ANALYSIS OF SOLAR POWER GENERATION ON CALIFORNIA TURKEY RANCHES

by

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B.S. California State University, Fresno, 1991

A THESIS

Submitted in partial fulfillment of the requirements

for the degree

MASTER OF AGRIBUSINESS

Department of Agricultural Economics

College of Agriculture

KANSAS STATE UNIVERSITY

Manhattan, Kansas

2009

Approved by:

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ABSTRACT

The objective of this thesis is to conduct a net present value analysis of installing a solar power generation system on company owned turkey growout ranches. This research project provides information regarding the systems power production capacity, investment cost, maintenance requirements, amount of energy saved, useful life of the equipment, marginal state and federal tax brackets for the company. The investment cost of the system includes the price of the equipment and installation service. Many of the system costs may be offset by rebates, tax credits and grants from various government agencies. These must also be included in the financial analysis as they can greatly affect the financial viability of the project.

The system is projected to have a useful life of 30 years with an inverter replacement planned for year 15. Four scenarios were evaluated using two levels of rebates and two electrical rate inflation levels. The evaluations conducted showed positive after tax NPV evaluations on three of four scenarios reviewed with the most financially attractive options available when the rebates, tax credits and grants were maximized. This was the case at both electrical rate inflation scenarios. These same scenarios produced favorable results when looking at reduction of live production ranch costs. The system effectively locked in electrical rates below current rates for the 30 year life of the system. This reduced ranch live production cost by as much as 11.73 percent. It also gives the company an advantage over the competition when used as a marketing tool due to the use of green technology in company production practices.

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ACKNOWLEDGMENTS

I wish to thank the MAB staff for their support during my time in the program. Everyone has been so helpful during this process. Dr. Williams has been especially helpful keeping tabs on me and encouraging me to continue to move forward on this project when my job was consuming my time these last few months.

To my classmates who made the campus sessions fun, it has been a pleasure working with all of you. Giving the rock will never be the same. It was so nice to have another California guy in class. I know I have a lifelong friend in Meng. Thanks for those late night homework sessions and early morning wakeup calls.

To my colleagues at Foster Farms, thank you for all of your support and encouragement. Vince and Charles thank you for helping me get in the program. Joe thank you for giving me the time I've needed to complete my school work. Special thanks to Kristi for helping me gather the information I needed to complete this project.

To my family, thanks for your patience with me during this time. Steven and Miya you always gave me my "study time" when I needed it. Marsha you must have thought my computer was our third child at times as much as it sat on my lap. You knew when I needed those weekends to work and made arrangements for a quiet house for me. I could not have done this without you. To our extended family, your words of support and help meant so much. A special thanks to my parents. You were always so encouraging of my efforts in this. I wish Dad could have seen it completed.

CHAPTER 1: INTRODUCTION

1.1 Company background

Foster Farms has been in business since 1939. It is a family-owned and operated company. It was started in Modesto, California by Max and Verda Foster. The company has grown to employ over 10,000 people in operations in California, Oregon, Washington, Colorado, Arkansas, Alabama and a complex recently purchased in Louisiana. The company produces a full line of fresh and frozen chicken and turkey products, lunchmeats, franks and corndogs. The company also runs a dairy operation. The poultry operations are structured in a vertically integrated system with company control or outright ownership of all aspects of the production process including breeder ranches, hatcheries, growout ranches, processing plants, feed mills and distribution centers for finished products. Contract growers are used for a portion of breeder operations and growout ranches, but they are under supervision of Foster Farms employees to ensure the highest quality standards are met. All other aspects of the operation are owned by Foster Farms. The importance of company owned facilities used in the live operations are unique in the U.S. poultry industry as most companies utilize only contract growers in their live operations. However, this structure presents some challenges for Foster Farms in maintaining and staffing these facilities. This gives the company more control over a critical part of the production process. In order to be competitive, the company must find innovative ways to manage costs and take advantage of that control over each facility to maximize the efficiency of the operation.

Due to our location on the west coast, we have a disadvantage in that the cost of many of our production inputs such as feed ingredients, fuel and labor are higher than our competition in the southeastern part of the country. The use of solar power generation technology could potentially be important to the company as a way to offset some of these cost disadvantages with a reduction in electricity costs. The system could provide years of power generation capacity for the ranch while making use of unproductive land surrounding the production houses. The capital investment to install the system is significant, but the advantage to this is that any increase in cost per kilowatt hour that is passed along to customers by the local utility company could be eliminated by the system. In essence, the company may be able to lock in the cost of electricity based on the cost of the system for the length of time that the system will last.

1.2 Project objectives

The objective of this thesis is to conduct a net present value analysis of installing a solar power generation system on company-owned turkey growout ranches. This research project provides information regarding the system's power production capacity, investment costs, maintenance requirements, amount of energy saved, useful life of the equipment, and combined marginal state and federal tax brackets for the company. The investment cost of the system includes the price of the equipment, installation and any ongoing operating costs. Many of the system costs may be offset by rebates, tax credits and grants from various government agencies. These must also be included in the financial analysis as they can greatly affect the financial viability of the project.

1.3 Methodology

The methods for evaluating the viability of this project will include a review of the available literature related to the topic, reviewing possible scenarios for utilization of the technology and a Net Present Value analysis to determine the economic returns and feasibility of the project.

A review of the literature available on this technology is important to determine if it can be used in a poultry production facility. There have been several uses of this technology, but it has been rather limited in a poultry scenario. Being able to determine if the equipment can function on poultry ranches as compared to the rooftop of a factory will be very important in determining whether the project can succeed.

Once the equipment is found to be appropriate, there are different goals that the system can be designed for. The capacity of the solar power system can be built to produce enough power to cover peak electrical usage only or it can be designed to produce all of the electrical need. The cost differences in each scenario will need to be evaluated and understood in order to make an informed decision about how large the system should be.

1.4 Scenarios for Evaluation

The final determinate of whether to proceed with the project is using a Net Present Value analysis of the system cash flows. Four scenarios are evaluated. They include two levels of rebates, tax credits and grants and two levels of electric rate inflation. Scenario 1 (S1) assumes an electrical rate increase of 7 percent and rebates of 55 percent. Scenario 2 (S2) assumes an electrical rate increase of 7 percent and rebates of 30 percent. Scenario 3 (S3) assumes an electrical rate increase of 5 percent and rebates of 55 percent. Scenario 4 (S4) assumes an electrical rate increase of 5 percent and rebates of 30 percent. A comparison of the NPV of these alternatives is used to determine which scenarios give the best economic outcome for the investment.

1.5 Data required and results presentation

Specific data needed about the solar system includes the annual electrical usage of the ranch, cost per kilowatt hour charged by the local utility provider, maintenance requirements of the system and the cost of the solar system. The electric usage of the chosen facility will be compiled from utility bills and supplied by Foster Farms. Cost per kilowatt hour is supplied by Pacific Gas and Electric company rate schedules. Cost and maintenance requirements for the system will be provided by vendor quotes supplied to Foster Farms. Once the cost of the system is determined, the NPV evaluation can be completed. This will require information including discount rates, marginal tax rates, tax credits, rebates, grants, inflation rates and depreciation schedules. This information will be used to determine whether to pursue the project. The results of the project will be presented in the form of a written thesis and oral defense.

CHAPTER 2: LITERATURE REVIEW

2.1 Photovoltaic technology

Solar power generation systems have been developing quickly over the past few years although the technology has been in existence for many years. The photovoltaic effect was observed as early as 1890. "In 1954, Bell Labs in the U.S. introduced the first solar photovoltaic device that produced a useable amount of electricity, and by 1958, solar cells were being used in a variety of small-scale scientific and commercial applications" (Solar Technology and Products, September 23, 2008). The photovoltaic solar panels are manufactured using crystalline silicon. "PV devices using crystalline silicon generate electricity directly from sunlight via an electric process that occurs naturally in this type of material" (Photovoltaic Solar Power – Technology Basics, May 31, 2009).

Improvements in the manufacturing process of photovoltaic solar panels continues to lower the cost of this technology. This will pave the way for enabling this technology to become cost competitive with fossil fuel energy generation. With the right incentives, cost competitiveness with grid prices in the US (e.g., $.06- $.10 per kWh) can be attained by 2020 (Fthenakis, Mason, Zweibel, 2009). A worldwide oversupply of solar panels will also contribute to lower cost of installing systems. "In California, which accounts for nearly 70% of the U.S. solar market, a typical 4-kilowatt, $32,000 solar energy system costs a homeowner about $23,000 last year after state and federal incentives. This year, if prices fall as expected, that system is likely to cost $10,000 to $12,000" (Davidson, January 13, 2009).

The potential for this type of power generation is dependent on the amount of sunlight available. Areas with long days of usable sunlight will benefit most from this technology. Figure 2.1 shows the kilowatt hour production potential of the United States in hours per day. Fortunately, the central valley of California is one of the areas with the greatest potential for solar power generation in the country.

