,151**	**$187,976**	**$189,818**
Total Annual Savings	**$259,507**	**$262,404**	**$265,336**	**$268,303**	**$271,305**	**$274,343**	**$277,418**

Table B-24. Case-2 100% power purchase agreement rate $0.02/kWh scenarios expenses and revenues

year	14	15	16	17	18	19	20
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$48,116	-$50,522	-$53,048	-$55,701	-$58,486	-$61,410	-$64,481
Loan (Interest)	-$19,588	-$17,182	-$14,656	-$12,004	-$9,219	-$6,295	-$3,224
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063
Operation and Maintenance Cost	-$5,335	-$5,388	-$5,442	-$5,496	-$5,551	-$5,607	-$5,663
Total Expenses Less Loan Principal and Interest	-$19,397	-$19,451	-$19,505	-$19,559	-$19,614	-$19,669	-$19,726
Total Expenses Cost	**-$87,102**	**-$87,155**	**-$87,209**	**-$87,264**	**-$87,319**	**-$87,374**	**-$87,430**
Revenues							
Total Energy Generated kWh/yr	1,411,175	1,397,063	1,383,093	1,369,262	1,355,569	1,342,014	1,328,593
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	0	0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)	$0.0259	$0.0264	$0.0269	$0.0275	$0.0280	$0.0286	$0.0291
Electricity Sales Revenue per Power Purchase Agreement	$0	$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Saving from Off-Setting Energy Purchasing	$191,678	$193,557	$195,453	$197,369	$199,303	$201,256	$203,229
Green Tag Rate ($/kWh)	$0.0358	$0.0368	$0.0378	$0.0389	$0.0400	$0.0411	$0.0422
Green Tag Sales Revenue	$50,516	$51,411	$52,322	$53,250	$54,193	$55,153	$56,131
Federal Production Tax Credit	$0.0272	$0.0277	$0.0283	$0.0288	$0.0294	$0.0300	$0.0306
Federal Production Tax Credit Revenue	$38,336	$38,711	$39,091	$39,474	$39,861	$40,251	$40,646
Total Annual Revenues	**$88,852**	**$90,123**	**$91,413**	**$92,723**	**$94,054**	**$95,405**	**$96,777**
Total Energy Cost Saving	**$191,678**	**$193,557**	**$195,453**	**$197,369**	**$199,303**	**$201,256**	**$203,229**
Total Annual Savings	**$280,530**	**$283,679**	**$286,867**	**$290,092**	**$293,357**	**$296,661**	**$300,005**

Table B-25. Case-2 100% power purchase agreement rate $0.02/kWh life cycle cost analysis

Power Cost Data		Financial Data	
kWh/year	1,550,000	Loan Amount	$937,500.00
Electricity Cost	$0.1050 /kWh	Loan Rate	5.0%
Avg Yearly Cost	$162,750	Down Payment	10%
		Discount Rate	5%
		General Inflation	3%
		Fuel Inflation	2%
		Analysis Period	20 years
		1st year I and M	5%

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
0				$843,750.00						
1	-$67,704.68	-$42,187.50	-$25,517.18	$818,232.82	-$32,813	$162,750	$71,985	$234,735	$134,218	$127,826
2	-$67,704.68	-$40,911.64	-$26,793.04	$791,439.77	-$18,797	$166,005	$73,737	$239,742	$153,240	$138,993
3	-$67,704.68	-$39,571.99	-$28,132.69	$763,307.08	-$18,844	$169,325	$75,532	$244,857	$158,308	$136,753
4	-$67,704.68	-$38,165.35	-$29,539.33	$733,767.75	-$18,892	$172,712	$77,373	$250,084	$163,487	$134,501
5	-$67,704.68	-$36,688.39	-$31,016.30	$702,751.46	-$18,940	$175,572	$78,244	$253,816	$167,171	$130,983
6	-$67,704.68	-$35,137.57	-$32,567.11	$670,184.35	-$18,989	$177,292	$79,352	$256,645	$169,951	$126,820
7	-$67,704.68	-$33,509.22	-$34,195.47	$635,988.88	-$19,038	$179,030	$80,478	$259,507	$172,764	$122,780
8	-$67,704.68	-$31,799.44	-$35,905.24	$600,083.64	-$19,088	$180,784	$81,620	$262,404	$175,611	$118,861
9	-$67,704.68	-$30,004.18	-$37,700.50	$562,383.14	-$19,138	$182,556	$82,780	$265,336	$178,493	$115,058
10	-$67,704.68	-$28,119.16	-$39,585.53	$522,797.62	-$19,189	$184,345	$83,958	$268,303	$181,409	$111,369
11	-$67,704.68	-$26,139.88	-$41,564.80	$481,232.81	-$19,240	$186,151	$85,154	$271,305	$184,360	$107,791
12	-$67,704.68	-$24,061.64	-$43,643.04	$437,589.77	-$19,292	$187,976	$86,368	$284,752	$197,755	$110,118
13	-$67,704.68	-$21,879.49	-$45,825.19	$391,764.58	-$19,344	$189,818	$87,600	$276,185	$189,136	$100,303
14	-$67,704.68	-$19,588.23	-$48,116.45	$343,648.12	-$19,397	$191,678	$88,852	$279,278	$192,176	$97,062
15	-$67,704.68	-$17,182.41	-$50,522.28	$293,125.85	-$19,451	$193,557	$90,123	$282,408	$195,253	$93,920
16	-$67,704.68	-$14,656.29	-$53,048.39	$240,077.45	-$19,505	$195,453	$91,413	$285,576	$198,367	$90,874
17	-$67,704.68	-$12,003.87	-$55,700.81	$184,376.64	-$19,559	$197,369	$92,723	$288,782	$201,518	$87,922
18	-$67,704.68	-$9,218.83	-$58,485.85	$125,890.79	-$19,614	$199,303	$94,054	$292,026	$204,708	$85,060
19	-$67,704.68	-$6,294.54	-$61,410.14	$64,480.65	-$19,669	$201,256	$95,405	$295,310	$207,936	$82,287
20	-$67,704.68	-$3,224.03	-$64,480.65	$0.00	-$19,726	$203,229	$96,777	$298,633	$211,203	$79,600
Totals	-$1,354,093.66	-$510,343.66	-$843,750.00			$3,696,159.40	$1,693,525.78	$5,389,685.19	$3,637,064.95	$2,198,882.38

Table B-26. Case-2 100% power purchase agreement rate $0.055/kWh scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	750				
Project Size (kW)	750				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	750				
Total Cost	$ 937,500				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	1,560,375	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	10,375				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.0550	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

Table B-27. Case-2 100% power purchase agreement rate $0.055/kWh scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$937,500						
Expenses							
Loan (Principal)		-$25,517	-$26,793	-$28,133	-$29,539	-$31,016	-$32,567
Loan (Interest)		-$42,188	-$40,912	-$39,572	-$38,165	-$36,688	-$35,138
Warranty Expense		-$14,063	$0	$0	$0	$0	$0
Insurance Cost		-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063
Operation and Maintenance Cost		-$4,688	-$4,734	-$4,782	-$4,830	-$4,878	-$4,927
Total Expenses Less Loan Principal and Interest		-$32,813	-$18,797	-$18,844	-$18,892	-$18,940	-$18,989
Total Expenses Cost		**-$100,517**	**-$86,502**	**-$86,549**	**-$86,597**	**-$86,645**	**-$86,694**
Revenues							
Total Energy Generated kWh/yr		1,560,375	1,560,375	1,560,375	1,560,375	1,544,771	1,529,324
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		10,375	10,375	10,375	10,375	0	0
Power Purchase Agreement Rate ($/kWh)		0.0550	$0.0561	$0.0572	$0.0584	$0.0595	$0.0607
Electricity Sales Revenue per Power Purchase Agreement		$571	$582	$594	$606	$0	$0
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$162,750	$166,005	$169,325	$172,712	$175,572	$177,292
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$39,009	$40,102	$41,224	$42,379	$43,130	$43,894
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$32,768	$33,423	$34,092	$34,774	$35,114	$35,458
Total Annual Revenues		**$72,348**	**$74,107**	**$75,910**	**$77,758**	**$78,244**	**$79,352**
Total Energy Cost Saving		**$162,750**	**$166,005**	**$169,325**	**$172,712**	**$175,572**	**$177,292**
Total Annual Savings		**$235,098**	**$240,112**	**$245,235**	**$250,469**	**$253,816**	**$256,645**

Table B-28. Case-2 100% power purchase agreement rate $0.055/kWh scenarios expenses and revenues

Year	7	8	9	10	11	12	13
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$34,195	-$35,905	-$37,701	-$39,586	-$41,565	-$43,643	-$45,825
Loan (Interest)	-$33,509	-$31,799	-$30,004	-$28,119	-$26,140	-$24,062	-$21,879
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063
Operation and Maintenance Cost	-$4,976	-$5,026	-$5,076	-$5,127	-$5,178	-$5,230	-$5,282
Total Expenses Less Loan Principal and Interest	-$19,038	-$19,088	-$19,138	-$19,189	-$19,240	-$19,292	-$19,344
Total Expenses Cost	**-$86,743**	**-$86,793**	**-$86,843**	**-$86,894**	**-$86,945**	**-$86,997**	**-$87,049**
Revenues							
Total Energy Generated kWh/yr	1,514,030	1,498,890	1,483,901	1,469,062	1,454,371	1,439,828	1,425,429
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	0	0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)	$0.0619	$0.0632	$0.0644	$0.0657	$0.0670	$0.0684	$0.0698
Electricity Sales Revenue per Power Purchase Agreement	$0	$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$179,030	$180,784	$182,556	$184,345	$186,151	$187,976	$189,818
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$44,672	$45,463	$46,269	$47,089	$47,923	$48,772	$49,637
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$35,806	$36,157	$36,511	$36,869	$37,230	$37,595	$37,964
Total Annual Revenues	**$80,478**	**$81,620**	**$82,780**	**$83,958**	**$85,154**	**$86,368**	**$87,600**
Total Energy Cost Saving	**$179,030**	**$180,784**	**$182,556**	**$184,345**	**$186,151**	**$187,976**	**$189,818**
Total Annual Savings	**$259,507**	**$262,404**	**$265,336**	**$268,303**	**$271,305**	**$274,343**	**$277,418**

Table B-29. Case-2 100% power purchase agreement rate $0.055/kWh scenarios expenses and revenues

Year	14	15	16	17	18	19	20
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$48,116	-$50,522	-$53,048	-$55,701	-$58,486	-$61,410	-$64,481
Loan (Interest)	-$19,588	-$17,182	-$14,656	-$12,004	-$9,219	-$6,295	-$3,224
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063
Operation and Maintenance Cost	-$5,335	-$5,388	-$5,442	-$5,496	-$5,551	-$5,607	-$5,663
Total Expenses Less Loan Principal and Interest	-$19,397	-$19,451	-$19,505	-$19,559	-$19,614	-$19,669	-$19,726
Total Expenses Cost	**-$87,102**	**-$87,155**	**-$87,209**	**-$87,264**	**-$87,319**	**-$87,374**	**-$87,430**
Revenues							
Total Energy Generated kWh/yr	1,411,175	1,397,063	1,383,093	1,369,262	1,355,569	1,342,014	1,328,593
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	0	0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)	$0.0711	$0.0726	$0.0740	$0.0755	$0.0770	$0.0786	$0.0801
Electricity Sales Revenue per Power Purchase Agreement	$0	$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Saving from Off-Setting Energy Purchasing	$191,678	$193,557	$195,453	$197,369	$199,303	$201,256	$203,229
Green Tag Rate ($/kWh)	$0.0358	$0.0368	$0.0378	$0.0389	$0.0400	$0.0411	$0.0422
Green Tag Sales Revenue	$50,516	$51,411	$52,322	$53,250	$54,193	$55,153	$56,131
Federal Production Tax Credit	$0.0272	$0.0277	$0.0283	$0.0288	$0.0294	$0.0300	$0.0306
Federal Production Tax Credit Revenue	$38,336	$38,711	$39,091	$39,474	$39,861	$40,251	$40,646
Total Annual Revenues	**$88,852**	**$90,123**	**$91,413**	**$92,723**	**$94,054**	**$95,405**	**$96,777**
Total Energy Cost Saving	**$191,678**	**$193,557**	**$195,453**	**$197,369**	**$199,303**	**$201,256**	**$203,229**
Total Annual Savings	**$280,530**	**$283,679**	**$286,867**	**$290,092**	**$293,357**	**$296,661**	**$300,005**

Table B-30. Case-2 100% power purchase agreement rate $0.055/kWh life cycle cost analysis

Power Cost Data		Financial Data	
kWh/year	1,550,000	Loan Amount	$937,500.00
Electricity Cost	$0.1050 /kWh	Loan Rate	5.0%
Avg Yearly Cost	$162,750	Down Payment	10%
		Discount Rate	5%
		General Inflation	3%
		Fuel Inflation	2%
		Analysis Period	20 years
		1st year I and M	5%

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
0				$843,750.00						
1	-$67,704.68	-$42,187.50	-$25,517.18	$818,232.82	-$32,813	$162,750	$72,348	$235,098	$134,581	$128,172
2	-$67,704.68	-$40,911.64	-$26,793.04	$791,439.77	-$18,797	$166,005	$74,107	$240,112	$153,610	$139,329
3	-$67,704.68	-$39,571.99	-$28,132.69	$763,307.08	-$18,844	$169,325	$75,910	$245,235	$158,686	$137,079
4	-$67,704.68	-$38,165.35	-$29,539.33	$733,767.75	-$18,892	$172,712	$77,758	$250,469	$163,873	$134,819
5	-$67,704.68	-$36,688.39	-$31,016.30	$702,751.46	-$18,940	$175,572	$78,244	$253,816	$167,171	$130,983
6	-$67,704.68	-$35,137.57	-$32,567.11	$670,184.35	-$18,989	$177,292	$79,352	$256,645	$169,951	$126,820
7	-$67,704.68	-$33,509.22	-$34,195.47	$635,988.88	-$19,038	$179,030	$80,478	$259,507	$172,764	$122,780
8	-$67,704.68	-$31,799.44	-$35,905.24	$600,083.64	-$19,088	$180,784	$81,620	$262,404	$175,611	$118,861
9	-$67,704.68	-$30,004.18	-$37,700.50	$562,383.14	-$19,138	$182,556	$82,780	$265,336	$178,493	$115,058
10	-$67,704.68	-$28,119.16	-$39,585.53	$522,797.62	-$19,189	$184,345	$83,958	$268,303	$181,409	$111,369
11	-$67,704.68	-$26,139.88	-$41,564.80	$481,232.81	-$19,240	$186,151	$85,154	$271,305	$184,360	$107,791
12	-$67,704.68	-$24,061.64	-$43,643.04	$437,589.77	-$19,292	$187,976	$86,368	$284,752	$197,755	$110,118
13	-$67,704.68	-$21,879.49	-$45,825.19	$391,764.58	-$19,344	$189,818	$87,600	$276,185	$189,136	$100,303
14	-$67,704.68	-$19,588.23	-$48,116.45	$343,648.12	-$19,397	$191,678	$88,852	$279,278	$192,176	$97,062
15	-$67,704.68	-$17,182.41	-$50,522.28	$293,125.85	-$19,451	$193,557	$90,123	$282,408	$195,253	$93,920
16	-$67,704.68	-$14,656.29	-$53,048.39	$240,077.45	-$19,505	$195,453	$91,413	$285,576	$198,367	$90,874
17	-$67,704.68	-$12,003.87	-$55,700.81	$184,376.64	-$19,559	$197,369	$92,723	$288,782	$201,518	$87,922
18	-$67,704.68	-$9,218.83	-$58,485.85	$125,890.79	-$19,614	$199,303	$94,054	$292,026	$204,708	$85,060
19	-$67,704.68	-$6,294.54	-$61,410.14	$64,480.65	-$19,669	$201,256	$95,405	$295,310	$207,936	$82,287
20	-$67,704.68	-$3,224.03	-$64,480.65	$0.00	-$19,726	$203,229	$96,777	$298,633	$211,203	$79,600
Totals	-$1,354,093.66	-$510,343.66	-$843,750.00			$3,696,159.40	$1,695,022.44	$5,391,181.84	$3,638,561.60	$2,200,207.55