2.2 How solar power works

A complete system of solar power generation includes the solar panels, an inverter and a system monitoring device. These are connected to the main electrical power supply at the breaker panel. This is also where the solar system with be interconnected with the local electrical utility companies power distribution grid. Figure 2.2 shows a typical residential installation with the photovoltaic panels mounted on the roof.

The solar panels can be mounted in many different ways. Residential installations are typically done on the roof, but can also be done on poles. Pole mounted systems can include tracking technology that allow the panels to move as the sun moves in order to maximize the exposure of the system to sunlight. Figure 2.3 shows a pole mounted system utilizing tracking technology for a residential installation. Commercial installations can also be done on rooftops, but larger system mounting can include ground mounting on metal legs. Figure 2.4 shows an agriculture installation utilizing this ground mounting system.

The panels produce power in the form of direct current (DC) electricity. The inverter portion of the systems converts this DC power to alternating current (AC) electricity which is commonly used in households. The inverters are sized to fit the amount of power produced by the panels they are connected to. Depending on the number of panels in a system, there may be several inverters included in the installation. The monitoring system can be programmed to keep track of how much energy your system should produce; if production levels ever dip below normal, the monitor sends an alert to a monitoring station (Solar City, September 23, 2008). This allows for constant performance evaluation of the system and can be used to track any problems with the system that may require servicing.

The solar power system is connected to the main power supply of the facility which allows the power generated by the panels to flow into the electrical system. This power is used when there is demand. If there is more demand than the solar system can produce, the difference is supplied by the electrical utility and the customer is charged. When the solar production is more than the facility demands or there is no demand, the power flows back into the electrical utility power grid. This causes the electric meter to turn backwards and results in a credit to the photovoltaic solar facility. This process is called net-metering. Pacific Gas and Electric Company customers who have solar systems are charged one time per year for any power used from the utility. This "true up" period occurs one year from the time the solar system is put in use.

> "U.S. customers can zero out their bill, but most net metering laws prevent them from collecting a credit over a period longer than one year. In the U.S., the utility will almost never cut you a check for production, whereas in Europe customers are paid for every kilowatt hour generated" (Gies, November 2008).

These net metering limitations discourage installations of systems capable of producing more power than can be used in one year at a particular facility in the U.S. Without these net metering laws, the power generated above what a facility uses could potentially be a source of income for the company installing the system. This being the case, the goal of any solar installation can range from only reduction of peak electric use to total production of yearly kilowatt hours required for the facility by the solar system.

2.3 California electrical rates

There are varying electrical rates based on time of year which are classified as Summer and Winter as well as time of day which are classified as Peak, Part peak and Off peak. To summarize, Pacific Gas and Electric provides four potential rate combinations based on time of day and time of year for Agricultural customers utilizing Electric Schedule AG-5. These are Summer/Peak, Summer/Off peak, Winter/Part peak and Winter/Off peak. Table 2.1 shows the combinations of time of year, time of day, energy rates and when each rate combination applies.

The electric meter used in solar installations tracks net power use by season and time of use. This is significant because overproduction typically happens on long summer days when power is at a premium or Peak rate. Power that is not used and supplied back into the power grid is credited at this higher rate. Similarly, power used from the grid during underproduction of the solar system, which is normally during night time, is charged at a lower rate or Off peak rate. The ability to receive these credits at a higher rate than the rate charged for power used off peak provides a great advantage.

The cost of a kilowatt hour of power has been on a steady increase for many years in California. This presents a compelling argument for businesses to adopt solar energy for its positive impact as a financial hedge. A study by Tioga Energy found that California rates have risen steadily from 1970 to 2004, with compound annual growth rates (CAGR) in the range of 7%, depending on customer and utility segments. Further analysis shows that a range of complex factors will have a significant impact on future utility rates, including increased reliance on natural gas; a high probability of additional operating costs associated with carbon emissions cap-and-trade legislation; and increased costs and time required for new power plant and transmission development (Tioga Energy, June 2008). These conditions would appear to be something that businesses in California must deal with in order to gain more control over the cost of production, especially when there are multiple facilities being operated. The US national average over all utility sectors shows an average increase over the 5 year time period 2003 to 2007 of 4.61 percent (Energy Information Administration, June 7, 2009).

2.4 Solar power system financing

There are some significant advantages available to encourage solar installations. Business and home offices benefit directly from the Federal Solar Investment Tax Credit and 5 Year Accelerated Depreciation. In most states, installation costs of solar energy systems do not affect the assessed value of your property and the purchase is exempt from sales taxes (Akeena Solar, May 31, 2009). In addition to these tax benefits, there are also rebates to help reduce the cost of installation, which include Green Energy Fund payments, USDA Renewable Energy Grants and Renewable Energy Credits. These incentives can reduce the cost of installing a solar power system by up to 70 percent (Van Wicklen, 2008). The program administered by the USDA is done through the Rural Energy for America Program (REAP). The program is designed to award grants to eligible projects and can cover 25 percent or a maximum of $500,000 of the cost of a qualifying renewable energy system (USDA Rural Development, May 31, 2009).

Other sectors of agriculture are seeing the benefits of solar power on their operations. Fruit and nut growers in California are finding ways to use this technology to reduce production costs. Ranch owner Hassan Yarpezeshkan has installed a solar electrical system on 400 acres of orchards on Ahoo Ranch in LeGrand, California. The solar electrical system is able to power the lift pumps, deep wells, filter stations, and booster pumps that comprise irrigation systems for his orchards. "Yarpezeshkan says he does not have to worry about the money for the system coming straight from his pocket because he can pay for it using the savings he obtains through using solar energy. Furthermore, the system increases the value of his land by $400,000 per each 100 kilowatt system" (Oster, 2008).

Another option that is becoming an alternative to purchasing a system is called a buy back arrangement. Solar power equipment supply companies install a system on your site with the understanding that you will buy all or part of the power generated at a pre-arranged rate for a certain period of time. There have been two high profile local projects at California State University, Fresno and Fresno Yosemite International (FYI) Airport that have been done this way. "Chevron Energy Solutions announced the completion of a large-scale solar power installation at Fresno State that will supply 20 percent of the university's annual power needs. The 1.1-megawatt solar power system – the largest photovoltaic (PV)-paneled parking installation at a U.S. university – is expected to save Fresno State more than $13 million in avoided utility costs over its 30-year lifespan" (Fresno State News, May 13, 2008). The FYI installation is a 2 megawatt array that provides enough electricity to power 40% of the lighting, air conditioning, controls and tower communications of the airport.

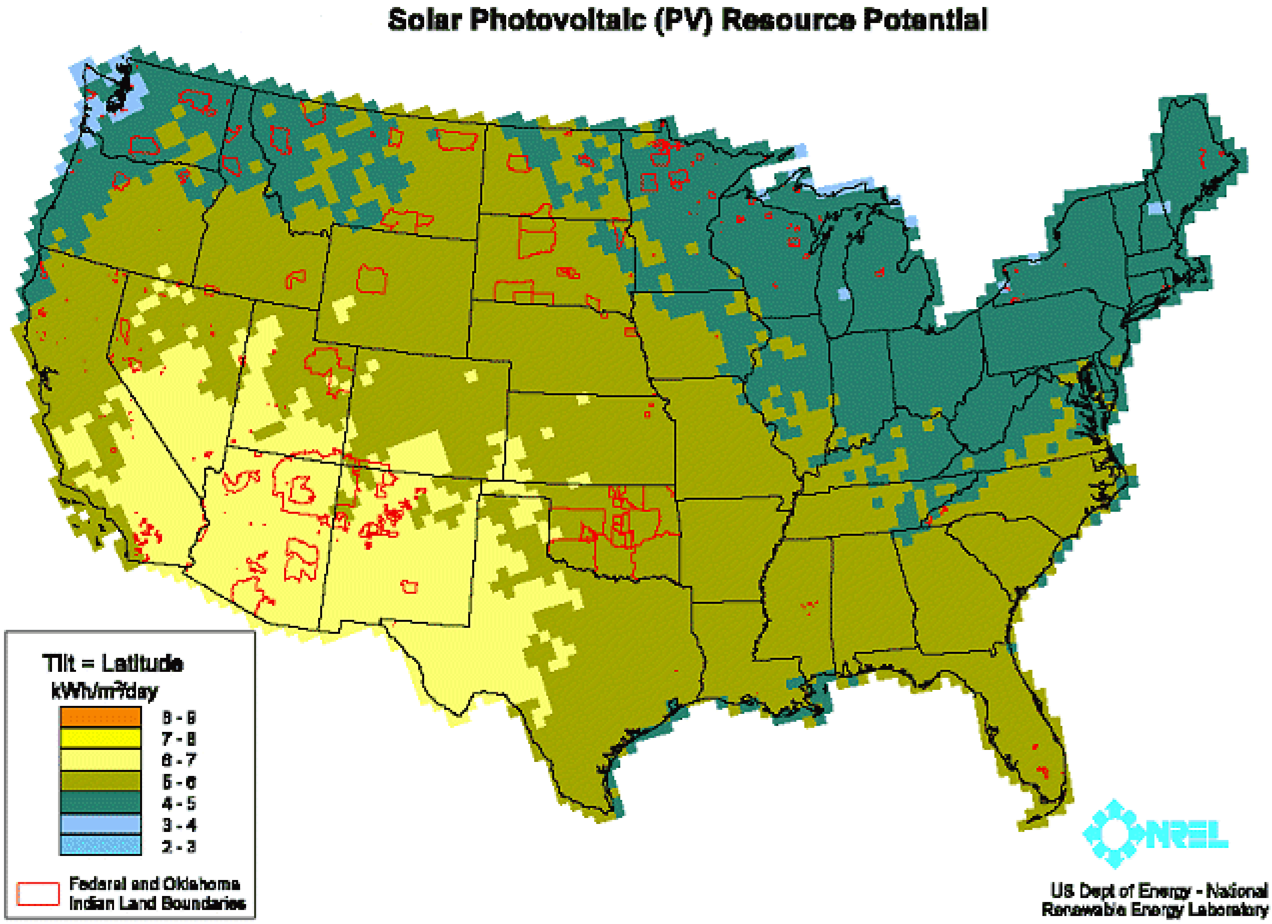
> "Partnering with FYI will be Sharp Solar, Xantrex Technology Inc., and Mill Valley, California's Solar Power Partners, who will operate the system, selling the electricity generated to the airport under a long term power purchase agreement. By having a third party manage and operate the solar array, FYI has reduced upfront costs for the airport while gaining the long-term financial savings of solar power, as well as improving their environmental image" (McDermott, 2008).