Table B-31. Case-2 100% power purchase agreement rate $0.105/kWh scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	750				
Project Size (kW)	750				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	750				
Total Cost	$ 937,500				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	1,560,375	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	10,375				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.1050	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

Table B-32. Case-2 100% power purchase agreement Rate $0.105/kWh scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$937,500						
Expenses							
Loan (Principal)		-$25,517	-$26,793	-$28,133	-$29,539	-$31,016	-$32,567
Loan (Interest)		-$42,188	-$40,912	-$39,572	-$38,165	-$36,688	-$35,138
Warranty Expense		-$14,063	$0	$0	$0	$0	$0
Insurance Cost		-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063
Operation and Maintenance Cost		-$4,688	-$4,734	-$4,782	-$4,830	-$4,878	-$4,927
Total Expenses Less Loan Principal and Interest		-$32,813	-$18,797	-$18,844	-$18,892	-$18,940	-$18,989
Total Expenses Cost		**-$100,517**	**-$86,502**	**-$86,549**	**-$86,597**	**-$86,645**	**-$86,694**
Revenues							
Total Energy Generated kWh/yr		1,560,375	1,560,375	1,560,375	1,560,375	1,544,771	1,529,324
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		10,375	10,375	10,375	10,375	0	0
Power Purchase Agreement Rate ($/kWh)		0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Electricity Sales Revenue per Power Purchase Agreement		$1,089	$1,111	$1,133	$1,156	$0	$0
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$162,750	$166,005	$169,325	$172,712	$175,572	$177,292
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$39,009	$40,102	$41,224	$42,379	$43,130	$43,894
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$32,768	$33,423	$34,092	$34,774	$35,114	$35,458
Total Annual Revenues		**$72,867**	**$74,636**	**$76,450**	**$78,308**	**$78,244**	**$79,352**
Total Energy Cost Saving		**$162,750**	**$166,005**	**$169,325**	**$172,712**	**$175,572**	**$177,292**
Total Annual Savings		**$235,617**	**$240,641**	**$245,775**	**$251,020**	**$253,816**	**$256,645**

Table B-33. Case-2 100% Power Purchase Agreement Rate $0.105/kWh Scenarios Expenses and Revenues

Year	7	8	9	10	11	12	13
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$34,195	-$35,905	-$37,701	-$39,586	-$41,565	-$43,643	-$45,825
Loan (Interest)	-$33,509	-$31,799	-$30,004	-$28,119	-$26,140	-$24,062	-$21,879
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063
Operation and Maintenance Cost	-$4,976	-$5,026	-$5,076	-$5,127	-$5,178	-$5,230	-$5,282
Total Expenses Less Loan Principal and Interest	-$19,038	-$19,088	-$19,138	-$19,189	-$19,240	-$19,292	-$19,344
Total Expenses Cost	**-$86,743**	**-$86,793**	**-$86,843**	**-$86,894**	**-$86,945**	**-$86,997**	**-$87,049**
Revenues							
Total Energy Generated kWh/yr	1,514,030	1,498,890	1,483,901	1,469,062	1,454,371	1,439,828	1,425,429
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	0	0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Electricity Sales Revenue per Power Purchase Agreement	$0	$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$179,030	$180,784	$182,556	$184,345	$186,151	$187,976	$189,818
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$44,672	$45,463	$46,269	$47,089	$47,923	$48,772	$49,637
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$35,806	$36,157	$36,511	$36,869	$37,230	$37,595	$37,964
Total Annual Revenues	**$80,478**	**$81,620**	**$82,780**	**$83,958**	**$85,154**	**$86,368**	**$87,600**
Total Energy Cost Saving	**$179,030**	**$180,784**	**$182,556**	**$184,345**	**$186,151**	**$187,976**	**$189,818**
Total Annual Savings	**$259,507**	**$262,404**	**$265,336**	**$268,303**	**$271,305**	**$274,343**	**$277,418**

Table B-34. Case-2 100% power purchase agreement rate $0.105kWh scenarios expenses and revenues

Year	7	8	9	10	11	12	13
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$34,195	-$35,905	-$37,701	-$39,586	-$41,565	-$43,643	-$45,825
Loan (Interest)	-$33,509	-$31,799	-$30,004	-$28,119	-$26,140	-$24,062	-$21,879
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063
Operation and Maintenance Cost	-$4,976	-$5,026	-$5,076	-$5,127	-$5,178	-$5,230	-$5,282
Total Expenses Less Loan Principal and Interest	-$19,038	-$19,088	-$19,138	-$19,189	-$19,240	-$19,292	-$19,344
Total Expenses Cost	**-$86,743**	**-$86,793**	**-$86,843**	**-$86,894**	**-$86,945**	**-$86,997**	**-$87,049**
Revenues							
Total Energy Generated kWh/yr	1,514,030	1,498,890	1,483,901	1,469,062	1,454,371	1,439,828	1,425,429
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	0	0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Electricity Sales Revenue per Power Purchase Agreement	$0	$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$179,030	$180,784	$182,556	$184,345	$186,151	$187,976	$189,818
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$44,672	$45,463	$46,269	$47,089	$47,923	$48,772	$49,637
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$35,806	$36,157	$36,511	$36,869	$37,230	$37,595	$37,964
Total Annual Revenues	**$80,478**	**$81,620**	**$82,780**	**$83,958**	**$85,154**	**$86,368**	**$87,600**
Total Energy Cost Saving	**$179,030**	**$180,784**	**$182,556**	**$184,345**	**$186,151**	**$187,976**	**$189,818**
Total Annual Savings	**$259,507**	**$262,404**	**$265,336**	**$268,303**	**$271,305**	**$274,343**	**$277,418**

Table B-35. Case-2 100% power purchase agreement rate $0.105/kWh life cycle cost analysis

Power Cost Data		Financial Data	
kWh/year	1,550,000	Loan Amount	$937,500.00
Electricity Cost	$0.1050 /kWh	Loan Rate	5.0%
Avg Yearly Cost	$162,750	Down Payment	10%
		Discount Rate	5%
		General Inflation	3%
		Fuel Inflation	2%
		Analysis Period	20 years
		1st year I and M	5%

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
0				$843,750						
1	-$67,705	-$42,188	-$25,517	$818,233	-$32,813	$162,750	$72,867	$235,617	$135,099	$128,666
2	-$67,705	-$40,912	-$26,793	$791,440	-$18,797	$166,005	$74,636	$240,641	$154,139	$139,809
3	-$67,705	-$39,572	-$28,133	$763,307	-$18,844	$169,325	$76,450	$245,775	$159,226	$137,545
4	-$67,705	-$38,165	-$29,539	$733,768	-$18,892	$172,712	$78,308	$251,020	$164,423	$135,271
5	-$67,705	-$36,688	-$31,016	$702,751	-$18,940	$175,572	$78,244	$253,816	$167,171	$130,983
6	-$67,705	-$35,138	-$32,567	$670,184	-$18,989	$177,292	$79,352	$256,645	$169,951	$126,820
7	-$67,705	-$33,509	-$34,195	$635,989	-$19,038	$179,030	$80,478	$259,507	$172,764	$122,780
8	-$67,705	-$31,799	-$35,905	$600,084	-$19,088	$180,784	$81,620	$262,404	$175,611	$118,861
9	-$67,705	-$30,004	-$37,701	$562,383	-$19,138	$182,556	$82,780	$265,336	$178,493	$115,058
10	-$67,705	-$28,119	-$39,586	$522,798	-$19,189	$184,345	$83,958	$268,303	$181,409	$111,369
11	-$67,705	-$26,140	-$41,565	$481,233	-$19,240	$186,151	$85,154	$271,305	$184,360	$107,791
12	-$67,705	-$24,062	-$43,643	$437,590	-$19,292	$187,976	$86,368	$284,752	$197,755	$110,118
13	-$67,705	-$21,879	-$45,825	$391,765	-$19,344	$189,818	$87,600	$276,185	$189,136	$100,303
14	-$67,705	-$19,588	-$48,116	$343,648	-$19,397	$191,678	$88,852	$279,278	$192,176	$97,062
15	-$67,705	-$17,182	-$50,522	$293,126	-$19,451	$193,557	$90,123	$282,408	$195,253	$93,920
16	-$67,705	-$14,656	-$53,048	$240,077	-$19,505	$195,453	$91,413	$285,576	$198,367	$90,874
17	-$67,705	-$12,004	-$55,701	$184,377	-$19,559	$197,369	$92,723	$288,782	$201,518	$87,922
18	-$67,705	-$9,219	-$58,486	$125,891	-$19,614	$199,303	$94,054	$292,026	$204,708	$85,060
19	-$67,705	-$6,295	-$61,410	$64,481	-$19,669	$201,256	$95,405	$295,310	$207,936	$82,287
20	-$67,705	-$3,224	-$64,481	$0	-$19,726	$203,229	$96,777	$298,633	$211,203	$79,600
Totals	-$1,354,094	-$510,344	-$843,750			$3,696,159	$1,697,161	$5,393,320	$3,640,700	$2,202,101

Table B-36. Case-2 100% power purchase agreement rate $0.3/kWh scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	750				
Project Size (kW)	750				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	750				
Total Cost	$ 937,500				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	1,560,375	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	10,375				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.3000	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

Table B-37. Case-2 100% power purchase agreement rate $0.3/kWh scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$937,500						
Expenses							
Loan (Principal)		-$25,517	-$26,793	-$28,133	-$29,539	-$31,016	-$32,567
Loan (Interest)		-$42,188	-$40,912	-$39,572	-$38,165	-$36,688	-$35,138
Warranty Expense		-$14,063	$0	$0	$0	$0	$0
Insurance Cost		-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063
Operation and Maintenance Cost		-$4,688	-$4,734	-$4,782	-$4,830	-$4,878	-$4,927
Total Expenses Less Loan Principal and Interest		-$32,813	-$18,797	-$18,844	-$18,892	-$18,940	-$18,989
Total Expenses Cost		**-$100,517**	**-$86,502**	**-$86,549**	**-$86,597**	**-$86,645**	**-$86,694**
Revenues							
Total Energy Generated kWh/yr		1,560,375	1,560,375	1,560,375	1,560,375	1,544,771	1,529,324
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		10,375	10,375	10,375	10,375	0	0
Power Purchase Agreement Rate ($/kWh)		0.3000	$0.3060	$0.3121	$0.3184	$0.3247	$0.3312
Electricity Sales Revenue per Power Purchase Agreement		$3,113	$3,175	$3,238	$3,303	$0	$0
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$162,750	$166,005	$169,325	$172,712	$175,572	$177,292
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$39,009	$40,102	$41,224	$42,379	$43,130	$43,894
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$32,768	$33,423	$34,092	$34,774	$35,114	$35,458
Total Annual Revenues		**$74,890**	**$76,700**	**$78,554**	**$80,455**	**$78,244**	**$79,352**
Total Energy Cost Saving		**$162,750**	**$166,005**	**$169,325**	**$172,712**	**$175,572**	**$177,292**
Total Annual Savings		**$237,640**	**$242,705**	**$247,880**	**$253,167**	**$253,816**	**$256,645**

Table B-38. Case-2 100% power purchase agreement rate $0.3/kWh scenarios expenses and revenues

Year	7	8	9	10	11	12	13
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$34,195	-$35,905	-$37,701	-$39,586	-$41,565	-$43,643	-$45,825
Loan (Interest)	-$33,509	-$31,799	-$30,004	-$28,119	-$26,140	-$24,062	-$21,879
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063
Operation and Maintenance Cost	-$4,976	-$5,026	-$5,076	-$5,127	-$5,178	-$5,230	-$5,282
Total Expenses Less Loan Principal and Interest	-$19,038	-$19,088	-$19,138	-$19,189	-$19,240	-$19,292	-$19,344
Total Expenses Cost	**-$86,743**	**-$86,793**	**-$86,843**	**-$86,894**	**-$86,945**	**-$86,997**	**-$87,049**
Revenues							
Total Energy Generated kWh/yr	1,514,030	1,498,890	1,483,901	1,469,062	1,454,371	1,439,828	1,425,429
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	0	0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)	$0.3378	$0.3446	$0.3515	$0.3585	$0.3657	$0.3730	$0.3805
Electricity Sales Revenue per Power Purchase Agreement	$0	$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$179,030	$180,784	$182,556	$184,345	$186,151	$187,976	$189,818
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$44,672	$45,463	$46,269	$47,089	$47,923	$48,772	$49,637
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$35,806	$36,157	$36,511	$36,869	$37,230	$37,595	$37,964
Total Annual Revenues	**$80,478**	**$81,620**	**$82,780**	**$83,958**	**$85,154**	**$86,368**	**$87,600**
Total Energy Cost Saving	**$179,030**	**$180,784**	**$182,556**	**$184,345**	**$186,151**	**$187,976**	**$189,818**
Total Annual Savings	**$259,507**	**$262,404**	**$265,336**	**$268,303**	**$271,305**	**$274,343**	**$277,418**

Table B-39. Case-2 100% power purchase agreement rate $0.3/kWh scenarios expenses and revenues