These buy back arrangements may be a good alternative for government and institutional customers who typically lack the capital for a project, but can benefit from the lowered utility costs solar provides over the long life of a system.

2.5 California business environment

The California consumer is very environmentally conscious. In order to do business in the state successfully in the future, businesses need to recognize this and become more environmentally conscience in their business practices. Animal agriculture is under greater pressure than others in business as evidenced by the recent passage of Proposition 2 which dictates production practices for egg producers. The pressure from environmental groups is becoming more intrusive and the ability to defend production practices while employing environmentally sensitive technologies and adapting to customer requirements for these types of projects is more critical to a companies' success than ever before. As noted in the FYI project justification, the ability to market the use of green technology presents a unique opportunity to business in the state. The use of green technology could potentially create a halo effect for the company. The California consumer is very aware of a companies' reputation, either good or bad, when it comes to environmental issues. If marketed properly, the use of environmentally friendly practices could create a competitive advantage in the marketplace. This should not be overlooked when evaluating the worthiness of this project.

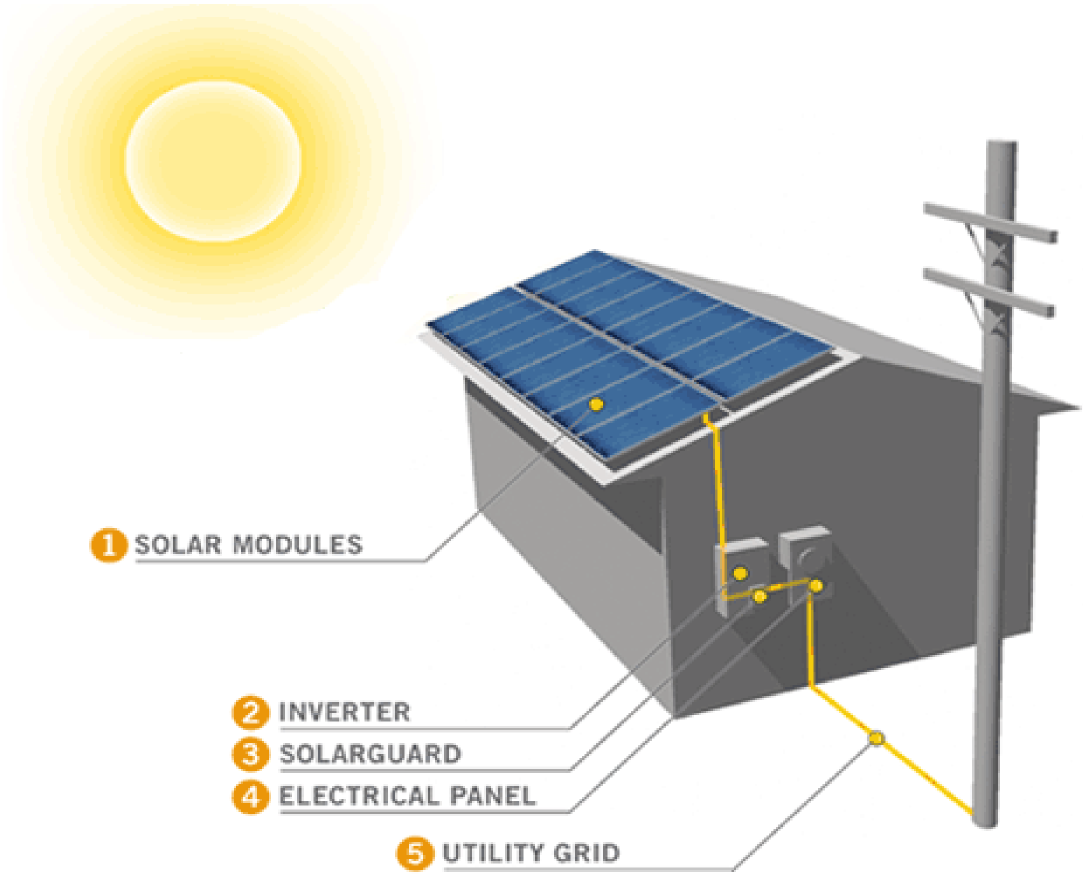
Figure 2.1: Solar Photovoltaic Resource Potential



Source: Energy Information Administration

http://www.eia.doe.gov/cneaf/solar.renewables/ilands/fig11.html

Figure 2.2: How Solar Power Works



Source: Solar City, http://solarlease.solarcity.com/SolarCityHowWorks.aspx

Figure 2.3: Pole mounting with tracking

Source: Unlimited Energy, http://unlimited-energy.com/component/option,com_gallery2/Itemid,76/?g2_itemId=219

Figure 2.4: Ground mounting with metal leg base

Source: Unlimited Energy, http://unlimited-energy.com/component/option,com_gallery2/Itemid,76/?g2_itemId=199

Table 2.1: Pacific Gas and Electric electrical rates

	Summer/Peak	Summer/Off peak	Winter/Part peak	Winter/Off peak
Total energy rates (per kilowatt hour)	$0.21744	$0.10923	$0.11499	$0.09717
Applicable dates	May 1st through October 31st	May 1st through October 31st	November 1st through April 30th	November 1st through April 30th
Applicable days	Monday - Friday	Monday – Friday Weekend, Holidays	Monday – Friday	Monday – Friday Weekend, Holidays
Applicable times	12 noon to 6 PM	All other hours All day	8:30 AM to 9:30 PM	All other hours All day

Source: Pacific Gas and Electric Company, Electric Schedule AG-5 – Large Time-of-Use Agricultural Power, December 30, 2008

CHAPTER 3: METHODS AND DATA

3.1 Net Present Value (NPV)

Net Present Value is a decision making tool utilizing financial analysis to decide whether a certain project is worth more than it costs. Since the goal of every company is to increase shareholder wealth, it makes sense to utilize a tool such as this when deciding what projects a company should invest in. It is also useful when comparing multiple projects within an organization especially when capital is limited. This ensures that the company gets the maximum possible return for the money it invests. The difference between the sum of the project's discounted cash flow over the project's lifespan and its cost is its Net Present Value (NPV). Companies can best help their shareholders by investing in projects with a positive NPV and rejecting those with a negative NPV (Brealey, Myers and Allen, 2006).

When a firm has cash in hand, it must make a decision whether to return that cash back to its stockholders or reinvest that cash into the business. One key feature of the NPV analysis is that it realizes that a dollar held today is worth more than a dollar tomorrow because the dollar today can be put to work earning interest right away. The decision to invest the dollar held today versus spending the dollar today on a project that will make money later is the opportunity cost of that money. Using forecasted cash flows of a given project, a comparison can be made between the two alternatives in the value of today's dollar (Brealey, Myers and Allen, 2006).

3.2 Alternatives to Net Present Value

There are several alternatives to NPV as an analytical tool, each of which has its own flaws or shortcomings. They are payback period, book rate of return and internal rate of return (IRR). The payback period technique uses the number of years it takes to recover the initial investment of a project by adding the projected cash flow from each year over a certain period of time. The flaw in this type of analysis is that there is no consideration for what happens in the years following the initial payback period. NPV in contrast evaluates the entire lifetime of a project in order to determine its worthiness.

Another alternative to NPV is book rate of return. This technique uses book income divided by book assets to calculate what, in reality, is the accounting rate of return (Brealey, Myers and Allen, 2006). This can be misleading because depending on accounting practices some companies classify expenses differently either as capital expenses or operating expenses. Since capital expenses are depreciated over time, this can distort the book rate of return. This method also does not take into account the opportunity cost of the money used for the potential investment where NPV does.

The other alternative to NPV is Internal Rate of Return (IRR). IRR is defined as the rate of discount at which a project would have a zero NPV. It is similar to NPV in that it is a technique based on discounted cash flows (Brealey, Myers and Allen, 2006). Using IRR will also give a good evaluation of a project and in many cases may also arrive at the same conclusion as NPV, but there are more consistent results when NPV is used. This is especially true when the firm is in a position of rationing capital. If there are multiple projects that have a positive IRR, but there is not enough capital to fund each, NPV is a more appropriate tool to use. In this scenario, calculating the profitability index of each project will allow the firm to select the best projects. This is done by dividing the NPV by the initial investment cost. Once this is done, a firm can select the most profitable projects to fund. The profitability index cannot be used when there is capital rationing in more than one period, if projects are mutually exclusive or if one project depends on the completion of another.

3.3 After Tax NPV Analysis of Solar Investment

The NPV model used in the analysis is described below.

$$PVSS_N = -C_0 + C_N(1+r)^{-N} + (1-T)\left[\sum_{k=1}^{N} E_k(1+r)^{-k}\right] + (1-T)\left[\sum_{k=1}^{5} CSI_k(1+r)^{-k}\right] + T\left[\sum_{k=1}^{N} D_K(1+r)^{-k}\right]$$

$$-(1-T)\left[\sum_{k=1}^{N}(R_k + IN_k)(1+r)^{-k}\right]$$

where:

$PVSS_N$	=	Present value of solar savings.
C_0	=	The original investment required for construction and installation of the solar collector less any rebates and tax credits.
C_N	=	The salvage value of the solar collector at the end of the N^{th} year. This term is discounted to present value by $(1+r)^{-N}$.
r	=	An after-tax discount rate.
T	=	The combined federal and state marginal income tax rate.
E_k	=	Energy savings in k^{th} year. This is the savings in fuel from using solar energy. This term is discounted and multiplied by (1 –T) to arrive at the actual after-tax savings. Savings are similar to income in this case.
CSI	=	California Solar Initiative Credit
R_k	=	Maintenance cost of the k^{th} year.
IN_k	=	Insurance cost in the k^{th} year.
D_k	=	Depreciation in k^{th} year. This term is discounted and then multiplied by the tax rate to arrive at the effective tax deduction for depreciation.
N	=	Lifespan of the project

R_k, and IN_k also are discounted and multiplied by (1 – T) to arrive at the after-tax costs. These costs are deductible expenses for business tax purposes and, therefore, the effective rate is found by multiplying the costs by (1 – T).

3.4 Discount Rate

The discount rate used can be adjusted for capital that is jointly or independently financed from owner's equity and/or borrowed funds with the use of the following equation.

$$r = (pe \times (re \times (1 - T))) + (pf \times (rf \times (1 - T)))$$

where:

r	=	after-tax discount rate
re	=	before-tax interest rate or opportunity cost on equity capital used to finance the investment
rf	=	before-tax interest rate or opportunity cost on financed or borrow capital used to finance the investment
pe	=	percent of financing from equity capital
pf	=	percent of financing from borrowed capital
T	=	marginal combined federal and state income tax rate

The discount rate was adjusted for tax purposes to account for the interest deduction allowed for interest payments on borrowed funds and the after-tax rate of return on equity capital. The after-tax rate for borrowed funds was multiplied by (1 – T) where T is the combined federal and state marginal tax rate. The discount rate used in this analysis was based on the assumption that 100 percent of the initial investment cost was financed from owner's equity and 0 percent from borrowed funds. The before-tax opportunity cost for the owner's equity is 13 percent.

3.5 Ranch profile

The ranch chosen for this study is the Bryan Ranch. It is located in western Fresno County. The ranch grows heavy tom turkeys. There are eight buildings with a size of 18,000 square feet each. The total production area is 144,000 square feet. This facility will produce two and one half flocks of 32,508 birds at a budget mortality rate of 84 percent at current bird performance standards. Table 3.1 shows the total production capacity of the facility over the 30 year life of the solar system. This assumes budget weight per bird and stocking density at three square feet per bird remains constant. The critical factor in this evaluation is turkey weight for age. The days to budget weight reduces each year assuming turkey growth in weight for age improvements of one percent per year due to improved genetics from primary breeders and parent breeder stock selection practices (Krueger, September 24-25, 2008).

The house construction is similar for all eight buildings. They are solid sidewall, tunnel ventilated houses. Each house is equipped with eight 48 inch fans powered with 1 horsepower motors, one 36 inch fan powered with a ½ horsepower motor and 100 total feet of cool cell pad with two 1/3 horsepower submersible pumps used for tunnel ventilation. The feed lines are center hopper, automatic pan style feeders run with two ½ horsepower motors. The house lighting is provided by three lines of fluorescent lights.

3.6 Ranch power usage

Power usage for the ranch was compiled using the Pacific Gas and Electric bills for the year 2008. This was the first complete year that this facility was used for turkey production. It was converted from chicken breeder production in June 2007. Table 3.2 shows the Total cost of power used divided by the annual power usage. This usage is the basis for sizing the photovoltaic solar power system.

3.7 Solar power system sizing

System sizing is based on the amount of productive sunlight hours. The number of solar panels used in a system determines the kilowatt production of the system. The system capacity also determines how many inverters are used and the proper size of each inverter. The inverters are not able to convert all of the power produced by the solar panels. A typical inverter is rated at approximately 87 percent efficiency. This inverter efficiency is included in the production capacity of the system. Table 3.3 shows the days per month, amount of sunlight hours for the Fresno area where the ranch is located, the amount of productive hours per month and the kilowatt hours the system will produce. (Unlimited Energy, August 11, 2006) The system proposed is a 207.5 kilowatt system that can produce 86.76 percent of the power needed for the ranch for the year. This is the optimal size as determined by the solar vendor used since there was no limitation on system size due the ample property available for mounting the system. The vendor determines this size by evaluating system purchasing costs for the additional production capacity versus what the cost to buy power from the local utility. When the cost to buy the power is less than adding additional solar production capacity, the optimal system size is found.

3.8 Solar power system pricing

System pricing was based on the reported yearly power usage for the ranch. The system designed by Akeena Solar includes 1184 solar power modules, and two inverters. The system is to be installed in a cleared area on the east side of the poultry houses near the location of the main electrical service for the ranch. The modules are to be ground mounted and installed by attaching them to galvanized steel pipe embedded in concrete footings. Electrical lines will be run from the modules underground to the inverters which will be located next to the existing electric service. The total investment cost for the system is $1,731,818.

There are tax credits, grants and rebates available to help offset the cost of installing this system. There is a 30 percent federal tax incentive available for businesses that install solar. This tax credit will be worth $519,545. This tax credit can be taken in the year of installation of the system. There is a USDA Renewable Energy Grant that can be used to cover up to 25 percent of the project cost to a maximum of $500,000 per qualifying project. This grant could be worth up to $432,954. The total cost impact including the USDA grant would be to reduce the cost of the system by $952,500. This would leave an out of pocket expense to the company of $779,318. Since the USDA grant is from a pool of money and requires that a project qualify, the NPV analysis is done both with this grant and without it. Excluding the grant would leave an out of pocket expense to the company of $1,212,273. The California Solar Initiative (CSI) Performance Based Incentive Program rebate is paid on a monthly basis at a rate of $.15 per solar kilowatt hour per year for five years. These payments are included in the first five years of the NPV analysis. The CSI present value is

$194,558.79 at a discount rate of 13%. Table 3.4 shows a summary of the tax credits, grants and rebates available for the project.

3.9 System maintenance and operating costs

The solar system requires only occasional maintenance. The extent of that maintenance is rinsing any accumulated dust from the solar power module surfaces. This work is made easier due to the ground mounting of the system allowing this work to be done at ground level. The removal of dust assures the maximum amount of light into the power generating material in the panel. The bulk of this work will be required during our dry season which runs from May through September. A yearly average of two hours per month has been allocated to this task. Table 3.5 shows the yearly hours for maintenance, labor rate per hour, benefits cost per hour, total cost per labor hour and yearly labor cost. The cost of the benefits included in hourly wages is calculated using 35 percent of the hourly wage rate.

3.10 Depreciation schedule

Table 3.6 shows the depreciation schedule used for this project. It is five years and based on the Modified Accelerated Cost Recovery System (MACRS). It includes the original project cost. Table 3.7 reflects an inverter replacement of $60,000 that will be required in year 15. The cost of the inverter replacement is a projected cost at the time of replacement taking into account technology improvements and price reduction trends as mass production of the inverters has reduced their cost. The salvage value of the investment and the inverter is assumed to be $0.00.

3.11 Marginal Tax Rate

A marginal tax rate of 42 percent is used in this evaluation taking into account federal and California state taxes.

3.12 Project financing and discount rate

There will be no borrowed money used to fund this project. Capital projects of this type are paid for out of a pool of money that is allocated for facility improvements each year. The discount rate of 13 percent was provided by company purchasing and is used for all capital project considerations.