Year	14	15	16	17	18	19	20
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$48,116	-$50,522	-$53,048	-$55,701	-$58,486	-$61,410	-$64,481
Loan (Interest)	-$19,588	-$17,182	-$14,656	-$12,004	-$9,219	-$6,295	-$3,224
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063	-$14,063
Operation and Maintenance Cost	-$5,335	-$5,388	-$5,442	-$5,496	-$5,551	-$5,607	-$5,663
Total Expenses Less Loan Principal and Interest	-$19,397	-$19,451	-$19,505	-$19,559	-$19,614	-$19,669	-$19,726
Total Expenses Cost	**-$87,102**	**-$87,155**	**-$87,209**	**-$87,264**	**-$87,319**	**-$87,374**	**-$87,430**
Revenues							
Total Energy Generated kWh/yr	1,411,175	1,397,063	1,383,093	1,369,262	1,355,569	1,342,014	1,328,593
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	0	0	0	0	0	0	0
Power Purchase Agreement Rate ($/kWh)	$0.3881	$0.3958	$0.4038	$0.4118	$0.4201	$0.4285	$0.4370
Electricity Sales Revenue per Power Purchase Agreement	$0	$0	$0	$0	$0	$0	$0
Cost of Energy if Purchased	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Saving from Off-Setting Energy Purchasing	$191,678	$193,557	$195,453	$197,369	$199,303	$201,256	$203,229
Green Tag Rate ($/kWh)	$0.0358	$0.0368	$0.0378	$0.0389	$0.0400	$0.0411	$0.0422
Green Tag Sales Revenue	$50,516	$51,411	$52,322	$53,250	$54,193	$55,153	$56,131
Federal Production Tax Credit	$0.0272	$0.0277	$0.0283	$0.0288	$0.0294	$0.0300	$0.0306
Federal Production Tax Credit Revenue	$38,336	$38,711	$39,091	$39,474	$39,861	$40,251	$40,646
Total Annual Revenues	**$88,852**	**$90,123**	**$91,413**	**$92,723**	**$94,054**	**$95,405**	**$96,777**
Total Energy Cost Saving	**$191,678**	**$193,557**	**$195,453**	**$197,369**	**$199,303**	**$201,256**	**$203,229**
Total Annual Savings	**$280,530**	**$283,679**	**$286,867**	**$290,092**	**$293,357**	**$296,661**	**$300,005**

Table B-40. Case-2 100% power purchase agreement rate $0.3/kWh life cycle cost analysis

Power Cost Data			Financial Data		
kWh/year	1,550,000		Loan Amount	$937,500	
Electricity Cost	$0.1050	/kWh	Loan Rate	5.0%	
Avg Yearly Cost	$162,750		Down Payment	10%	
			Discount Rate	5%	
			General Inflation	3%	
			Fuel Inflation	2%	
			Analysis Period	20	years
			1st year I and M	5%	

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
0				$843,750						
1	-$67,705	-$42,188	-$25,517	$818,233	-$32,813	$162,750	$74,890	$237,640	$137,123	$130,593
2	-$67,705	-$40,912	-$26,793	$791,440	-$18,797	$166,005	$76,700	$242,705	$156,203	$141,681
3	-$67,705	-$39,572	-$28,133	$763,307	-$18,844	$169,325	$78,554	$247,880	$161,331	$139,363
4	-$67,705	-$38,165	-$29,539	$733,768	-$18,892	$172,712	$80,455	$253,167	$166,570	$137,038
5	-$67,705	-$36,688	-$31,016	$702,751	-$18,940	$175,572	$78,244	$253,816	$167,171	$130,983
6	-$67,705	-$35,138	-$32,567	$670,184	-$18,989	$177,292	$79,352	$256,645	$169,951	$126,820
7	-$67,705	-$33,509	-$34,195	$635,989	-$19,038	$179,030	$80,478	$259,507	$172,764	$122,780
8	-$67,705	-$31,799	-$35,905	$600,084	-$19,088	$180,784	$81,620	$262,404	$175,611	$118,861
9	-$67,705	-$30,004	-$37,701	$562,383	-$19,138	$182,556	$82,780	$265,336	$178,493	$115,058
10	-$67,705	-$28,119	-$39,586	$522,798	-$19,189	$184,345	$83,958	$268,303	$181,409	$111,369
11	-$67,705	-$26,140	-$41,565	$481,233	-$19,240	$186,151	$85,154	$271,305	$184,360	$107,791
12	-$67,705	-$24,062	-$43,643	$437,590	-$19,292	$187,976	$86,368	$284,752	$197,755	$110,118
13	-$67,705	-$21,879	-$45,825	$391,765	-$19,344	$189,818	$87,600	$276,185	$189,136	$100,303
14	-$67,705	-$19,588	-$48,116	$343,648	-$19,397	$191,678	$88,852	$279,278	$192,176	$97,062
15	-$67,705	-$17,182	-$50,522	$293,126	-$19,451	$193,557	$90,123	$282,408	$195,253	$93,920
16	-$67,705	-$14,656	-$53,048	$240,077	-$19,505	$195,453	$91,413	$285,576	$198,367	$90,874
17	-$67,705	-$12,004	-$55,701	$184,377	-$19,559	$197,369	$92,723	$288,782	$201,518	$87,922
18	-$67,705	-$9,219	-$58,486	$125,891	-$19,614	$199,303	$94,054	$292,026	$204,708	$85,060
19	-$67,705	-$6,295	-$61,410	$64,481	-$19,669	$201,256	$95,405	$295,310	$207,936	$82,287
20	-$67,705	-$3,224	-$64,481	$0	-$19,726	$203,229	$96,777	$298,633	$211,203	$79,600
Totals	-$1,354,094	-$510,344	-$843,750			$3,696,159	$1,705,499	$5,401,658	$3,649,038	$2,209,484

Table B-41. Case-2 125% power purchase agreement rate $0.02/kWh scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	1000				
Project Size (kW)	1000				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	1000				
Total Cost	$ 1,250,000				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	2,080,500	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	530,500				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.0200	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

Table B-42. Case-2 125% power purchase agreement rate $0.02/kWh scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital Expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$1,250,000						
Expenses							
Loan (Principal)		-$34,023	-$35,724	-$37,510	-$39,386	-$41,355	-$43,423
Loan (Interest)		-$56,250	-$54,549	-$52,763	-$50,887	-$48,918	-$46,850
Warranty Expense		-$18,750	$0	$0	$0	$0	$0
Insurance Cost		-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750
Operation and Maintenance Cost		-$6,250	-$6,313	-$6,376	-$6,439	-$6,504	-$6,569
Total Expenses Less Loan Principal and Interest		-$43,750	-$25,063	-$25,126	-$25,189	-$25,254	-$25,319
Total Expenses Cost		**-$134,023**	**-$115,335**	**-$115,399**	**-$115,462**	**-$115,527**	**-$115,592**
Revenues							
Total Energy Generated kWh/yr		2,080,500	2,080,500	2,080,500	2,080,500	2,059,695	2,039,098
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		530,500	530,500	530,500	530,500	509,695	489,098
Power Purchase Agreement Rate ($/kWh)		0.0200	$0.0204	$0.0208	$0.0212	$0.0216	$0.0221
Electricity Sales Revenue per Power Purchase Agreement		$10,610	$10,822	$11,039	$11,259	$11,034	$10,800
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$162,750	$166,005	$169,325	$172,712	$176,166	$179,689
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$52,013	$53,469	$54,966	$56,505	$57,506	$58,525
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$43,691	$44,564	$45,456	$46,365	$46,819	$47,278
Total Annual Revenues		**$106,313**	**$108,855**	**$111,460**	**$114,129**	**$115,360**	**$116,603**
Total Energy Cost Saving		**$162,750**	**$166,005**	**$169,325**	**$172,712**	**$176,166**	**$179,689**
Total Annual Savings		**$269,063**	**$274,860**	**$280,785**	**$286,841**	**$291,525**	**$296,292**

Table B-43. Case-2 125% power purchase agreement rate $0.02/kWh scenarios expenses and revenues

Year	7	8	9	10	11	12	13
Capital Expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$45,594	-$47,874	-$50,267	-$52,781	-$55,420	-$58,191	-$61,100
Loan (Interest)	-$44,679	-$42,399	-$40,006	-$37,492	-$34,853	-$32,082	-$29,173
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750
Operation and Maintenance Cost	-$6,635	-$6,701	-$6,768	-$6,836	-$6,904	-$6,973	-$7,043
Total Expenses Less Loan Principal and Interest	-$25,385	-$25,451	-$25,518	-$25,586	-$25,654	-$25,723	-$25,793
Total Expenses Cost	**-$115,657**	**-$115,724**	**-$115,791**	**-$115,858**	**-$115,927**	**-$115,996**	**-$116,066**
Revenues							
Total Energy Generated kWh/yr	2,018,707	1,998,520	1,978,535	1,958,749	1,939,162	1,919,770	1,900,573
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	468,707	448,520	428,535	408,749	389,162	369,770	350,573
Power Purchase Agreement Rate ($/kWh)	$0.0225	$0.0230	$0.0234	$0.0239	$0.0244	$0.0249	$0.0254
Electricity Sales Revenue per Power Purchase Agreement	$10,557	$10,304	$10,042	$9,770	$9,488	$9,195	$8,892
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$183,283	$186,949	$190,688	$194,501	$198,391	$202,359	$206,406
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$59,562	$60,618	$61,692	$62,785	$63,898	$65,030	$66,182
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$47,741	$48,209	$48,682	$49,159	$49,640	$50,127	$50,618
Total Annual Revenues	**$117,860**	**$119,131**	**$120,415**	**$121,714**	**$123,026**	**$124,352**	**$125,693**
Total Energy Cost Saving	**$183,283**	**$186,949**	**$190,688**	**$194,501**	**$198,391**	**$202,359**	**$206,406**
Total Annual Savings	**$301,143**	**$306,080**	**$311,103**	**$316,215**	**$321,417**	**$326,711**	**$332,099**

Table B-44. Case-2 125% power purchase agreement rate $0.02/kWh scenarios expenses and revenues

Year	14	15	16	17	18	19	20
Capital Expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$64,155	-$67,363	-$70,731	-$74,268	-$77,981	-$81,880	-$85,974
Loan (Interest)	-$26,118	-$22,910	-$19,542	-$16,005	-$12,292	-$8,393	-$4,299
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750
Operation and Maintenance Cost	-$7,113	-$7,184	-$7,256	-$7,329	-$7,402	-$7,476	-$7,551
Total Expenses Less Loan Principal and Interest	-$25,863	-$25,934	-$26,006	-$26,079	-$26,152	-$26,226	-$26,301
Total Expenses Cost	**-$116,136**	**-$116,207**	**-$116,279**	**-$116,352**	**-$116,425**	**-$116,499**	**-$116,574**
Revenues							
Total Energy Generated kWh/yr	1,881,567	1,862,751	1,844,124	1,825,682	1,807,426	1,789,351	1,771,458
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	331,567	312,751	294,124	275,682	257,426	239,351	221,458
Power Purchase Agreement Rate ($/kWh)	$0.0259	$0.0264	$0.0269	$0.0275	$0.0280	$0.0286	$0.0291
Electricity Sales Revenue per Power Purchase Agreement	$8,578	$8,253	$7,917	$7,569	$7,209	$6,837	$6,452
Cost of Energy if Purchased	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Saving from Off-Setting Energy Purchasing	$210,534	$214,745	$219,040	$223,421	$227,889	$232,447	$237,096
Green Tag Rate ($/kWh)	$0.0358	$0.0368	$0.0378	$0.0389	$0.0400	$0.0411	$0.0422
Green Tag Sales Revenue	$67,355	$68,549	$69,763	$70,999	$72,258	$73,538	$74,841
Federal Production Tax Credit	$0.0272	$0.0277	$0.0283	$0.0288	$0.0294	$0.0300	$0.0306
Federal Production Tax Credit Revenue	$51,114	$51,615	$52,121	$52,632	$53,147	$53,668	$54,194
Total Annual Revenues	**$127,048**	**$128,417**	**$129,801**	**$131,200**	**$132,614**	**$134,043**	**$135,488**
Total Energy Cost Saving	**$210,534**	**$214,745**	**$219,040**	**$223,421**	**$227,889**	**$232,447**	**$237,096**
Total Annual Savings	**$337,582**	**$343,162**	**$348,841**	**$354,621**	**$360,504**	**$366,490**	**$372,584**

Table B-45. 2 125% power purchase agreement rate $0.02/kWh life cycle cost analysis

Power Cost Data		Financial Data	
kWh/year	1,550,000	Loan Amount	$1,250,000.00
Electricity Cost	$0.1050 /kWh	Loan Rate	5.0%
Avg Yearly Cost	$162,750	Down Payment	10%
		Discount Rate	5%
		General Inflation	3%
		Fuel Inflation	2%
		Analysis Period	20 years
		1st year I and M	5%

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
0				$1,125,000.00						
1	-$90,272.91	-$56,250.00	-$34,022.91	$1,090,977.09	-$43,750	$162,750	$106,313	$269,063	$135,040	$128,610
2	-$90,272.91	-$54,548.85	-$35,724.06	$1,055,253.03	-$25,063	$166,005	$108,855	$274,860	$159,525	$144,694
3	-$90,272.91	-$52,762.65	-$37,510.26	$1,017,742.77	-$25,126	$169,325	$111,460	$280,785	$165,387	$142,867
4	-$90,272.91	-$50,887.14	-$39,385.77	$978,357.00	-$25,189	$172,712	$114,129	$286,841	$171,378	$140,993
5	-$90,272.91	-$48,917.85	-$41,355.06	$937,001.94	-$25,254	$176,166	$115,360	$291,525	$175,999	$137,900
6	-$90,272.91	-$46,850.10	-$43,422.81	$893,579.13	-$25,319	$179,689	$116,603	$296,292	$180,701	$134,842
7	-$90,272.91	-$44,678.96	-$45,593.95	$847,985.17	-$25,385	$183,283	$117,860	$301,143	$185,486	$131,821
8	-$90,272.91	-$42,399.26	-$47,873.65	$800,111.52	-$25,451	$186,949	$119,131	$306,080	$190,356	$128,840
9	-$90,272.91	-$40,005.58	-$50,267.33	$749,844.19	-$25,518	$190,688	$120,415	$311,103	$195,312	$125,900
10	-$90,272.91	-$37,492.21	-$52,780.70	$697,063.49	-$25,586	$194,501	$121,714	$316,215	$200,357	$123,002
11	-$90,272.91	-$34,853.17	-$55,419.74	$641,643.75	-$25,654	$198,391	$123,026	$321,417	$205,490	$120,146
12	-$90,272.91	-$32,082.19	-$58,190.72	$583,453.03	-$25,723	$202,359	$124,352	$337,847	$221,851	$123,535
13	-$90,272.91	-$29,172.65	-$61,100.26	$522,352.77	-$25,793	$206,406	$125,693	$330,758	$214,693	$113,856
14	-$90,272.91	-$26,117.64	-$64,155.27	$458,197.50	-$25,863	$210,534	$127,048	$336,227	$220,091	$111,161
15	-$90,272.91	-$22,909.87	-$67,363.04	$390,834.46	-$25,934	$214,745	$128,417	$341,793	$225,586	$108,511
16	-$90,272.91	-$19,541.72	-$70,731.19	$320,103.27	-$26,006	$219,040	$129,801	$347,457	$231,178	$105,905
17	-$90,272.91	-$16,005.16	-$74,267.75	$245,835.53	-$26,079	$223,421	$131,200	$353,222	$236,871	$103,346
18	-$90,272.91	-$12,291.78	-$77,981.13	$167,854.39	-$26,152	$227,889	$132,614	$359,090	$242,665	$100,832
19	-$90,272.91	-$8,392.72	-$81,880.19	$85,974.20	-$26,226	$232,447	$134,043	$365,061	$248,562	$98,365
20	-$90,272.91	-$4,298.71	-$85,974.20	$0.00	-$26,301	$237,096	$135,488	$371,139	$254,566	$95,943
Totals	-$1,805,458.21	-$680,458.21	-$1,125,000.00			$3,954,396.93	$2,443,523.06	$6,397,920.00	$4,061,093.01	$2,421,068.65