Table 3.1: Yearly Ranch Production

Yearly Ranch Production					
Year	Days to budget weight	Tom flocks per year	Birds per flock	Budget weight lbs/bird	Pounds per year
1	138.0	2.64	32,508	41.80	3,594,019
2	136.6	2.67	32,508	41.80	3,630,322
3	135.3	2.70	32,508	41.80	3,666,992
4	133.9	2.73	32,508	41.80	3,704,032
5	132.6	2.75	32,508	41.80	3,741,446
6	131.2	2.78	32,508	41.80	3,779,239
7	129.9	2.81	32,508	41.80	3,817,413
8	128.6	2.84	32,508	41.80	3,855,973
9	127.3	2.87	32,508	41.80	3,894,922
10	126.1	2.90	32,508	41.80	3,934,265
11	124.8	2.92	32,508	41.80	3,974,005
12	123.6	2.95	32,508	41.80	4,014,146
13	122.3	2.98	32,508	41.80	4,054,693
14	121.1	3.01	32,508	41.80	4,095,649
15	119.9	3.04	32,508	41.80	4,137,020
16	118.7	3.08	32,508	41.80	4,178,808
17	117.5	3.11	32,508	41.80	4,221,018
18	116.3	3.14	32,508	41.80	4,263,654
19	115.2	3.17	32,508	41.80	4,306,722
20	114.0	3.20	32,508	41.80	4,350,224
21	112.9	3.23	32,508	41.80	4,394,166
22	111.7	3.27	32,508	41.80	4,438,551
23	110.6	3.30	32,508	41.80	4,483,385
24	109.5	3.33	32,508	41.80	4,528,672
25	108.4	3.37	32,508	41.80	4,574,416
26	107.3	3.40	32,508	41.80	4,620,622
27	106.3	3.43	32,508	41.80	4,667,295
28	105.2	3.47	32,508	41.80	4,714,439
29	104.2	3.50	32,508	41.80	4,762,060
30	103.1	3.54	32,508	41.80	4,810,162
Total		**92**	**975,240**		**125,208,327**

Table 3.2: Ranch power usage for 2008

Bryan Ranch Power Usage for 2008			
Time Period	**Kwh Usage**	**Total Cost**	**Cost/ Kwh**
1/1/08-1/10/08	517	$171	$0.33068
1/11/08-2/11/08	49773	$3,917	$0.07869
2/12/08-2/29/08	19648	$1,821	$0.09269
3/12/08-4/9/08	15599	$1,553	$0.09958
4/10/08-4/30/08	34790	$3,559	$0.10230
5/1/08-5/14/08	38130	$4,480	$0.11751
5/15/08-6/10/08	33451	$6,144	$0.18366
6/11/08-7/10/08	43322	$6,971	$0.16092
7/11/08-7/16/08	36708	$4,041	$0.11009
7/17/08-8/13/08	39397	$4,907	$0.12454
8/14/2008-8/31/08	19776	$2,446	$0.12370
9/1/08-10/15/08	39279	$6,681	$0.17008
10/16/08-10/31/08	30031	$3,815	$0.12704
11/1/08-11/10/08	9069	$1,973	$0.21757
11/11/08-12/9/08	9864	$1,598	$0.16203
12/11/08-12/31/08	5677	$538	$0.09482
Total for 2008	**425031**	**$54,616**	**$0.12850**

Table 3.3: Solar power generation potential

System size (Kwh AC)			207.5	
Month	Days	Sun hours	Productive hours	Kwh's produced
January	31	3.1	96.1	16,969
February	28	4.4	123.2	21,754
March	31	5.7	176.7	31,200
April	30	6.7	201.0	35,491
May	31	7.1	220.1	38,864
June	30	7.2	216.0	38,140
July	31	7.3	226.3	39,958
August	31	7.3	226.3	39,958
September	30	6.9	207.0	36,551
October	31	6.0	186.0	32,843
November	30	4.1	123.0	21,718
December	31	2.8	86.8	15,327
Monthly average	30	5.7	173.9	30,731
Yearly totals	365	68.6	2088.5	368,773
			Yearly average usage	425,031
			Solar System Production	86.76%

Table 3.4: Rebates

California Solar Initiative Annual Performance Based Program		
	Kwh's produced	Rebate @ $.15/Kwh $0.15
	16,969	$2,545.30
	21,754	$3,263.07
	31,200	$4,680.07
	35,491	$5,323.67
	38,864	$5,829.56
	38,140	$5,720.96
	39,958	$5,993.77
	39,958	$5,993.77
	36,551	$5,482.59
	32,843	$4,926.39
	21,718	$3,257.77
	15,327	$2,298.98
Average	30,731	$4,609.66
Total	368,773	$55,315.89
Annuity	$55,316	
Discount Rate	0.13	
Years	5	
PV Annuity	$194,558.79	

Federal Tax Credit @ 30% of Investment	
Investment	$1,731,818.00
Tax Credit	$519,545.40

USDA Renewable Energy Grant @ 25% of Investment (Maximum $500,000)	
Investment	$1,731,818.00
Grant	$432,954.50

Table 3.5: Solar system operating cost

Yearly Solar System Operating Costs					
Yearly labor rate increase			**2.50%**		
Year	**Hours used**	**Labor rate per hour**	**Benefit cost per hour**	**Total labor cost per hour**	**Yearly Cost**
1	24	$9.00	$3.15	$12.15	$291.60
2	24	$9.23	$3.23	$12.45	$298.89
3	24	$9.46	$3.31	$12.77	$306.36
4	24	$9.69	$3.39	$13.08	$314.02
5	24	$9.93	$3.48	$13.41	$321.87
6	24	$10.18	$3.56	$13.75	$329.92
7	24	$10.44	$3.65	$14.09	$338.17
8	24	$10.70	$3.74	$14.44	$346.62
9	24	$10.97	$3.84	$14.80	$355.29
10	24	$11.24	$3.93	$15.17	$364.17
11	24	$11.52	$4.03	$15.55	$373.27
12	24	$11.81	$4.13	$15.94	$382.60
13	24	$12.10	$4.24	$16.34	$392.17
14	24	$12.41	$4.34	$16.75	$401.97
15	24	$12.72	$4.45	$17.17	$412.02
16	24	$13.03	$4.56	$17.60	$422.32
17	24	$13.36	$4.68	$18.04	$432.88
18	24	$13.69	$4.79	$18.49	$443.70
19	24	$14.04	$4.91	$18.95	$454.80
20	24	$14.39	$5.04	$19.42	$466.17
21	24	$14.75	$5.16	$19.91	$477.82
22	24	$15.12	$5.29	$20.41	$489.77
23	24	$15.49	$5.42	$20.92	$502.01
24	24	$15.88	$5.56	$21.44	$514.56
25	24	$16.28	$5.70	$21.98	$527.42
26	24	$16.69	$5.84	$22.53	$540.61
27	24	$17.10	$5.99	$23.09	$554.13
28	24	$17.53	$6.14	$23.67	$567.98
29	24	$17.97	$6.29	$24.26	$582.18
30	24	$18.42	$6.45	$24.86	$596.73
Total	720				$12,802.03

Table 3.6: Depreciation schedule for original equipment purchase

5 year depreciation schedule using Modified Accelerated Cost Recovery System (MACRS) Depreciated Asset Life 5					
		Invest. Cost 55% rebate	Invest. Cost 30% rebate		
		$779,318.02	$1,212,272.52		
Year	% Depreciation	Depreciation	Depreciation	Book Value	Book Value
0					
1	0.2000	$155,863.60	$242,454.50	$623,454.42	$969,818.02
2	0.3200	$249,381.77	$387,927.21	$374,072.65	$581,890.81
3	0.1920	$149,629.06	$232,756.32	$224,443.59	$349,134.49
4	0.1152	$89,777.44	$139,653.79	$134,666.15	$209,480.69
5	0.1152	$89,777.44	$139,653.79	$44,888.72	$69,826.90
6	0.0576	$44,888.72	$69,826.90	$0.00	$0.00
7	0.0000	$0.00	$0.00		
8	0.0000	$0.00	$0.00		
9	0.0000	$0.00	$0.00		
10	0.0000	$0.00	$0.00		
11	0.0000	$0.00	$0.00		
12	0.0000	$0.00	$0.00		
13	0.0000	$0.00	$0.00		
14	0.0000	$0.00	$0.00		
15	0.0000	$0.00	$0.00		
16	0.0000	$0.00	$0.00		
17	0.0000	$0.00	$0.00		
18	0.0000	$0.00	$0.00		
19	0.0000	$0.00	$0.00		
20	0.0000	$0.00	$0.00		
21	0.0000	$0.00	$0.00		
22	0.0000	$0.00	$0.00		
23	0.0000	$0.00	$0.00		
24	0.0000	$0.00	$0.00		
25	0.0000	$0.00	$0.00		
26	0.0000	$0.00	$0.00		
27	0.0000	$0.00	$0.00		
28	0.0000	$0.00	$0.00		
29	0.0000	$0.00	$0.00		
30	0.0000	$0.00	$0.00		