Table B-46. Case-2 125% power purchase agreement rate $0.055/kWh scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**7Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	1000				
Project Size (kW)	1000				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	1000				
Total Cost	$ 1,250,000				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	2,080,500	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	530,500				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.0550	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

Table B-47. Case-2 125% power purchase agreement rate $0.055/kWh scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$1,250,000						
Expenses							
Loan (Principal)		-$34,023	-$35,724	-$37,510	-$39,386	-$41,355	-$43,423
Loan (Interest)		-$56,250	-$54,549	-$52,763	-$50,887	-$48,918	-$46,850
Warranty Expense		-$18,750	$0	$0	$0	$0	$0
Insurance Cost		-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750
Operation and Maintenance Cost		-$6,250	-$6,313	-$6,376	-$6,439	-$6,504	-$6,569
Total Expenses Less Loan Principal and Interest		-$43,750	-$25,063	-$25,126	-$25,189	-$25,254	-$25,319
Total Expenses Cost		**-$134,023**	**-$115,335**	**-$115,399**	**-$115,462**	**-$115,527**	**-$115,592**
Revenues							
Total Energy Generated kWh/yr		2,080,500	2,080,500	2,080,500	2,080,500	2,059,695	2,039,098
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		530,500	530,500	530,500	530,500	509,695	489,098
Power Purchase Agreement Rate ($/kWh)		0.0550	$0.0561	$0.0572	$0.0584	$0.0595	$0.0607
Electricity Sales Revenue per Power Purchase Agreement		$29,178	$29,761	$30,356	$30,963	$30,344	$29,700
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$162,750	$166,005	$169,325	$172,712	$176,166	$179,689
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$52,013	$53,469	$54,966	$56,505	$57,506	$58,525
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$43,691	$44,564	$45,456	$46,365	$46,819	$47,278
Total Annual Revenues		**$124,881**	**$127,794**	**$130,778**	**$133,833**	**$134,669**	**$135,503**
Total Energy Cost Saving		**$162,750**	**$166,005**	**$169,325**	**$172,712**	**$176,166**	**$179,689**
Total Annual Savings		**$287,631**	**$293,799**	**$300,103**	**$306,545**	**$310,835**	**$315,193**

Table B-48. Case-2 125% power purchase agreement rate $0.055/kWh scenarios expenses and revenues

Year	7	8	9	10	11	12	13
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$45,594	-$47,874	-$50,267	-$52,781	-$55,420	-$58,191	-$61,100
Loan (Interest)	-$44,679	-$42,399	-$40,006	-$37,492	-$34,853	-$32,082	-$29,173
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750
Operation and Maintenance Cost	-$6,635	-$6,701	-$6,768	-$6,836	-$6,904	-$6,973	-$7,043
Total Expenses Less Loan Principal and Interest	-$25,385	-$25,451	-$25,518	-$25,586	-$25,654	-$25,723	-$25,793
Total Expenses Cost	**-$115,657**	**-$115,724**	**-$115,791**	**-$115,858**	**-$115,927**	**-$115,996**	**-$116,066**
Revenues							
Total Energy Generated kWh/yr	2,018,707	1,998,520	1,978,535	1,958,749	1,939,162	1,919,770	1,900,573
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	468,707	448,520	428,535	408,749	389,162	369,770	350,573
Power Purchase Agreement Rate ($/kWh)	$0.0619	$0.0632	$0.0644	$0.0657	$0.0670	$0.0684	$0.0698
Electricity Sales Revenue per Power Purchase Agreement	$29,031	$28,336	$27,615	$26,867	$26,091	$25,287	$24,454
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$183,283	$186,949	$190,688	$194,501	$198,391	$202,359	$206,406
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$59,562	$60,618	$61,692	$62,785	$63,898	$65,030	$66,182
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$47,741	$48,209	$48,682	$49,159	$49,640	$50,127	$50,618
Total Annual Revenues	**$136,335**	**$137,163**	**$137,989**	**$138,811**	**$139,629**	**$140,444**	**$141,254**
Total Energy Cost Saving	**$183,283**	**$186,949**	**$190,688**	**$194,501**	**$198,391**	**$202,359**	**$206,406**
Total Annual Savings	**$319,618**	**$324,112**	**$328,676**	**$333,312**	**$338,021**	**$342,803**	**$347,660**

Table B-49. Case-2 125% power purchase agreement rate $0.055/kWh scenarios expenses and revenues

Year	14	15	16	17	18	19	20
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$64,155	-$67,363	-$70,731	-$74,268	-$77,981	-$81,880	-$85,974
Loan (Interest)	-$26,118	-$22,910	-$19,542	-$16,005	-$12,292	-$8,393	-$4,299
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750
Operation and Maintenance Cost	-$7,113	-$7,184	-$7,256	-$7,329	-$7,402	-$7,476	-$7,551
Total Expenses Less Loan Principal and Interest	-$25,863	-$25,934	-$26,006	-$26,079	-$26,152	-$26,226	-$26,301
Total Expenses Cost	**-$116,136**	**-$116,207**	**-$116,279**	**-$116,352**	**-$116,425**	**-$116,499**	**-$116,574**
Revenues							
Total Energy Generated kWh/yr	1,881,567	1,862,751	1,844,124	1,825,682	1,807,426	1,789,351	1,771,458
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	331,567	312,751	294,124	275,682	257,426	239,351	221,458
Power Purchase Agreement Rate ($/kWh)	$0.0711	$0.0726	$0.0740	$0.0755	$0.0770	$0.0786	$0.0801
Electricity Sales Revenue per Power Purchase Agreement	$23,590	$22,697	$21,772	$20,815	$19,825	$18,802	$17,744
Cost of Energy if Purchased	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Saving from Off-Setting Energy Purchasing	$210,534	$214,745	$219,040	$223,421	$227,889	$232,447	$237,096
Green Tag Rate ($/kWh)	$0.0358	$0.0368	$0.0378	$0.0389	$0.0400	$0.0411	$0.0422
Green Tag Sales Revenue	$67,355	$68,549	$69,763	$70,999	$72,258	$73,538	$74,841
Federal Production Tax Credit	$0.0272	$0.0277	$0.0283	$0.0288	$0.0294	$0.0300	$0.0306
Federal Production Tax Credit Revenue	$51,114	$51,615	$52,121	$52,632	$53,147	$53,668	$54,194
Total Annual Revenues	**$142,060**	**$142,860**	**$143,656**	**$144,446**	**$145,230**	**$146,008**	**$146,780**
Total Energy Cost Saving	**$210,534**	**$214,745**	**$219,040**	**$223,421**	**$227,889**	**$232,447**	**$237,096**
Total Annual Savings	**$352,594**	**$357,606**	**$362,696**	**$367,867**	**$373,120**	**$378,455**	**$383,876**

Table B-50 Case-2 125% power purchase agreement rate $0.055/kWh life cycle cost analysis

Power Cost Data		Financial Data		
kWh/year	1,550,000	Loan Amount	$1,250,000	
Electricity Cost	$0.1050 /kWh	Loan Rate	5.0%	
Avg Yearly Cost	$162,750	Down Payment	10%	
		Discount Rate	5%	
		General Inflation	3%	
		Fuel Inflation	2%	
		Analysis Period	20	years
		1st year I and M	5%	

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
0				$1,125,000						
1	-$90,273	-$56,250	-$34,023	$1,090,977	-$43,750	$162,750	$124,881	$287,631	$153,608	$146,293
2	-$90,273	-$54,549	-$35,724	$1,055,253	-$25,063	$166,005	$127,794	$293,799	$178,464	$161,872
3	-$90,273	-$52,763	-$37,510	$1,017,743	-$25,126	$169,325	$130,778	$300,103	$184,704	$159,555
4	-$90,273	-$50,887	-$39,386	$978,357	-$25,189	$172,712	$133,833	$306,545	$191,082	$157,204
5	-$90,273	-$48,918	-$41,355	$937,002	-$25,254	$176,166	$134,669	$310,835	$195,309	$153,029
6	-$90,273	-$46,850	-$43,423	$893,579	-$25,319	$179,689	$135,503	$315,193	$199,601	$148,945
7	-$90,273	-$44,679	-$45,594	$847,985	-$25,385	$183,283	$136,335	$319,618	$203,960	$144,951
8	-$90,273	-$42,399	-$47,874	$800,112	-$25,451	$186,949	$137,163	$324,112	$208,388	$141,045
9	-$90,273	-$40,006	-$50,267	$749,844	-$25,518	$190,688	$137,989	$328,676	$212,886	$137,228
10	-$90,273	-$37,492	-$52,781	$697,063	-$25,586	$194,501	$138,811	$333,312	$217,454	$133,498
11	-$90,273	-$34,853	-$55,420	$641,644	-$25,654	$198,391	$139,629	$338,021	$222,094	$129,854
12	-$90,273	-$32,082	-$58,191	$583,453	-$25,723	$202,359	$140,444	$349,139	$233,143	$129,823
13	-$90,273	-$29,173	-$61,100	$522,353	-$25,793	$206,406	$141,254	$346,850	$230,785	$122,390
14	-$90,273	-$26,118	-$64,155	$458,197	-$25,863	$210,534	$142,060	$351,788	$235,652	$119,021
15	-$90,273	-$22,910	-$67,363	$390,834	-$25,934	$214,745	$142,860	$356,805	$240,598	$115,732
16	-$90,273	-$19,542	-$70,731	$320,103	-$26,006	$219,040	$143,656	$361,901	$245,622	$112,522
17	-$90,273	-$16,005	-$74,268	$245,836	-$26,079	$223,421	$144,446	$367,077	$250,725	$109,391
18	-$90,273	-$12,292	-$77,981	$167,854	-$26,152	$227,889	$145,230	$372,335	$255,911	$106,336
19	-$90,273	-$8,393	-$81,880	$85,974	-$26,226	$232,447	$146,008	$377,677	$261,178	$103,357
20	-$90,273	-$4,299	-$85,974	$0	-$26,301	$237,096	$146,780	$383,104	$266,531	$100,453
Totals	-$1,805,458	-$680,458	-$1,125,000			$3,954,397	$2,770,124	$6,724,521	$4,387,694	$2,632,497

Table B-51. Case-2 125% power purchase agreement rate $0.105/kWh scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	1000				
Project Size (kW)	1000				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	1000				
Total Cost	$ 1,250,000				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	2,080,500	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	530,500				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.1050	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

Table B-52. Case-2 125% power purchase agreement rate $0.105/kWh scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$1,250,000						
Expenses							
Loan (Principal)		-$34,023	-$35,724	-$37,510	-$39,386	-$41,355	-$43,423
Loan (Interest)		-$56,250	-$54,549	-$52,763	-$50,887	-$48,918	-$46,850
Warranty Expense		-$18,750	$0	$0	$0	$0	$0
Insurance Cost		-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750
Operation and Maintenance Cost		-$6,250	-$6,313	-$6,376	-$6,439	-$6,504	-$6,569
Total Expenses Less Loan Principal and Interest		-$43,750	-$25,063	-$25,126	-$25,189	-$25,254	-$25,319
		-	-	-	-	-	-
Total Expenses Cost		**$134,023**	**$115,335**	**$115,399**	**$115,462**	**$115,527**	**$115,592**
Revenues							
Total Energy Generated kWh/yr		2,080,500	2,080,500	2,080,500	2,080,500	2,059,695	2,039,098
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		530,500	530,500	530,500	530,500	509,695	489,098
Power Purchase Agreement Rate ($/kWh)		0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Electricity Sales Revenue per Power Purchase Agreement		$55,703	$56,817	$57,953	$59,112	$57,930	$56,700
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$162,750	$166,005	$169,325	$172,712	$176,166	$179,689
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$52,013	$53,469	$54,966	$56,505	$57,506	$58,525
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$43,691	$44,564	$45,456	$46,365	$46,819	$47,278
Total Annual Revenues		**$151,406**	**$154,850**	**$158,374**	**$161,982**	**$162,255**	**$162,504**
Total Energy Cost Saving		**$162,750**	**$166,005**	**$169,325**	**$172,712**	**$176,166**	**$179,689**
Total Annual Savings		**$314,156**	**$320,855**	**$327,700**	**$334,693**	**$338,421**	**$342,193**

Table B-53. Case-2 125% power purchase agreement rate $0.105/kWh scenarios expenses and revenues

Year	7	8	9	10	11	12	13
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$45,594	-$47,874	-$50,267	-$52,781	-$55,420	-$58,191	-$61,100
Loan (Interest)	-$44,679	-$42,399	-$40,006	-$37,492	-$34,853	-$32,082	-$29,173
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750
Operation and Maintenance Cost	-$6,635	-$6,701	-$6,768	-$6,836	-$6,904	-$6,973	-$7,043
Total Expenses Less Loan Principal and Interest	-$25,385	-$25,451	-$25,518	-$25,586	-$25,654	-$25,723	-$25,793
	-	-	-	-	-	-	-
Total Expenses Cost	**$115,657**	**$115,724**	**$115,791**	**$115,858**	**$115,927**	**$115,996**	**$116,066**
Revenues							
Total Energy Generated kWh/yr	2,018,707	1,998,520	1,978,535	1,958,749	1,939,162	1,919,770	1,900,573
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	468,707	448,520	428,535	408,749	389,162	369,770	350,573
Power Purchase Agreement Rate ($/kWh)	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Electricity Sales Revenue per Power Purchase Agreement	$55,423	$54,097	$52,720	$51,292	$49,811	$48,275	$46,684
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$183,283	$186,949	$190,688	$194,501	$198,391	$202,359	$206,406
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$59,562	$60,618	$61,692	$62,785	$63,898	$65,030	$66,182
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$47,741	$48,209	$48,682	$49,159	$49,640	$50,127	$50,618
Total Annual Revenues	**$162,727**	**$162,924**	**$163,094**	**$163,236**	**$163,349**	**$163,432**	**$163,485**
Total Energy Cost Saving	**$183,283**	**$186,949**	**$190,688**	**$194,501**	**$198,391**	**$202,359**	**$206,406**
Total Annual Savings	**$346,010**	**$349,872**	**$353,781**	**$357,737**	**$361,740**	**$365,791**	**$369,891**

Table B-54. Case-2 125% power purchase agreement rate $0.105/kWh scenarios expenses and revenues

Year	14	15	16	17	18	19	20
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$64,155	-$67,363	-$70,731	-$74,268	-$77,981	-$81,880	-$85,974
Loan (Interest)	-$26,118	-$22,910	-$19,542	-$16,005	-$12,292	-$8,393	-$4,299
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750
Operation and Maintenance Cost	-$7,113	-$7,184	-$7,256	-$7,329	-$7,402	-$7,476	-$7,551
Total Expenses Less Loan Principal and Interest	-$25,863	-$25,934	-$26,006	-$26,079	-$26,152	-$26,226	-$26,301
	-	-	-	-	-	-	-
Total Expenses Cost	**$116,136**	**$116,207**	**$116,279**	**$116,352**	**$116,425**	**$116,499**	**$116,574**
Revenues							
Total Energy Generated kWh/yr	1,881,567	1,862,751	1,844,124	1,825,682	1,807,426	1,789,351	1,771,458
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	331,567	312,751	294,124	275,682	257,426	239,351	221,458
Power Purchase Agreement Rate ($/kWh)	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Electricity Sales Revenue per Power Purchase Agreement	$45,036	$43,330	$41,564	$39,738	$37,848	$35,895	$33,875
Cost of Energy if Purchased	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Saving from Off-Setting Energy Purchasing	$210,534	$214,745	$219,040	$223,421	$227,889	$232,447	$237,096
Green Tag Rate ($/kWh)	$0.0358	$0.0368	$0.0378	$0.0389	$0.0400	$0.0411	$0.0422
Green Tag Sales Revenue	$67,355	$68,549	$69,763	$70,999	$72,258	$73,538	$74,841
Federal Production Tax Credit	$0.0272	$0.0277	$0.0283	$0.0288	$0.0294	$0.0300	$0.0306
Federal Production Tax Credit Revenue	$51,114	$51,615	$52,121	$52,632	$53,147	$53,668	$54,194
Total Annual Revenues	**$163,506**	**$163,494**	**$163,449**	**$163,369**	**$163,253**	**$163,101**	**$162,911**
Total Energy Cost Saving	**$210,534**	**$214,745**	**$219,040**	**$223,421**	**$227,889**	**$232,447**	**$237,096**
Total Annual Savings	**$374,040**	**$378,239**	**$382,489**	**$386,790**	**$391,142**	**$395,548**	**$400,007**

Table B-55. Case-2 125% power purchase agreement rate $0.105/kWh life cycle cost analysis

Power Cost Data			Financial Data		
kWh/year	1,550,000		Loan Amount	$1,250,000	
Electricity Cost	$0.1050	/kWh	Loan Rate	5.0%	
Avg Yearly Cost	$162,750		Down Payment	10%	
			Discount Rate	5%	
			General Inflation	3%	
			Fuel Inflation	2%	
			Analysis Period	20	years
			1st year I and M	5%	

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
$0				$1,125,000						
$1	-$90,273	-$56,250	-$34,023	$1,090,977	-$43,750	$162,750	$151,406	$314,156	$180,133	$171,555
$2	-$90,273	-$54,549	-$35,724	$1,055,253	-$25,063	$166,005	$154,850	$320,855	$205,519	$186,412
$3	-$90,273	-$52,763	-$37,510	$1,017,743	-$25,126	$169,325	$158,374	$327,700	$212,301	$183,394
$4	-$90,273	-$50,887	-$39,386	$978,357	-$25,189	$172,712	$161,982	$334,693	$219,231	$180,362
$5	-$90,273	-$48,918	-$41,355	$937,002	-$25,254	$176,166	$162,255	$338,421	$222,894	$174,643
$6	-$90,273	-$46,850	-$43,423	$893,579	-$25,319	$179,689	$162,504	$342,193	$226,601	$169,093
$7	-$90,273	-$44,679	-$45,594	$847,985	-$25,385	$183,283	$162,727	$346,010	$230,352	$163,707
$8	-$90,273	-$42,399	-$47,874	$800,112	-$25,451	$186,949	$162,924	$349,872	$234,149	$158,481
$9	-$90,273	-$40,006	-$50,267	$749,844	-$25,518	$190,688	$163,094	$353,781	$237,990	$153,411
$10	-$90,273	-$37,492	-$52,781	$697,063	-$25,586	$194,501	$163,236	$357,737	$241,878	$148,492
$11	-$90,273	-$34,853	-$55,420	$641,644	-$25,654	$198,391	$163,349	$361,740	$245,813	$143,722
$12	-$90,273	-$32,082	-$58,191	$583,453	-$25,723	$202,359	$163,432	$365,270	$249,274	$138,805
$13	-$90,273	-$29,173	-$61,100	$522,353	-$25,793	$206,406	$163,485	$369,838	$253,773	$134,581
$14	-$90,273	-$26,118	-$64,155	$458,197	-$25,863	$210,534	$163,506	$374,019	$257,883	$130,248
$15	-$90,273	-$22,910	-$67,363	$390,834	-$25,934	$214,745	$163,494	$378,251	$262,044	$126,047
$16	-$90,273	-$19,542	-$70,731	$320,103	-$26,006	$219,040	$163,449	$382,534	$266,255	$121,974
$17	-$90,273	-$16,005	-$74,268	$245,836	-$26,079	$223,421	$163,369	$386,869	$270,518	$118,026
$18	-$90,273	-$12,292	-$77,981	$167,854	-$26,152	$227,889	$163,253	$391,258	$274,833	$114,199
$19	-$90,273	-$8,393	-$81,880	$85,974	-$26,226	$232,447	$163,101	$395,700	$279,201	$110,489
$20	-$90,273	-$4,299	-$85,974	$0	-$26,301	$237,096	$162,911	$400,197	$283,623	$106,895
Totals	-$1,805,458	-$680,458	-$1,125,000			$3,954,397	$3,236,696	$7,191,093	$4,854,266	$2,934,538

Table B-56. Case-2 125% power purchase agreement rate $0.3/kWh scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	1000				
Project Size (kW)	1000				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	1000				
Total Cost	$ 1,250,000				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	2,080,500	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	530,500				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.3000	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

Table B-57. Case-2 125% power purchase agreement rate $0.3/kWh scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$1,250,000						
Expenses							
Loan (Principal)		-$34,023	-$35,724	-$37,510	-$39,386	-$41,355	-$43,423
Loan (Interest)		-$56,250	-$54,549	-$52,763	-$50,887	-$48,918	-$46,850
Warranty Expense		-$18,750	$0	$0	$0	$0	$0
Insurance Cost		-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750
Operation and Maintenance Cost		-$6,250	-$6,313	-$6,376	-$6,439	-$6,504	-$6,569
Total Expenses Less Loan Principal and Interest		-$43,750	-$25,063	-$25,126	-$25,189	-$25,254	-$25,319
		-	-	-	-	-	-
Total Expenses Cost		**$134,023**	**$115,335**	**$115,399**	**$115,462**	**$115,527**	**$115,592**
Revenues							
Total Energy Generated kWh/yr		2,080,500	2,080,500	2,080,500	2,080,500	2,059,695	2,039,098
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		530,500	530,500	530,500	530,500	509,695	489,098
Power Purchase Agreement Rate ($/kWh)		0.3000	$0.3060	$0.3121	$0.3184	$0.3247	$0.3312
Electricity Sales Revenue per Power Purchase Agreement		$159,150	$162,333	$165,580	$168,891	$165,513	$162,001
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$162,750	$166,005	$169,325	$172,712	$176,166	$179,689
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$52,013	$53,469	$54,966	$56,505	$57,506	$58,525
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$43,691	$44,564	$45,456	$46,365	$46,819	$47,278
Total Annual Revenues		**$254,853**	**$260,366**	**$266,001**	**$271,761**	**$269,838**	**$267,804**
Total Energy Cost Saving		**$162,750**	**$166,005**	**$169,325**	**$172,712**	**$176,166**	**$179,689**
Total Annual Savings		**$417,603**	**$426,371**	**$435,326**	**$444,473**	**$446,004**	**$447,493**

Table B-58. Case-2 125% power purchase agreement rate $0.3/kWh scenarios expenses and revenues

Year	7	8	9	10	11	12	13
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$45,594	-$47,874	-$50,267	-$52,781	-$55,420	-$58,191	-$61,100
Loan (Interest)	-$44,679	-$42,399	-$40,006	-$37,492	-$34,853	-$32,082	-$29,173
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750
Operation and Maintenance Cost	-$6,635	-$6,701	-$6,768	-$6,836	-$6,904	-$6,973	-$7,043
Total Expenses Less Loan Principal and Interest	-$25,385	-$25,451	-$25,518	-$25,586	-$25,654	-$25,723	-$25,793
Total Expenses Cost	**$115,657**	**$115,724**	**$115,791**	**$115,858**	**$115,927**	**$115,996**	**$116,066**
Revenues							
Total Energy Generated kWh/yr	2,018,707	1,998,520	1,978,535	1,958,749	1,939,162	1,919,770	1,900,573
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	468,707	448,520	428,535	408,749	389,162	369,770	350,573
Power Purchase Agreement Rate ($/kWh)	$0.3378	$0.3446	$0.3515	$0.3585	$0.3657	$0.3730	$0.3805
Electricity Sales Revenue per Power Purchase Agreement	$158,352	$154,563	$150,629	$146,548	$142,316	$137,929	$133,383
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$183,283	$186,949	$190,688	$194,501	$198,391	$202,359	$206,406
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$59,562	$60,618	$61,692	$62,785	$63,898	$65,030	$66,182
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$47,741	$48,209	$48,682	$49,159	$49,640	$50,127	$50,618
Total Annual Revenues	**$265,656**	**$263,389**	**$261,003**	**$258,492**	**$255,854**	**$253,086**	**$250,184**
Total Energy Cost Saving	**$183,283**	**$186,949**	**$190,688**	**$194,501**	**$198,391**	**$202,359**	**$206,406**
Total Annual Savings	**$448,939**	**$450,338**	**$451,690**	**$452,993**	**$454,245**	**$455,445**	**$456,590**

Table B-59. Case-2 125% power purchase agreement rate $0.3/kWh scenarios expenses and revenues

Year	14	15	16	17	18	19	20
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$64,155	-$67,363	-$70,731	-$74,268	-$77,981	-$81,880	-$85,974
Loan (Interest)	-$26,118	-$22,910	-$19,542	-$16,005	-$12,292	-$8,393	-$4,299
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750	-$18,750
Operation and Maintenance Cost	-$7,113	-$7,184	-$7,256	-$7,329	-$7,402	-$7,476	-$7,551
Total Expenses Less Loan Principal and Interest	-$25,863	-$25,934	-$26,006	-$26,079	-$26,152	-$26,226	-$26,301
	-	-	-	-	-	-	-
Total Expenses Cost	**$116,136**	**$116,207**	**$116,279**	**$116,352**	**$116,425**	**$116,499**	**$116,574**
Revenues							
Total Energy Generated kWh/yr	1,881,567	1,862,751	1,844,124	1,825,682	1,807,426	1,789,351	1,771,458
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	331,567	312,751	294,124	275,682	257,426	239,351	221,458
Power Purchase Agreement Rate ($/kWh)	$0.3881	$0.3958	$0.4038	$0.4118	$0.4201	$0.4285	$0.4370
Electricity Sales Revenue per Power Purchase Agreement	$128,675	$123,801	$118,756	$113,536	$108,137	$102,556	$96,787
Cost of Energy if Purchased	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Saving from Off-Setting Energy Purchasing	$210,534	$214,745	$219,040	$223,421	$227,889	$232,447	$237,096
Green Tag Rate ($/kWh)	$0.0358	$0.0368	$0.0378	$0.0389	$0.0400	$0.0411	$0.0422
Green Tag Sales Revenue	$67,355	$68,549	$69,763	$70,999	$72,258	$73,538	$74,841
Federal Production Tax Credit	$0.0272	$0.0277	$0.0283	$0.0288	$0.0294	$0.0300	$0.0306
Federal Production Tax Credit Revenue	$51,114	$51,615	$52,121	$52,632	$53,147	$53,668	$54,194
Total Annual Revenues	**$247,144**	**$243,964**	**$240,640**	**$237,167**	**$233,542**	**$229,762**	**$225,822**
Total Energy Cost Saving	**$210,534**	**$214,745**	**$219,040**	**$223,421**	**$227,889**	**$232,447**	**$237,096**
Total Annual Savings	**$457,679**	**$458,709**	**$459,680**	**$460,588**	**$461,432**	**$462,209**	**$462,918**

Table B-60. Case-2 125% power purchase agreement rate $0.3/kWh life cycle cost analysis

Power Cost Data			Financial Data		
kWh/year	1,550,000		Loan Amount	$1,250,000.00	
Electricity Cost	$0.1050	/kWh	Loan Rate	5.0%	
Avg Yearly Cost	$162,750		Down Payment	10%	
			Discount Rate	5%	
			General Inflation	3%	
			Fuel Inflation	2%	
			Analysis Period	20	years
			1st year I and M	5%	

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
0				$1,125,000						
1	-$90,273	-$56,250	-$34,023	$1,090,977	-$43,750	$162,750	$254,853	$417,603	$283,580	$270,076
2	-$90,273	-$54,549	-$35,724	$1,055,253	-$25,063	$166,005	$260,366	$426,371	$311,036	$282,119
3	-$90,273	-$52,763	-$37,510	$1,017,743	-$25,126	$169,325	$266,001	$435,326	$319,928	$276,366
4	-$90,273	-$50,887	-$39,386	$978,357	-$25,189	$172,712	$271,761	$444,473	$329,010	$270,678
5	-$90,273	-$48,918	-$41,355	$937,002	-$25,254	$176,166	$269,838	$446,004	$330,478	$258,938
6	-$90,273	-$46,850	-$43,423	$893,579	-$25,319	$179,689	$267,804	$447,493	$331,902	$247,670
7	-$90,273	-$44,679	-$45,594	$847,985	-$25,385	$183,283	$265,656	$448,939	$333,281	$236,857
8	-$90,273	-$42,399	-$47,874	$800,112	-$25,451	$186,949	$263,389	$450,338	$334,614	$226,480
9	-$90,273	-$40,006	-$50,267	$749,844	-$25,518	$190,688	$261,003	$451,690	$335,899	$216,524
10	-$90,273	-$37,492	-$52,781	$697,063	-$25,586	$194,501	$258,492	$452,993	$337,135	$206,971
11	-$90,273	-$34,853	-$55,420	$641,644	-$25,654	$198,391	$255,854	$454,245	$338,319	$197,808
12	-$90,273	-$32,082	-$58,191	$583,453	-$25,723	$202,359	$253,086	$428,181	$312,185	$173,837
13	-$90,273	-$29,173	-$61,100	$522,353	-$25,793	$206,406	$250,184	$459,492	$343,426	$182,126
14	-$90,273	-$26,118	-$64,155	$458,197	-$25,863	$210,534	$247,144	$460,718	$344,582	$174,037
15	-$90,273	-$22,910	-$67,363	$390,834	-$25,934	$214,745	$243,964	$461,890	$345,682	$166,279
16	-$90,273	-$19,542	-$70,731	$320,103	-$26,006	$219,040	$240,640	$463,004	$346,725	$158,839
17	-$90,273	-$16,005	-$74,268	$245,836	-$26,079	$223,421	$237,167	$464,061	$347,709	$151,704
18	-$90,273	-$12,292	-$77,981	$167,854	-$26,152	$227,889	$233,542	$465,056	$348,632	$144,864
19	-$90,273	-$8,393	-$81,880	$85,974	-$26,226	$232,447	$229,762	$465,990	$349,491	$138,305
20	-$90,273	-$4,299	-$85,974	$0	-$26,301	$237,096	$225,822	$466,858	$350,285	$132,019
Totals	-$1,805,458	-$680,458	-$1,125,000			$3,954,397	$5,056,329	$9,010,726	$6,673,899	$4,112,496