Table 3.7: Depreciation schedule for inverter replacement in year 15

Modified Accelerated Cost Recovery System (MACRS) depreciation			
Depreciated Asset Life		5 years	
		Invest. Cost Inverters in Yr 15	
Year	% Depreciation	$60,000.00 Depreciation	Book Value
0			
1	0.0000	$0.00	
2	0.0000	$0.00	
3	0.0000	$0.00	
4	0.0000	$0.00	
5	0.0000	$0.00	
6	0.0000	$0.00	
7	0.0000	$0.00	
8	0.0000	$0.00	
9	0.0000	$0.00	
10	0.0000	$0.00	
11	0.0000	$0.00	
12	0.0000	$0.00	
13	0.0000	$0.00	
14	0.0000	$0.00	
15	0.0000	$0.00	
16	0.2000	$12,000.00	$48,000.00
17	0.3200	$19,200.00	$28,800.00
18	0.1920	$11,520.00	$17,280.00
19	0.1152	$6,912.00	$10,368.00
20	0.1152	$6,912.00	$3,456.00
21	0.0576	$3,456.00	$0.00
22	0.0000	$0.00	
23	0.0000	$0.00	
24	0.0000	$0.00	
25	0.0000	$0.00	
26	0.0000	$0.00	
27	0.0000	$0.00	
28	0.0000	$0.00	
29	0.0000	$0.00	
30	0.0000	$0.00	

CHAPTER 4: RESULTS

4.1 NPV evaluation

The NPV evaluation is calculated using two levels of rebates and two levels of cost per kilowatt inflation over time. The rebate levels used were 55 percent which included all available tax credits and grants discussed in Chapter 3. The other level of rebates used was 30 percent which did not include the USDA grant. The California Solar Initiative (CSI) Performance Based Incentive Program rebate was accounted for in the first five years of the NPV analysis since it is paid out on a monthly basis over the first five years of operation of the system at a rate of $.15 per solar kilowatt hour. The levels of electric rate inflation used were 7 percent which, as confirmed by my research, has been a common level of increase in California over the last few years and 5 percent which is a nationwide average rate increase since 1997. Table 4.1 shows the Net Present Value evaluation before taxes. Table 4.2 shows the Net Present Value evaluation after taxes. The after tax evaluation will be the focus of the decision of whether to pursue the project.

4.2 Model results

There are four scenarios that will be compared in these results. Scenario 1 (S1) assumes an electrical rate increase of 7 percent and rebates of 55 percent. Scenario 2 (S2) assumes an electrical rate increase of 7 percent and rebates of 30 percent. Scenario 3 (S3) assumes an electrical rate increase of 5 percent and rebates of 55 percent. Scenario 4 (S4) assumes an electrical rate increase of 5 percent and rebates of 30 percent. The only scenario that shows a negative NPV is S4. The NPV for this scenario is -$125,365. This scenario represents the lowest electrical rate increase and lowest level of rebates. The most positive NPV is shown in S1. The NPV for this scenario is $317,987. This scenario represents the highest electrical rate increase and maximizes available rebates. The rebates make the most impact on the end result as seen with S3. It represents the lower electrical rate increase, but maximizes the available rebates. The NPV for this scenario is $158,384. S2 also presents a positive NPV at $34,238.

The solar power system will enable the company to effectively lock in the price of electricity for the 30 year life of the project. From a production cost standpoint, this would be critical to the companies' ability to stay competitive in the poultry industry. The same three scenarios would result in significant savings to the live production area. Table 4.3 shows an NPV analysis of the cost per kilowatt hour of power purchased from the electric utility before taxes. Table 4.4 shows an NPV analysis of the cost per kilowatt hour of power purchased from the electric utility after taxes. Table 4.5 shows an NPV analysis of the cost per kilowatt hour of power produced by solar before taxes. Table 4.6 shows an NPV analysis of the cost per kilowatt hour of power produced by solar after taxes. Table 4.7 shows the amortized cost comparison per kilowatt hour before taxes. Table 4.8 shows the amortized cost comparison per kilowatt hour after taxes. The after tax analysis will be the focus of the evaluation. S1 would result in electric rate savings of $0.073 per kilowatt and save $0.0065 per pound of meat produced over the life of the system. S2 would result in electric rate savings of $0.008 per kilowatt and save $0.0007 per pound of meat produced over the life of the system. S3 would result in electric rate savings of $0.037 per kilowatt and save $0.0032 per pound of meat produced over the life of the system. The savings per pound of meat would be reflected in the ranch cost of each flock produced. The major cost items included in ranch costs are utility costs, ranch labor and employee benefit costs. The budgeted amount in 2009 for ranch costs per flock is $.0552 per pound of meat produced. The savings shown in S1 would be 11.73 percent, S2 would save 1.26 percent and S3 would save 5.84 percent. This is represented in the table as the ranch cost savings percentage. These reductions would be directly reflected in live production ranch costs per flock.

4.3 Sensitivity analysis

Sensitivity analysis was done with differing discount rates. The standard discount rate used was 13 percent. Evaluations were also done at 10 and 16 percent. At the 10 percent discount rate, all of the scenarios showed positive Net Present Values after taxes. At the 16 percent discount rate, only S1 and S3 showed positive Net Present Values after taxes. Table 4.9 shows the 10 percent discount rate Net Present Value after taxes. Table

4.10 shows the 16 percent discount rate Net Present Value after taxes. The positive NPV values translated to positive ranch cost reductions similar to those done at the 13 percent level. The 10 percent discount rate showed ranch cost reductions ranging from .12 percent to 14.56 percent. The 16 percent discount rate showed ranch cost reductions ranging from 2.71 percent on S3 to 8.60 percent on S1.

Table 4.1: NPV evaluation before taxes

NPV (Before tax) Adjusted for $60,000 inverter replacement in year 15				
Discount rate	13.0%			
Year	**Scenario 1 (S1)** Rate increase 7.00% Rebate 55.00%	**Scenario 2 (S2)** Rate increase 7.00% Rebate 30.00%	**Scenario 3 (S3)** Rate increase 5.00% Rebate 55.00%	**Scenario 4 (S4)** Rate increase 5.00% Rebate 30.00%
0	-$779,318	-$1,212,273	-$779,318	-$1,212,273
1	$102,412	$102,412	$102,412	$102,412
2	$105,721	$105,721	$104,774	$104,774
3	$109,263	$109,263	$107,254	$107,254
4	$113,053	$113,053	$109,859	$109,859
5	$117,109	$117,109	$112,594	$112,594
6	$66,133	$66,133	$60,150	$60,150
7	$70,777	$70,777	$63,165	$63,165
8	$75,747	$75,747	$66,332	$66,332
9	$81,065	$81,065	$69,657	$69,657
10	$86,755	$86,755	$73,149	$73,149
11	$92,845	$92,845	$76,816	$76,816
12	$99,361	$99,361	$80,666	$80,666
13	$106,333	$106,333	$84,709	$84,709
14	$113,794	$113,794	$88,954	$88,954
15	$121,778	$121,778	$93,412	$93,412
16	$70,321	$70,321	$38,092	$38,092
17	$139,462	$139,462	$103,008	$103,008
18	$149,244	$149,244	$108,169	$108,169
19	$159,711	$159,711	$113,588	$113,588
20	$170,911	$170,911	$119,279	$119,279
21	$182,896	$182,896	$125,255	$125,255
22	$195,720	$195,720	$131,529	$131,529
23	$209,443	$209,443	$138,118	$138,118
24	$224,126	$224,126	$145,037	$145,037
25	$239,838	$239,838	$152,301	$152,301
26	$256,651	$256,651	$159,930	$159,930
27	$274,641	$274,641	$167,940	$167,940
28	$293,890	$293,890	$176,350	$176,350
29	$314,488	$314,488	$185,182	$185,182
30	$336,529	$336,529	$194,456	$194,456
IRR	13.6145%	8.9550%	11.7823%	7.1002%
NPV	$40,211.96	-$392,742.54	-$68,984.38	-$501,938.88
Annualized	$5,364.70	($52,396.04)	($9,203.25)	($66,963.99)

Table 4.2: NPV evaluation after taxes

NPV (After tax) Adjusted for $60,000 inverter replacement in year 15				
Marginal Tax Rate	0.42			
Discount rate	13.0%			
After Tax Discount Rate	7.5%			
Year	**Scenario 1 (S1)** Rate increase 7.00% Rebate 55.00%	**Scenario 2 (S2)** Rate increase 7.00% Rebate 30.00%	**Scenario 3 (S3)** Rate increase 5.00% Rebate 55.00%	**Scenario 4 (S4)** Rate increase 5.00% Rebate 30.00%
0	-$779,318	-$1,212,273	-$779,318	-$1,212,273
1	$124,861	$161,230	$124,861	$161,230
2	$166,059	$224,248	$165,509	$223,698
3	$126,217	$161,130	$125,052	$159,965
4	$103,277	$124,226	$101,424	$122,373
5	$105,630	$126,578	$103,011	$123,959
6	$57,211	$67,685	$53,740	$64,214
7	$41,051	$41,051	$36,636	$36,636
8	$43,933	$43,933	$38,473	$38,473
9	$47,018	$47,018	$40,401	$40,401
10	$50,318	$50,318	$42,426	$42,426
11	$53,850	$53,850	$44,553	$44,553
12	$57,629	$57,629	$46,786	$46,786
13	$61,673	$61,673	$49,131	$49,131
14	$66,001	$66,001	$51,593	$51,593
15	$70,631	$70,631	$54,179	$54,179
16	$20,626	$20,626	$1,934	$1,934
17	$88,952	$88,952	$67,808	$67,808
18	$91,400	$91,400	$67,576	$67,576
19	$95,535	$95,535	$68,784	$68,784
20	$102,032	$102,032	$72,085	$72,085
21	$107,531	$107,531	$74,099	$74,099
22	$113,518	$113,518	$76,287	$76,287
23	$121,477	$121,477	$80,109	$80,109
24	$129,993	$129,993	$84,121	$84,121
25	$139,106	$139,106	$88,335	$88,335
26	$148,857	$148,857	$92,759	$92,759
27	$159,292	$159,292	$97,405	$97,405
28	$170,456	$170,456	$102,283	$102,283
29	$182,403	$182,403	$107,406	$107,406
30	$195,187	$195,187	$112,784	$112,784
IRR	11.6241%	7.8539%	9.9732%	6.1853%
NPV	$317,987.44	$34,237.97	$158,383.96	-$125,365.51
Annualized	$27,029.30	$2,910.27	$13,462.82	($10,656.21)

Table 4.3: Cost per kilowatt hour of purchased power before taxes

NPV (Before tax) Adjusted for $60,000 inverter replacement in year 15				
Kwh replaced annually	368773			
Discount rate	13.0%			
Year	**Scenario 1 (S1)** Rate increase 7.00% Rebate 55.00%	**Scenario 2 (S2)** Rate increase 7.00% Rebate 30.00%	**Scenario 3 (S3)** Rate increase 5.00% Rebate 55.00%	**Scenario 4 (S4)** Rate increase 5.00% Rebate 30.00%
0	$0	$0	$0	$0
1	$47,387	$47,387	$47,387	$47,387
2	$50,704	$50,704	$49,757	$49,757
3	$54,254	$54,254	$52,244	$52,244
4	$58,051	$58,051	$54,857	$54,857
5	$62,115	$62,115	$57,600	$57,600
6	$66,463	$66,463	$60,480	$60,480
7	$71,116	$71,116	$63,503	$63,503
8	$76,094	$76,094	$66,679	$66,679
9	$81,420	$81,420	$70,013	$70,013
10	$87,120	$87,120	$73,513	$73,513
11	$93,218	$93,218	$77,189	$77,189
12	$99,743	$99,743	$81,048	$81,048
13	$106,725	$106,725	$85,101	$85,101
14	$114,196	$114,196	$89,356	$89,356
15	$122,190	$122,190	$93,824	$93,824
16	$130,743	$130,743	$98,515	$98,515
17	$139,895	$139,895	$103,440	$103,440
18	$149,688	$149,688	$108,613	$108,613
19	$160,166	$160,166	$114,043	$114,043
20	$171,377	$171,377	$119,745	$119,745
21	$183,374	$183,374	$125,733	$125,733
22	$196,210	$196,210	$132,019	$132,019
23	$209,945	$209,945	$138,620	$138,620
24	$224,641	$224,641	$145,551	$145,551
25	$240,366	$240,366	$152,829	$152,829
26	$257,191	$257,191	$160,470	$160,470
27	$275,195	$275,195	$168,494	$168,494
28	$294,458	$294,458	$176,918	$176,918
29	$315,070	$315,070	$185,764	$185,764
30	$337,125	$337,125	$195,052	$195,052
NPV	$636,089.19	$636,089.19	$526,892.85	$526,892.85
Annualized	$84,861.07	$84,861.07	$70,293.12	$70,293.12
$/Kwh	$0.230	$0.230	$0.191	$0.191

Table 4.4: Cost per kilowatt hour of purchased power after taxes

NPV (After tax) Adjusted for $60,000 inverter replacement in year 15				
Marginal Tax Rate 0.42 After Tax Discount Rate	Discount rate 13.0% 7.5%			
Year	**Scenario 1 (S1)** Rate increase 7.00% Rebate 55.00%	**Scenario 2 (S2)** Rate increase 7.00% Rebate 30.00%	**Scenario 3 (S3)** Rate increase 5.00% Rebate 55.00%	**Scenario 4 (S4)** Rate increase 5.00% Rebate 30.00%
0	$0	$0	$0	$0
1	$27,485	$27,485	$27,485	$27,485
2	$29,409	$29,409	$28,859	$28,859
3	$31,467	$31,467	$30,302	$30,302
4	$33,670	$33,670	$31,817	$31,817
5	$36,027	$36,027	$33,408	$33,408
6	$38,549	$38,549	$35,078	$35,078
7	$41,247	$41,247	$36,832	$36,832
8	$44,134	$44,134	$38,674	$38,674
9	$47,224	$47,224	$40,607	$40,607
10	$50,529	$50,529	$42,638	$42,638
11	$54,066	$54,066	$44,770	$44,770
12	$57,851	$57,851	$47,008	$47,008
13	$61,901	$61,901	$49,358	$49,358
14	$66,234	$66,234	$51,826	$51,826
15	$70,870	$70,870	$54,418	$54,418
16	$75,831	$75,831	$57,139	$57,139
17	$81,139	$81,139	$59,995	$59,995
18	$86,819	$86,819	$62,995	$62,995
19	$92,896	$92,896	$66,145	$66,145
20	$99,399	$99,399	$69,452	$69,452
21	$106,357	$106,357	$72,925	$72,925
22	$113,802	$113,802	$76,571	$76,571
23	$121,768	$121,768	$80,400	$80,400
24	$130,292	$130,292	$84,420	$84,420
25	$139,412	$139,412	$88,641	$88,641
26	$149,171	$149,171	$93,073	$93,073
27	$159,613	$159,613	$97,726	$97,726
28	$170,786	$170,786	$102,613	$102,613
29	$182,741	$182,741	$107,743	$107,743
30	$195,533	$195,533	$113,130	$113,130
NPV	$713,431.85	$713,431.85	$553,828.38	$553,828.38
Annualized	$60,642.54	$60,642.54	$47,076.06	$47,076.06
$/Kwh	$0.164	$0.164	$0.128	$0.128

Table 4.5: Cost per kilowatt hour of solar produced power before taxes

NPV (Before tax) Adjusted for $60,000 inverter replacement in year 15				
Kwh replaced annually	368773			
Discount rate	13.0%			
Year	**Scenario 1 (S1)** Rate increase 7.00% Rebate 55.00%	**Scenario 2 (S2)** Rate increase 7.00% Rebate 30.00%	**Scenario 3 (S3)** Rate increase 5.00% Rebate 55.00%	**Scenario 4 (S4)** Rate increase 5.00% Rebate 30.00%
0	-$779,318	-$1,212,273	-$779,318	-$1,212,273
1	$55,024	$55,024	$55,024	$55,024
2	$55,017	$55,017	$55,017	$55,017
3	$55,010	$55,010	$55,010	$55,010
4	$55,002	$55,002	$55,002	$55,002
5	$54,994	$54,994	$54,994	$54,994
6	-$330	-$330	-$330	-$330
7	-$338	-$338	-$338	-$338
8	-$347	-$347	-$347	-$347
9	-$355	-$355	-$355	-$355
10	-$364	-$364	-$364	-$364
11	-$373	-$373	-$373	-$373
12	-$383	-$383	-$383	-$383
13	-$392	-$392	-$392	-$392
14	-$402	-$402	-$402	-$402
15	-$412	-$412	-$412	-$412
16	-$60,422	-$60,422	-$60,422	-$60,422
17	-$433	-$433	-$433	-$433
18	-$444	-$444	-$444	-$444
19	-$455	-$455	-$455	-$455
20	-$466	-$466	-$466	-$466
21	-$478	-$478	-$478	-$478
22	-$490	-$490	-$490	-$490
23	-$502	-$502	-$502	-$502
24	-$515	-$515	-$515	-$515
25	-$527	-$527	-$527	-$527
26	-$541	-$541	-$541	-$541
27	-$554	-$554	-$554	-$554
28	-$568	-$568	-$568	-$568
29	-$582	-$582	-$582	-$582
30	-$597	-$597	-$597	-$597
NPV	-$595,877.23	-$1,028,831.73	-$595,877.23	-$1,028,831.73
Annualized	($79,496.37)	($137,257.11)	($79,496.37)	($137,257.11)
$/Kwh	($0.216)	($0.372)	($0.216)	($0.372)