Table B-61. Case-2 200% power purchase agreement rate $0.02/kWh scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	1500				
Project Size (kW)	1500				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	1500				
Total Cost	$ 1,875,000				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	3,120,750	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	1,570,750				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.0200	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

Table B-62. Case-2 200% power purchase agreement rate $0.02/kWh scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$1,875,000						
Expenses							
Loan (Principal)		-$51,034	-$53,586	-$56,265	-$59,079	-$62,033	-$65,134
Loan (Interest)		-$84,375	-$81,823	-$79,144	-$76,331	-$73,377	-$70,275
Warranty Expense		-$28,125	$0	$0	$0	$0	$0
Insurance Cost		-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125
Operation and Maintenance Cost		-$9,375	-$9,469	-$9,563	-$9,659	-$9,756	-$9,853
Total Expenses Less Loan Principal and Interest		-$65,625	-$37,594	-$37,688	-$37,784	-$37,881	-$37,978
Total Expenses Cost		**-$201,034**	**-$173,003**	**-$173,098**	**-$173,193**	**-$173,290**	**-$173,388**
Revenues							
Total Energy Generated kWh/yr		3,120,750	3,120,750	3,120,750	3,120,750	3,089,543	3,058,647
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		1,570,750	1,570,750	1,570,750	1,570,750	1,539,543	1,508,647
Power Purchase Agreement Rate ($/kWh)		0.0200	$0.0204	$0.0208	$0.0212	$0.0216	$0.0221
Electricity Sales Revenue per Power Purchase Agreement		$31,415	$32,043	$32,684	$33,338	$33,329	$33,313
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$162,750	$166,005	$169,325	$172,712	$176,166	$179,689
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$78,019	$80,203	$82,449	$84,758	$86,259	$87,788
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$65,536	$66,846	$68,183	$69,547	$70,229	$70,917
Total Annual Revenues		**$174,970**	**$179,093**	**$183,317**	**$187,642**	**$189,817**	**$192,018**
Total Energy Cost Saving		**$162,750**	**$166,005**	**$169,325**	**$172,712**	**$176,166**	**$179,689**
Total Annual Savings		**$337,720**	**$345,098**	**$352,642**	**$360,354**	**$365,983**	**$371,707**

Table B-63. Case-2 200% power purchase agreement rate $0.02/kWh scenarios expenses and revenues

Year	7	8	9	10	11	12	13
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$68,391	-$71,810	-$75,401	-$79,171	-$83,130	-$87,286	-$91,650
Loan (Interest)	-$67,018	-$63,599	-$60,008	-$56,238	-$52,280	-$48,123	-$43,759
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125
Operation and Maintenance Cost	-$9,952	-$10,051	-$10,152	-$10,253	-$10,356	-$10,459	-$10,564
Total Expenses Less Loan Principal and Interest	-$38,077	-$38,176	-$38,277	-$38,378	-$38,481	-$38,584	-$38,689
Total Expenses Cost	**-$173,486**	**-$173,586**	**-$173,686**	**-$173,788**	**-$173,890**	**-$173,994**	**-$174,098**
Revenues							
Total Energy Generated kWh/yr	3,028,061	2,997,780	2,967,802	2,938,124	2,908,743	2,879,656	2,850,859
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	1,478,061	1,447,780	1,417,802	1,388,124	1,358,743	1,329,656	1,300,859
Power Purchase Agreement Rate ($/kWh)	$0.0225	$0.0230	$0.0234	$0.0239	$0.0244	$0.0249	$0.0254
Electricity Sales Revenue per Power Purchase Agreement	$33,291	$33,261	$33,224	$33,179	$33,126	$33,065	$32,996
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$183,283	$186,949	$190,688	$194,501	$198,391	$202,359	$206,406
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$89,344	$90,927	$92,538	$94,178	$95,847	$97,545	$99,273
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$71,612	$72,314	$73,022	$73,738	$74,461	$75,190	$75,927
Total Annual Revenues	**$194,246**	**$196,501**	**$198,784**	**$201,094**	**$203,433**	**$205,800**	**$208,197**
Total Energy Cost Saving	**$183,283**	**$186,949**	**$190,688**	**$194,501**	**$198,391**	**$202,359**	**$206,406**
Total Annual Savings	**$377,529**	**$383,450**	**$389,471**	**$395,596**	**$401,824**	**$408,160**	**$414,603**

Table B-64. Case-2 200% power purchase agreement rate $0.02/kWh scenarios expenses and revenues

Year	14	15	16	17	18	19	20
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$96,233	-$101,045	-$106,097	-$111,402	-$116,972	-$122,820	-$128,961
Loan (Interest)	-$39,176	-$34,365	-$29,313	-$24,008	-$18,438	-$12,589	-$6,448
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125
Operation and Maintenance Cost	-$10,670	-$10,776	-$10,884	-$10,993	-$11,103	-$11,214	-$11,326
Total Expenses Less Loan Principal and Interest	-$38,795	-$38,901	-$39,009	-$39,118	-$39,228	-$39,339	-$39,451
Total Expenses Cost	**-$174,204**	**-$174,311**	**-$174,418**	**-$174,527**	**-$174,637**	**-$174,748**	**-$174,860**
Revenues							
Total Energy Generated kWh/yr	2,822,350	2,794,127	2,766,186	2,738,524	2,711,138	2,684,027	2,657,187
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	1,272,350	1,244,127	1,216,186	1,188,524	1,161,138	1,134,027	1,107,187
Power Purchase Agreement Rate ($/kWh)	$0.0259	$0.0264	$0.0269	$0.0275	$0.0280	$0.0286	$0.0291
Electricity Sales Revenue per Power Purchase Agreement	$32,918	$32,832	$32,737	$32,632	$32,517	$32,393	$32,259
Cost of Energy if Purchased	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Saving from Off-Setting Energy Purchasing	$210,534	$214,745	$219,040	$223,421	$227,889	$232,447	$237,096
Green Tag Rate ($/kWh)	$0.0358	$0.0368	$0.0378	$0.0389	$0.0400	$0.0411	$0.0422
Green Tag Sales Revenue	$101,033	$102,823	$104,645	$106,499	$108,386	$110,307	$112,262
Federal Production Tax Credit	$0.0272	$0.0277	$0.0283	$0.0288	$0.0294	$0.0300	$0.0306
Federal Production Tax Credit Revenue	$76,671	$77,423	$78,181	$78,948	$79,721	$80,502	$81,291
Total Annual Revenues	**$210,622**	**$213,077**	**$215,563**	**$218,079**	**$220,625**	**$223,203**	**$225,812**
Total Energy Cost Saving	**$210,534**	**$214,745**	**$219,040**	**$223,421**	**$227,889**	**$232,447**	**$237,096**
Total Annual Savings	**$421,157**	**$427,823**	**$434,603**	**$441,499**	**$448,514**	**$455,650**	**$462,908**

Table B-65. 2 200% power purchase agreement rate $0.02/kWh life cycle cost analysis

Power Cost Data			Financial Data		
kWh/year	1,550,000		Loan Amount	$1,875,000.00	
Electricity Cost	$0.1050	/kWh	Loan Rate	5.0%	
Avg Yearly Cost	$162,750		Down Payment	10%	
			Discount Rate	5%	
			General Inflation	3%	
			Fuel Inflation	2%	
			Analysis Period	20	years
			1st year I and M	5%	

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
0				$1,687,500.00						
1	-$135,409.37	-$84,375.00	-$51,034.37	$1,636,465.63	-$65,625	$162,750	$174,970	$337,720	$136,685	$130,176
2	-$135,409.37	-$81,823.28	-$53,586.08	$1,582,879.55	-$37,594	$166,005	$179,093	$345,098	$172,095	$156,095
3	-$135,409.37	-$79,143.98	-$56,265.39	$1,526,614.16	-$37,688	$169,325	$183,317	$352,642	$179,544	$155,097
4	-$135,409.37	-$76,330.71	-$59,078.66	$1,467,535.50	-$37,784	$172,712	$187,642	$360,354	$187,161	$153,977
5	-$135,409.37	-$73,376.78	-$62,032.59	$1,405,502.91	-$37,881	$176,166	$189,817	$365,983	$192,693	$150,980
6	-$135,409.37	-$70,275.15	-$65,134.22	$1,340,368.69	-$37,978	$179,689	$192,018	$371,707	$198,320	$147,989
7	-$135,409.37	-$67,018.43	-$68,390.93	$1,271,977.76	-$38,077	$183,283	$194,246	$377,529	$204,043	$145,010
8	-$135,409.37	-$63,598.89	-$71,810.48	$1,200,167.28	-$38,176	$186,949	$196,501	$383,450	$209,864	$142,044
9	-$135,409.37	-$60,008.36	-$75,401.00	$1,124,766.28	-$38,277	$190,688	$198,784	$389,471	$215,785	$139,097
10	-$135,409.37	-$56,238.31	-$79,171.05	$1,045,595.23	-$38,378	$194,501	$201,094	$395,596	$221,808	$136,171
11	-$135,409.37	-$52,279.76	-$83,129.60	$962,465.63	-$38,481	$198,391	$203,433	$401,824	$227,934	$133,268
12	-$135,409.37	-$48,123.28	-$87,286.08	$875,179.54	-$38,584	$202,359	$205,800	$428,171	$254,178	$141,536
13	-$135,409.37	-$43,758.98	-$91,650.39	$783,529.15	-$38,689	$206,406	$208,197	$412,207	$238,108	$126,274
14	-$135,409.37	-$39,176.46	-$96,232.91	$687,296.24	-$38,795	$210,534	$210,622	$418,731	$244,527	$123,503
15	-$135,409.37	-$34,364.81	-$101,044.55	$586,251.69	-$38,901	$214,745	$213,077	$425,367	$251,057	$120,763
16	-$135,409.37	-$29,312.58	-$106,096.78	$480,154.91	-$39,009	$219,040	$215,563	$432,118	$257,699	$118,055
17	-$135,409.37	-$24,007.75	-$111,401.62	$368,753.29	-$39,118	$223,421	$218,079	$438,984	$264,456	$115,381
18	-$135,409.37	-$18,437.66	-$116,971.70	$251,781.59	-$39,228	$227,889	$220,625	$445,968	$271,331	$112,743
19	-$135,409.37	-$12,589.08	-$122,820.29	$128,961.30	-$39,339	$232,447	$223,203	$453,072	$278,324	$110,142
20	-$135,409.37	-$6,448.07	-$128,961.30	$0.00	-$39,451	$237,096	$225,812	$460,299	$285,438	$107,579
Totals	-$2,708,187.32	-$1,020,687.32	-$1,687,500.00			$3,954,396.93	$4,041,893.83	$7,996,290.76	$4,491,050.28	$2,665,881.03

Table B-66. Case-2 200% power purchase agreement rate $0.055/kWh scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	1500				
Project Size (kW)	1500				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	1500				
Total Cost	$ 1,875,000				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	3,120,750	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	1,570,750				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.0550	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

Table B-67. Case-2 200% power purchase agreement rate $0.055/kWh scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$1,875,000						
Expenses							
Loan (Principal)		-$51,034	-$53,586	-$56,265	-$59,079	-$62,033	-$65,134
Loan (Interest)		-$84,375	-$81,823	-$79,144	-$76,331	-$73,377	-$70,275
Warranty Expense		-$28,125	$0	$0	$0	$0	$0
Insurance Cost		-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125
Operation and Maintenance Cost		-$9,375	-$9,469	-$9,563	-$9,659	-$9,756	-$9,853
Total Expenses Less Loan Principal and Interest		-$65,625	-$37,594	-$37,688	-$37,784	-$37,881	-$37,978
Total Expenses Cost		**-$201,034**	**-$173,003**	**-$173,098**	**-$173,193**	**-$173,290**	**-$173,388**
Revenues							
Total Energy Generated kWh/yr		3,120,750	3,120,750	3,120,750	3,120,750	3,089,543	3,058,647
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		1,570,750	1,570,750	1,570,750	1,570,750	1,539,543	1,508,647
Power Purchase Agreement Rate ($/kWh)		0.0550	$0.0561	$0.0572	$0.0584	$0.0595	$0.0607
Electricity Sales Revenue per Power Purchase Agreement		$86,391	$88,119	$89,881	$91,679	$91,655	$91,612
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$162,750	$166,005	$169,325	$172,712	$176,166	$179,689
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$78,019	$80,203	$82,449	$84,758	$86,259	$87,788
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$65,536	$66,846	$68,183	$69,547	$70,229	$70,917
Total Annual Revenues		**$229,946**	**$235,169**	**$240,514**	**$245,984**	**$248,143**	**$250,317**
Total Energy Cost Saving		**$162,750**	**$166,005**	**$169,325**	**$172,712**	**$176,166**	**$179,689**
Total Annual Savings		**$392,696**	**$401,174**	**$409,839**	**$418,695**	**$424,309**	**$430,006**

Table B-68. Case-2 200% power purchase agreement rate $0.055/kWh scenarios expenses and revenues

Year	7	8	9	10	11	12	13
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$68,391	-$71,810	-$75,401	-$79,171	-$83,130	-$87,286	-$91,650
Loan (Interest)	-$67,018	-$63,599	-$60,008	-$56,238	-$52,280	-$48,123	-$43,759
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125
Operation and Maintenance Cost	-$9,952	-$10,051	-$10,152	-$10,253	-$10,356	-$10,459	-$10,564
Total Expenses Less Loan Principal and Interest	-$38,077	-$38,176	-$38,277	-$38,378	-$38,481	-$38,584	-$38,689
Total Expenses Cost	**-$173,486**	**-$173,586**	**-$173,686**	**-$173,788**	**-$173,890**	**-$173,994**	**-$174,098**
Revenues							
Total Energy Generated kWh/yr	3,028,061	2,997,780	2,967,802	2,938,124	2,908,743	2,879,656	2,850,859
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	1,478,061	1,447,780	1,417,802	1,388,124	1,358,743	1,329,656	1,300,859
Power Purchase Agreement Rate ($/kWh)	$0.0619	$0.0632	$0.0644	$0.0657	$0.0670	$0.0684	$0.0698
Electricity Sales Revenue per Power Purchase Agreement	$91,549	$91,467	$91,365	$91,242	$91,097	$90,929	$90,739
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$183,283	$186,949	$190,688	$194,501	$198,391	$202,359	$206,406
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$89,344	$90,927	$92,538	$94,178	$95,847	$97,545	$99,273
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$71,612	$72,314	$73,022	$73,738	$74,461	$75,190	$75,927
Total Annual Revenues	**$252,505**	**$254,708**	**$256,925**	**$259,157**	**$261,404**	**$263,665**	**$265,940**
Total Energy Cost Saving	**$183,283**	**$186,949**	**$190,688**	**$194,501**	**$198,391**	**$202,359**	**$206,406**
Total Annual Savings	**$435,788**	**$441,656**	**$447,613**	**$453,659**	**$459,795**	**$466,024**	**$472,346**

Table B-69. Case-2 200% power purchase agreement rate $0.055/kWh scenarios expenses and revenues

Year	14	15	16	17	18	19	20
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$96,233	-$101,045	-$106,097	-$111,402	-$116,972	-$122,820	-$128,961
Loan (Interest)	-$39,176	-$34,365	-$29,313	-$24,008	-$18,438	-$12,589	-$6,448
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125
Operation and Maintenance Cost	-$10,670	-$10,776	-$10,884	-$10,993	-$11,103	-$11,214	-$11,326
Total Expenses Less Loan Principal and Interest	-$38,795	-$38,901	-$39,009	-$39,118	-$39,228	-$39,339	-$39,451
Total Expenses Cost	**-$174,204**	**-$174,311**	**-$174,418**	**-$174,527**	**-$174,637**	**-$174,748**	**-$174,860**
Revenues							
Total Energy Generated kWh/yr	2,822,350	2,794,127	2,766,186	2,738,524	2,711,138	2,684,027	2,657,187
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	1,272,350	1,244,127	1,216,186	1,188,524	1,161,138	1,134,027	1,107,187
Power Purchase Agreement Rate ($/kWh)	$0.0711	$0.0726	$0.0740	$0.0755	$0.0770	$0.0786	$0.0801
Electricity Sales Revenue per Power Purchase Agreement	$90,526	$90,288	$90,025	$89,737	$89,423	$89,082	$88,713
Cost of Energy if Purchased	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Saving from Off-Setting Energy Purchasing	$210,534	$214,745	$219,040	$223,421	$227,889	$232,447	$237,096
Green Tag Rate ($/kWh)	$0.0358	$0.0368	$0.0378	$0.0389	$0.0400	$0.0411	$0.0422
Green Tag Sales Revenue	$101,033	$102,823	$104,645	$106,499	$108,386	$110,307	$112,262
Federal Production Tax Credit	$0.0272	$0.0277	$0.0283	$0.0288	$0.0294	$0.0300	$0.0306
Federal Production Tax Credit Revenue	$76,671	$77,423	$78,181	$78,948	$79,721	$80,502	$81,291
Total Annual Revenues	**$268,229**	**$270,533**	**$272,852**	**$275,184**	**$277,531**	**$279,891**	**$282,266**
Total Energy Cost Saving	**$210,534**	**$214,745**	**$219,040**	**$223,421**	**$227,889**	**$232,447**	**$237,096**
Total Annual Savings	**$478,764**	**$485,279**	**$491,892**	**$498,605**	**$505,420**	**$512,338**	**$519,362**

Table B-70. Case-2 200% power purchase agreement rate $0.055/kWh life cycle cost analysis

Power Cost Data		Financial Data	
kWh/year	1,550,000	Loan Amount	$1,875,000
Electricity Cost	$0.1050 /kWh	Loan Rate	5.0%
Avg Yearly Cost	$162,750	Down Payment	10%
		Discount Rate	5%
		General Inflation	3%
		Fuel Inflation	2%
		Analysis Period	20 years
		1st year I and M	5%

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
$0				$1,687,500						
$1	-$135,409	-$84,375	-$51,034	$1,636,466	-$65,625	$162,750	$229,946	$392,696	$191,661	$182,535
$2	-$135,409	-$81,823	-$53,586	$1,582,880	-$37,594	$166,005	$235,169	$401,174	$228,171	$206,958
$3	-$135,409	-$79,144	-$56,265	$1,526,614	-$37,688	$169,325	$240,514	$409,839	$236,741	$204,506
$4	-$135,409	-$76,331	-$59,079	$1,467,536	-$37,784	$172,712	$245,984	$418,695	$245,502	$201,975
$5	-$135,409	-$73,377	-$62,033	$1,405,503	-$37,881	$176,166	$248,143	$424,309	$251,019	$196,680
$6	-$135,409	-$70,275	-$65,134	$1,340,369	-$37,978	$179,689	$250,317	$430,006	$256,618	$191,492
$7	-$135,409	-$67,018	-$68,391	$1,271,978	-$38,077	$183,283	$252,505	$435,788	$262,302	$186,413
$8	-$135,409	-$63,599	-$71,810	$1,200,167	-$38,176	$186,949	$254,708	$441,656	$268,071	$181,441
$9	-$135,409	-$60,008	-$75,401	$1,124,766	-$38,277	$190,688	$256,925	$447,613	$273,927	$176,576
$10	-$135,409	-$56,238	-$79,171	$1,045,595	-$38,378	$194,501	$259,157	$453,659	$279,871	$171,816
$11	-$135,409	-$52,280	-$83,130	$962,466	-$38,481	$198,391	$261,404	$459,795	$285,905	$167,163
$12	-$135,409	-$48,123	-$87,286	$875,180	-$38,584	$202,359	$263,665	$484,625	$310,631	$172,971
$13	-$135,409	-$43,759	-$91,650	$783,529	-$38,689	$206,406	$265,940	$470,071	$295,973	$156,961
$14	-$135,409	-$39,176	-$96,233	$687,296	-$38,795	$210,534	$268,229	$476,474	$302,270	$152,667
$15	-$135,409	-$34,365	-$101,045	$586,252	-$38,901	$214,745	$270,533	$482,975	$308,664	$148,473
$16	-$135,409	-$29,313	-$106,097	$480,155	-$39,009	$219,040	$272,852	$489,574	$315,155	$144,376
$17	-$135,409	-$24,008	-$111,402	$368,753	-$39,118	$223,421	$275,184	$496,273	$321,745	$140,376
$18	-$135,409	-$18,438	-$116,972	$251,782	-$39,228	$227,889	$277,531	$503,073	$328,436	$136,472
$19	-$135,409	-$12,589	-$122,820	$128,961	-$39,339	$232,447	$279,891	$509,978	$335,229	$132,662
$20	-$135,409	-$6,448	-$128,961	$0	-$39,451	$237,096	$282,266	$516,987	$342,127	$128,944
Totals	-$2,708,187	-$1,020,687	-$1,687,500			$3,954,397	$5,190,861	$9,145,258	$5,640,018	$3,381,455

Table B-71. Case-2 200% power purchase agreement rate $0.105/kWh scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	1500				
Project Size (kW)	1500				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	1500				
Total Cost	$ 1,875,000				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	3,120,750	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	1,570,750				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.1050	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

Table B-72. Case-2 200% power purchase agreement rate $0.105/kWh scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$1,875,000						
Expenses							
Loan (Principal)		-$51,034	-$53,586	-$56,265	-$59,079	-$62,033	-$65,134
Loan (Interest)		-$84,375	-$81,823	-$79,144	-$76,331	-$73,377	-$70,275
Warranty Expense		-$28,125	$0	$0	$0	$0	$0
Insurance Cost		-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125
Operation and Maintenance Cost		-$9,375	-$9,469	-$9,563	-$9,659	-$9,756	-$9,853
Total Expenses Less Loan Principal and Interest		-$65,625	-$37,594	-$37,688	-$37,784	-$37,881	-$37,978
		-	-	-	-	-	-
Total Expenses Cost		**$201,034**	**$173,003**	**$173,098**	**$173,193**	**$173,290**	**$173,388**
Revenues							
Total Energy Generated kWh/yr		3,120,750	3,120,750	3,120,750	3,120,750	3,089,543	3,058,647
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		1,570,750	1,570,750	1,570,750	1,570,750	1,539,543	1,508,647
Power Purchase Agreement Rate ($/kWh)		0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Electricity Sales Revenue per Power Purchase Agreement		$164,929	$168,227	$171,592	$175,024	$174,977	$174,895
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$162,750	$166,005	$169,325	$172,712	$176,166	$179,689
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$78,019	$80,203	$82,449	$84,758	$86,259	$87,788
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$65,536	$66,846	$68,183	$69,547	$70,229	$70,917
Total Annual Revenues		**$308,483**	**$315,277**	**$322,224**	**$329,328**	**$331,465**	**$333,600**
Total Energy Cost Saving		**$162,750**	**$166,005**	**$169,325**	**$172,712**	**$176,166**	**$179,689**
Total Annual Savings		**$471,233**	**$481,282**	**$491,549**	**$502,040**	**$507,631**	**$513,289**

Table B-73. Case-2 200% power purchase agreement rate $0.105/kWh scenarios expenses and revenues

Year	7	8	9	10	11	12	13
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$68,391	-$71,810	-$75,401	-$79,171	-$83,130	-$87,286	-$91,650
Loan (Interest)	-$67,018	-$63,599	-$60,008	-$56,238	-$52,280	-$48,123	-$43,759
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125
Operation and Maintenance Cost	-$9,952	-$10,051	-$10,152	-$10,253	-$10,356	-$10,459	-$10,564
Total Expenses Less Loan Principal and Interest	-$38,077	-$38,176	-$38,277	-$38,378	-$38,481	-$38,584	-$38,689
	-	-	-	-	-	-	-
Total Expenses Cost	**$173,486**	**$173,586**	**$173,686**	**$173,788**	**$173,890**	**$173,994**	**$174,098**
Revenues							
Total Energy Generated kWh/yr	3,028,061	2,997,780	2,967,802	2,938,124	2,908,743	2,879,656	2,850,859
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	1,478,061	1,447,780	1,417,802	1,388,124	1,358,743	1,329,656	1,300,859
Power Purchase Agreement Rate ($/kWh)	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Electricity Sales Revenue per Power Purchase Agreement	$174,776	$174,620	$174,424	$174,188	$173,912	$173,592	$173,229
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$183,283	$186,949	$190,688	$194,501	$198,391	$202,359	$206,406
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$89,344	$90,927	$92,538	$94,178	$95,847	$97,545	$99,273
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$71,612	$72,314	$73,022	$73,738	$74,461	$75,190	$75,927
Total Annual Revenues	**$335,732**	**$337,860**	**$339,984**	**$342,104**	**$344,219**	**$346,327**	**$348,430**
Total Energy Cost Saving	**$183,283**	**$186,949**	**$190,688**	**$194,501**	**$198,391**	**$202,359**	**$206,406**
Total Annual Savings	**$519,015**	**$524,809**	**$530,672**	**$536,605**	**$542,610**	**$548,687**	**$554,836**

Table B-74. Case-2 200% power purchase agreement rate $0.105/kWh scenarios expenses and revenues

Year	14	15	16	17	18	19	20
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
		-	-	-	-	-	-
Loan (Principal)	-$96,233	$101,045	$106,097	$111,402	$116,972	$122,820	$128,961
Loan (Interest)	-$39,176	-$34,365	-$29,313	-$24,008	-$18,438	-$12,589	-$6,448
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125
Operation and Maintenance Cost	-$10,670	-$10,776	-$10,884	-$10,993	-$11,103	-$11,214	-$11,326
Total Expenses Less Loan Principal and Interest	-$38,795	-$38,901	-$39,009	-$39,118	-$39,228	-$39,339	-$39,451
	-	-	-	-	-	-	-
Total Expenses Cost	**$174,204**	**$174,311**	**$174,418**	**$174,527**	**$174,637**	**$174,748**	**$174,860**
Revenues							
Total Energy Generated kWh/yr	2,822,350	2,794,127	2,766,186	2,738,524	2,711,138	2,684,027	2,657,187
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	1,272,350	1,244,127	1,216,186	1,188,524	1,161,138	1,134,027	1,107,187
Power Purchase Agreement Rate ($/kWh)	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Electricity Sales Revenue per Power Purchase Agreement	$172,822	$172,368	$171,867	$171,317	$170,717	$170,065	$169,361
Cost of Energy if Purchased	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Saving from Off-Setting Energy Purchasing	$210,534	$214,745	$219,040	$223,421	$227,889	$232,447	$237,096
Green Tag Rate ($/kWh)	$0.0358	$0.0368	$0.0378	$0.0389	$0.0400	$0.0411	$0.0422
Green Tag Sales Revenue	$101,033	$102,823	$104,645	$106,499	$108,386	$110,307	$112,262
Federal Production Tax Credit	$0.0272	$0.0277	$0.0283	$0.0288	$0.0294	$0.0300	$0.0306
Federal Production Tax Credit Revenue	$76,671	$77,423	$78,181	$78,948	$79,721	$80,502	$81,291
Total Annual Revenues	**$350,526**	**$352,613**	**$354,693**	**$356,764**	**$358,824**	**$360,875**	**$362,914**
Total Energy Cost Saving	**$210,534**	**$214,745**	**$219,040**	**$223,421**	**$227,889**	**$232,447**	**$237,096**
Total Annual Savings	**$561,060**	**$567,359**	**$573,733**	**$580,184**	**$586,714**	**$593,322**	**$600,010**

Table B-75. Case-2 200% power purchase agreement rate $0.105/kWh life cycle cost analysis

Power Cost Data			Financial Data		
kWh/year	1,550,000		Loan Amount	$1,875,000	
Electricity Cost	$0.1050	/kWh	Loan Rate	5.0%	
Avg Yearly Cost	$162,750		Down Payment	10%	
			Discount Rate	5%	
			General Inflation	3%	
			Fuel Inflation	2%	
			Analysis Period	20	years
			1st year I and M	5%	

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
$0				$1,687,500						
$1	-$135,409	-$84,375	-$51,034	$1,636,466	-$65,625	$162,750	$308,483	$471,233	$270,199	$257,332
$2	-$135,409	-$81,823	-$53,586	$1,582,880	-$37,594	$166,005	$315,277	$481,282	$308,279	$279,618
$3	-$135,409	-$79,144	-$56,265	$1,526,614	-$37,688	$169,325	$322,224	$491,549	$318,452	$275,090
$4	-$135,409	-$76,331	-$59,079	$1,467,536	-$37,784	$172,712	$329,328	$502,040	$328,846	$270,543
$5	-$135,409	-$73,377	-$62,033	$1,405,503	-$37,881	$176,166	$331,465	$507,631	$334,341	$261,965
$6	-$135,409	-$70,275	-$65,134	$1,340,369	-$37,978	$179,689	$333,600	$513,289	$339,902	$253,640
$7	-$135,409	-$67,018	-$68,391	$1,271,978	-$38,077	$183,283	$335,732	$519,015	$345,529	$245,561
$8	-$135,409	-$63,599	-$71,810	$1,200,167	-$38,176	$186,949	$337,860	$524,809	$351,223	$237,722
$9	-$135,409	-$60,008	-$75,401	$1,124,766	-$38,277	$190,688	$339,984	$530,672	$356,986	$230,116
$10	-$135,409	-$56,238	-$79,171	$1,045,595	-$38,378	$194,501	$342,104	$536,605	$362,818	$222,739
$11	-$135,409	-$52,280	-$83,130	$962,466	-$38,481	$198,391	$344,219	$542,610	$368,720	$215,583
$12	-$135,409	-$48,123	-$87,286	$875,180	-$38,584	$202,359	$346,327	$565,273	$391,279	$217,879
$13	-$135,409	-$43,759	-$91,650	$783,529	-$38,689	$206,406	$348,430	$552,734	$378,635	$200,798
$14	-$135,409	-$39,176	-$96,233	$687,296	-$38,795	$210,534	$350,526	$558,964	$384,760	$194,330
$15	-$135,409	-$34,365	-$101,045	$586,252	-$38,901	$214,745	$352,613	$565,271	$390,960	$188,058
$16	-$135,409	-$29,313	-$106,097	$480,155	-$39,009	$219,040	$354,693	$571,653	$397,235	$181,978
$17	-$135,409	-$24,008	-$111,402	$368,753	-$39,118	$223,421	$356,764	$578,114	$403,587	$176,083
$18	-$135,409	-$18,438	-$116,972	$251,782	-$39,228	$227,889	$358,824	$584,653	$410,016	$170,370
$19	-$135,409	-$12,589	-$122,820	$128,961	-$39,339	$232,447	$360,875	$591,271	$416,523	$164,832
$20	-$135,409	-$6,448	-$128,961	$0	-$39,451	$237,096	$362,914	$597,971	$423,110	$159,466
Totals	-$2,708,187	-$1,020,687	-$1,687,500			$3,954,397	$6,832,243	$10,786,640	$7,281,399	$4,403,704

Table B-76. Case-2 200% power purchase agreement rate $0.3/kWh scenarios project parameters

Cells Set by Project Specific Parameters					
Project Generation		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Number of Turbines	1				
Turbine Size (kW)	1500				
Project Size (kW)	1500				
Net Capacity Factor	25%				
Annual Hours	8,760				
Availability	95%	-1%	5	20	
Project Cost		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Project Cost per kW	$ 1,250				
Project Power, kW	1500				
Total Cost	$ 1,875,000				
Down Payment Percentage	10.0%				
Loan Rate	5.0%		1	20	
Analysis Period	20				
Energy Inflation	2.0%		1	20	
Warranty Expense	1.5%		1	1	
Insurance Cost	1.5%		1	20	
Operation and Maintenance Cost	0.5%	1%	1	20	
Energy Production/Use		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Year Total (kW)	3,120,750	-1%	5	20	
On-Site Energy Usage kW/year	1,550,000				
Surplus Energy	1,570,750				
Revenue		**Annual Escalation**	**Year Start**	**Year End**	**Notes**
Power Purchase Agreement Rate ($/kWh)	$0.3000	2.0%	1	20	
Cost of Energy Purchased	$0.1050	2.0%			
Green Tag Revenues ($/kWh)	$0.0250	2.8%	1	20	
Federal Production Tax Credit ($/kWh)	$0.0210	2%	1	20	

Table B-77. Case-2 200% power purchase agreement rate $0.3/kWh scenarios expenses and revenues

Year	0	1	2	3	4	5	6
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)	$1,875,000						
Expenses							
Loan (Principal)		-$51,034	-$53,586	-$56,265	-$59,079	-$62,033	-$65,134
Loan (Interest)		-$84,375	-$81,823	-$79,144	-$76,331	-$73,377	-$70,275
Warranty Expense		-$28,125	$0	$0	$0	$0	$0
Insurance Cost		-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125
Operation and Maintenance Cost		-$9,375	-$9,469	-$9,563	-$9,659	-$9,756	-$9,853
Total Expenses Less Loan Principal and Interest		-$65,625	-$37,594	-$37,688	-$37,784	-$37,881	-$37,978
Total Expenses Cost		**-$201,034**	**-$173,003**	**-$173,098**	**-$173,193**	**-$173,290**	**-$173,388**
Revenues							
Total Energy Generated kWh/yr		3,120,750	3,120,750	3,120,750	3,120,750	3,089,543	3,058,647
On-Site Energy Usage kWh/yr		1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation		1,570,750	1,570,750	1,570,750	1,570,750	1,539,543	1,508,647
Power Purchase Agreement Rate ($/kWh)		0.3000	$0.3060	$0.3121	$0.3184	$0.3247	$0.3312
Electricity Sales Revenue per Power Purchase Agreement		$471,225	$480,650	$490,262	$500,068	$499,935	$499,700
Cost of Energy if Purchased		$0.1050	$0.1071	$0.1092	$0.1114	$0.1137	$0.1159
Saving from Off-Setting Energy Purchasing		$162,750	$166,005	$169,325	$172,712	$176,166	$179,689
Green Tag Rate ($/kWh)		$0.0250	$0.0257	$0.0264	$0.0272	$0.0279	$0.0287
Green Tag Sales Revenue		$78,019	$80,203	$82,449	$84,758	$86,259	$87,788
Federal Production Tax Credit		$0.0210	$0.0214	$0.0218	$0.0223	$0.0227	$0.0232
Federal Production Tax Credit Revenue		$65,536	$66,846	$68,183	$69,547	$70,229	$70,917
Total Annual Revenues		**$614,780**	**$627,699**	**$640,895**	**$654,372**	**$656,423**	**$658,405**
Total Energy Cost Saving		**$162,750**	**$166,005**	**$169,325**	**$172,712**	**$176,166**	**$179,689**
Total Annual Savings		**$777,530**	**$793,704**	**$810,220**	**$827,084**	**$832,589**	**$838,094**

Table B-78. Case-2 200% power purchase agreement rate $0.3/kWh scenarios expenses and revenues

Year	7	8	9	10	11	12	13
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$68,391	-$71,810	-$75,401	-$79,171	-$83,130	-$87,286	-$91,650
Loan (Interest)	-$67,018	-$63,599	-$60,008	-$56,238	-$52,280	-$48,123	-$43,759
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125
Operation and Maintenance Cost	-$9,952	-$10,051	-$10,152	-$10,253	-$10,356	-$10,459	-$10,564
Total Expenses Less Loan Principal and Interest	-$38,077	-$38,176	-$38,277	-$38,378	-$38,481	-$38,584	-$38,689
Total Expenses Cost	**-$173,486**	**-$173,586**	**-$173,686**	**-$173,788**	**-$173,890**	**-$173,994**	**-$174,098**
Revenues							
Total Energy Generated kWh/yr	3,028,061	2,997,780	2,967,802	2,938,124	2,908,743	2,879,656	2,850,859
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	1,478,061	1,447,780	1,417,802	1,388,124	1,358,743	1,329,656	1,300,859
Power Purchase Agreement Rate ($/kWh)	$0.3378	$0.3446	$0.3515	$0.3585	$0.3657	$0.3730	$0.3805
Electricity Sales Revenue per Power Purchase Agreement	$499,361	$498,913	$498,354	$497,681	$496,890	$495,978	$494,941
Cost of Energy if Purchased	$0.1182	$0.1206	$0.1230	$0.1255	$0.1280	$0.1306	$0.1332
Saving from Off-Setting Energy Purchasing	$183,283	$186,949	$190,688	$194,501	$198,391	$202,359	$206,406
Green Tag Rate ($/kWh)	$0.0295	$0.0303	$0.0312	$0.0321	$0.0330	$0.0339	$0.0348
Green Tag Sales Revenue	$89,344	$90,927	$92,538	$94,178	$95,847	$97,545	$99,273
Federal Production Tax Credit	$0.0236	$0.0241	$0.0246	$0.0251	$0.0256	$0.0261	$0.0266
Federal Production Tax Credit Revenue	$71,612	$72,314	$73,022	$73,738	$74,461	$75,190	$75,927
Total Annual Revenues	**$660,316**	**$662,154**	**$663,915**	**$665,597**	**$667,197**	**$668,713**	**$670,142**
Total Energy Cost Saving	**$183,283**	**$186,949**	**$190,688**	**$194,501**	**$198,391**	**$202,359**	**$206,406**
Total Annual Savings	**$843,599**	**$849,102**	**$854,602**	**$860,098**	**$865,588**	**$871,072**	**$876,548**

Table B-79. Case-2 200% power purchase agreement rate $0.3/kWh scenarios expenses and revenues

Year	14	15	16	17	18	19	20
Capital expenditures							
Equity Investment (Project Cost Less Debt and Grants)							
Expenses							
Loan (Principal)	-$96,233	-$101,045	-$106,097	-$111,402	-$116,972	-$122,820	-$128,961
Loan (Interest)	-$39,176	-$34,365	-$29,313	-$24,008	-$18,438	-$12,589	-$6,448
Warranty Expense	$0	$0	$0	$0	$0	$0	$0
Insurance Cost	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125	-$28,125
Operation and Maintenance Cost	-$10,670	-$10,776	-$10,884	-$10,993	-$11,103	-$11,214	-$11,326
Total Expenses Less Loan Principal and Interest	-$38,795	-$38,901	-$39,009	-$39,118	-$39,228	-$39,339	-$39,451
Total Expenses Cost	**-$174,204**	**-$174,311**	**-$174,418**	**-$174,527**	**-$174,637**	**-$174,748**	**-$174,860**
Revenues							
Total Energy Generated kWh/yr	2,822,350	2,794,127	2,766,186	2,738,524	2,711,138	2,684,027	2,657,187
On-Site Energy Usage kWh/yr	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000	1,550,000
Surplus Energy Generation	1,272,350	1,244,127	1,216,186	1,188,524	1,161,138	1,134,027	1,107,187
Power Purchase Agreement Rate ($/kWh)	$0.3881	$0.3958	$0.4038	$0.4118	$0.4201	$0.4285	$0.4370
Electricity Sales Revenue per Power Purchase Agreement	$493,776	$492,480	$491,048	$489,477	$487,762	$485,901	$483,889
Cost of Energy if Purchased	$0.1358	$0.1385	$0.1413	$0.1441	$0.1470	$0.1500	$0.1530
Saving from Off-Setting Energy Purchasing	$210,534	$214,745	$219,040	$223,421	$227,889	$232,447	$237,096
Green Tag Rate ($/kWh)	$0.0358	$0.0368	$0.0378	$0.0389	$0.0400	$0.0411	$0.0422
Green Tag Sales Revenue	$101,033	$102,823	$104,645	$106,499	$108,386	$110,307	$112,262
Federal Production Tax Credit	$0.0272	$0.0277	$0.0283	$0.0288	$0.0294	$0.0300	$0.0306
Federal Production Tax Credit Revenue	$76,671	$77,423	$78,181	$78,948	$79,721	$80,502	$81,291
Total Annual Revenues	**$671,480**	**$672,725**	**$673,874**	**$674,923**	**$675,870**	**$676,710**	**$677,442**
Total Energy Cost Saving	**$210,534**	**$214,745**	**$219,040**	**$223,421**	**$227,889**	**$232,447**	**$237,096**
Total Annual Savings	**$882,015**	**$887,470**	**$892,914**	**$898,344**	**$903,759**	**$909,158**	**$914,538**

Table B-80. Case-2 200% power purchase agreement rate $0.3/kWh life cycle cost analysis

Power Cost Data			Financial Data		
kWh/year	1,550,000		Loan Amount	$1,875,000	
Electricity Cost	$0.1050	/kWh	Loan Rate	5.0%	
Avg Yearly Cost	$162,750		Down Payment	10%	
			Discount Rate	5%	
			General Inflation	3%	
			Fuel Inflation	2%	
			Analysis Period	20	years
			1st year I and M	5%	

Year	Loan Payment	Interest	Principal	Principal Balance	I and M.	Energy Savings	Total Annual Revenues	Total Annual Savings	Net Savings	Present Value of Net Savings
0				$1,687,500						
1	-$135,409	-$84,375	-$51,034	$1,636,466	-$65,625	$162,750	$614,780	$777,530	$576,495	$549,043
2	-$135,409	-$81,823	-$53,586	$1,582,880	-$37,594	$166,005	$627,699	$793,704	$620,701	$562,994
3	-$135,409	-$79,144	-$56,265	$1,526,614	-$37,688	$169,325	$640,895	$810,220	$637,122	$550,370
4	-$135,409	-$76,331	-$59,079	$1,467,536	-$37,784	$172,712	$654,372	$827,084	$653,891	$537,957
5	-$135,409	-$73,377	-$62,033	$1,405,503	-$37,881	$176,166	$656,423	$832,589	$659,299	$516,578
6	-$135,409	-$70,275	-$65,134	$1,340,369	-$37,978	$179,689	$658,405	$838,094	$664,707	$496,015
7	-$135,409	-$67,018	-$68,391	$1,271,978	-$38,077	$183,283	$660,316	$843,599	$670,113	$476,237
8	-$135,409	-$63,599	-$71,810	$1,200,167	-$38,176	$186,949	$662,154	$849,102	$675,517	$457,216
9	-$135,409	-$60,008	-$75,401	$1,124,766	-$38,277	$190,688	$663,915	$854,602	$680,916	$438,925
10	-$135,409	-$56,238	-$79,171	$1,045,595	-$38,378	$194,501	$665,597	$860,098	$686,310	$421,335
11	-$135,409	-$52,280	-$83,130	$962,466	-$38,481	$198,391	$667,197	$865,588	$691,698	$404,422
12	-$135,409	-$48,123	-$87,286	$875,180	-$38,584	$202,359	$668,713	$879,801	$705,807	$393,020
13	-$135,409	-$43,759	-$91,650	$783,529	-$38,689	$206,406	$670,142	$875,119	$701,021	$371,766
14	-$135,409	-$39,176	-$96,233	$687,296	-$38,795	$210,534	$671,480	$880,676	$706,472	$356,816
15	-$135,409	-$34,365	-$101,045	$586,252	-$38,901	$214,745	$672,725	$886,225	$711,915	$342,443
16	-$135,409	-$29,313	-$106,097	$480,155	-$39,009	$219,040	$673,874	$891,765	$717,347	$328,625
17	-$135,409	-$24,008	-$111,402	$368,753	-$39,118	$223,421	$674,923	$897,295	$722,768	$315,341
18	-$135,409	-$18,438	-$116,972	$251,782	-$39,228	$227,889	$675,870	$902,813	$728,175	$302,572
19	-$135,409	-$12,589	-$122,820	$128,961	-$39,339	$232,447	$676,710	$908,317	$733,569	$290,298
20	-$135,409	-$6,448	-$128,961	$0	-$39,451	$237,096	$677,442	$913,806	$738,946	$278,501
Totals	-$2,708,187	-$1,020,687	-$1,687,500			$3,954,397	$13,233,632	$17,188,029	$13,682,788	$8,390,474

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BIOGRAPHICAL SKETCH

Terry Lee Clinefelter was born in Gainesville, Florida, in 1983 and raised in the rural outstretches of Alachua County. Terry's parents raised him to understand the value of hard work and education. Spending four year at Florida State University achieving a bachelor's degree in business management and working part time jobs at local bars and at the University itself teaching stain glass craftsmanship and wood working at the Master Craftsmen Program at the University, allowed Terry to continue working in carpentry, which was a skill passed down from his father, a cabinet maker for more than 30 years.

Wanting to continue in the field of construction after his bachelor's degree, Terry applied to the M.E. Rinker, Sr. School of Building Construction for a master's degree in building construction management. Over the next two years, Terry found himself fascinated with the field of renewable energy generation and devoted his studies to focusing on this emerging field. Working on the construction of a wind farm in West Texas during his summer break gave Terry hands on experience in his field of choice. Terry hopes to continue working in the field of renewable energy generation as it takes an even greater role in the years to come.