Table 4.6: Cost per kilowatt hour of solar produced power after taxes

NPV (After tax)
Adjusted for $60,000 inverter replacement in year 15

Marginal Tax Rate 0.42 Discount rate 13.0%
After Tax Discount Rate 7.5%

Year	**Scenario 1 (S1)** Rate increase 7.00% Rebate 55.00%	**Scenario 2 (S2)** Rate increase 7.00% Rebate 30.00%	**Scenario 3 (S3)** Rate increase 5.00% Rebate 55.00%	**Scenario 4 (S4)** Rate increase 5.00% Rebate 30.00%
0	-$779,318	-$1,212,273	-$779,318	-$1,212,273
1	$97,377	$133,745	$97,377	$133,745
2	$136,650	$194,839	$136,650	$194,839
3	$94,750	$129,663	$94,750	$129,663
4	$69,608	$90,556	$69,608	$90,556
5	$69,603	$90,551	$69,603	$90,551
6	$18,662	$29,136	$18,662	$29,136
7	-$196	-$196	-$196	-$196
8	-$201	-$201	-$201	-$201
9	-$206	-$206	-$206	-$206
10	-$211	-$211	-$211	-$211
11	-$216	-$216	-$216	-$216
12	-$222	-$222	-$222	-$222
13	-$227	-$227	-$227	-$227
14	-$233	-$233	-$233	-$233
15	-$239	-$239	-$239	-$239
16	-$55,205	-$55,205	-$55,205	-$55,205
17	$7,813	$7,813	$7,813	$7,813
18	$4,581	$4,581	$4,581	$4,581
19	$2,639	$2,639	$2,639	$2,639
20	$2,633	$2,633	$2,633	$2,633
21	$1,174	$1,174	$1,174	$1,174
22	-$284	-$284	-$284	-$284
23	-$291	-$291	-$291	-$291
24	-$298	-$298	-$298	-$298
25	-$306	-$306	-$306	-$306
26	-$314	-$314	-$314	-$314
27	-$321	-$321	-$321	-$321
28	-$329	-$329	-$329	-$329
29	-$338	-$338	-$338	-$338
30	-$346	-$346	-$346	-$346
NPV	-$395,444.41	-$679,193.89	-$395,444.41	-$679,193.89
Annualized	($33,613.24)	($57,732.27)	($33,613.24)	($57,732.27)
$/Kwh	($0.091)	($0.157)	($0.091)	($0.157)

Table 4.7: Amortized cost comparison of $Kwh before taxes

Amortized Cost Comparison of $Kwh (Before tax)				
	Scenario 1 (S1)	**Scenario 2 (S2)**	**Scenario 3 (S3)**	**Scenario 4 (S4)**
	Rate increase 7.00% Rebate 55.00%	Rate increase 7.00% Rebate 30.00%	Rate increase 5.00% Rebate 55.00%	Rate increase 5.00% Rebate 30.00%
Purchased Electicity ($/Kwh)	$0.230	$0.230	$0.191	$0.191
Solar Generated ($/Kwh)	$0.216	$0.372	$0.216	$0.372
Solar Savings ($/Kwh)	$0.015	-$0.142	-$0.025	-$0.182
NPV Result	+	-	-	-
Kilowatt hours from Solar per year	368,773	368,773	368,773	368,773
30 year kilowatt hours from Solar	11,063,190	11,063,190	11,063,190	11,063,190
30 year dollar savings from Solar	$160,941.11	-$1,571,881.13	-$276,097.52	-$2,008,919.76
Total pounds produced over 30 years	125,208,327	125,208,327	125,208,327	125,208,327
Cost per pound savings from Solar	$0.0013	-$0.0126	-$0.0022	-$0.0160
Ranch cost budget	$0.0552	$0.0552	$0.0552	$0.0552
Ranch cost savings %	2.33%	-22.74%	-3.99%	-29.07%

Table 4.8: Amortized cost comparison of $Kwh after taxes

Amortized Cost Comparison of $Kwh (After tax)				
	Scenario 1 (S1)	**Scenario 2 (S2)**	**Scenario 3 (S3)**	**Scenario 4 (S4)**
	Rate increase 7.00% Rebate 55.00%	Rate increase 7.00% Rebate 30.00%	Rate increase 5.00% Rebate 55.00%	Rate increase 5.00% Rebate 30.00%
Purchased Electicity ($/Kwh)	$0.164	$0.164	$0.128	$0.128
Solar Generated ($/Kwh)	$0.091	$0.157	$0.091	$0.157
Solar Savings ($/Kwh)	$0.073	$0.008	$0.037	-$0.029
NPV Result	+	+	+	-
Kilowatt hours from Solar per year	368,773	368,773	368,773	368,773
30 year kilowatt hours from Solar	11,063,190	11,063,190	11,063,190	11,063,190
30 year dollar savings from Solar	$810,879.07	$87,308.01	$403,884.64	-$319,686.43
Total pounds produced over 30 years	125,208,327	125,208,327	125,208,327	125,208,327
Cost per pound savings from Solar	$0.0065	$0.0007	$0.0032	-$0.0026
Ranch cost budget	$0.0552	$0.0552	$0.0552	$0.0552
Ranch cost savings %	11.73%	1.26%	5.84%	-4.63%

Table 4.9: NPV after taxes with 10 percent discount rate

NPV evaluation (After tax) Adjusted for $60,000 inverter replacement in year 15				
Marginal Tax Rate	0.42			
Discount rate	10.0%			
After Tax Discount Rate	5.8%			
Year	**Scenario 1 (S1)** Rate increase 7.00% Rebate 55.00%	**Scenario 2 (S2)** Rate increase 7.00% Rebate 30.00%	**Scenario 3 (S3)** Rate increase 5.00% Rebate 55.00%	**Scenario 4 (S4)** Rate increase 5.00% Rebate 30.00%
0	-$779,318	-$1,212,273	-$779,318	-$1,212,273
1	$124,861	$161,230	$124,861	$161,230
2	$166,059	$224,248	$165,509	$223,698
3	$126,217	$161,130	$125,052	$159,965
4	$103,277	$124,226	$101,424	$122,373
5	$105,630	$126,578	$103,011	$123,959
6	$57,211	$67,685	$53,740	$64,214
7	$41,051	$41,051	$36,636	$36,636
8	$43,933	$43,933	$38,473	$38,473
9	$47,018	$47,018	$40,401	$40,401
10	$50,318	$50,318	$42,426	$42,426
11	$53,850	$53,850	$44,553	$44,553
12	$57,629	$57,629	$46,786	$46,786
13	$61,673	$61,673	$49,131	$49,131
14	$66,001	$66,001	$51,593	$51,593
15	$70,631	$70,631	$54,179	$54,179
16	$20,626	$20,626	$1,934	$1,934
17	$88,952	$88,952	$67,808	$67,808
18	$91,400	$91,400	$67,576	$67,576
19	$95,535	$95,535	$68,784	$68,784
20	$102,032	$102,032	$72,085	$72,085
21	$107,531	$107,531	$74,099	$74,099
22	$113,518	$113,518	$76,287	$76,287
23	$121,477	$121,477	$80,109	$80,109
24	$129,993	$129,993	$84,121	$84,121
25	$139,106	$139,106	$88,335	$88,335
26	$148,857	$148,857	$92,759	$92,759
27	$159,292	$159,292	$97,405	$97,405
28	$170,456	$170,456	$102,283	$102,283
29	$182,403	$182,403	$107,406	$107,406
30	$195,187	$195,187	$112,784	$112,784
IRR	11.6241%	7.8539%	9.9732%	6.1853%
NPV	$541,017.93	$263,891.22	$318,463.02	$41,336.31
Annualized	$38,466.94	$18,762.94	$22,643.05	$2,939.06

Table 4.10: NPV after taxes with 16 percent discount rate

NPV evaluation (After tax) Adjusted for $60,000 inverter replacement in year 15				
Marginal Tax Rate	0.42			
Discount rate	16.0%			
After Tax Discount Rate	9.3%			
Year	**Scenario 1 (S1)** Rate increase 7.00% Rebate 55.00%	**Scenario 2 (S2)** Rate increase 7.00% Rebate 30.00%	**Scenario 3 (S3)** Rate increase 5.00% Rebate 55.00%	**Scenario 4 (S4)** Rate increase 5.00% Rebate 30.00%
0	-$779,318	-$1,212,273	-$779,318	-$1,212,273
1	$124,861	$161,230	$124,861	$161,230
2	$166,059	$224,248	$165,509	$223,698
3	$126,217	$161,130	$125,052	$159,965
4	$103,277	$124,226	$101,424	$122,373
5	$105,630	$126,578	$103,011	$123,959
6	$57,211	$67,685	$53,740	$64,214
7	$41,051	$41,051	$36,636	$36,636
8	$43,933	$43,933	$38,473	$38,473
9	$47,018	$47,018	$40,401	$40,401
10	$50,318	$50,318	$42,426	$42,426
11	$53,850	$53,850	$44,553	$44,553
12	$57,629	$57,629	$46,786	$46,786
13	$61,673	$61,673	$49,131	$49,131
14	$66,001	$66,001	$51,593	$51,593
15	$70,631	$70,631	$54,179	$54,179
16	$20,626	$20,626	$1,934	$1,934
17	$88,952	$88,952	$67,808	$67,808
18	$91,400	$91,400	$67,576	$67,576
19	$95,535	$95,535	$68,784	$68,784
20	$102,032	$102,032	$72,085	$72,085
21	$107,531	$107,531	$74,099	$74,099
22	$113,518	$113,518	$76,287	$76,287
23	$121,477	$121,477	$80,109	$80,109
24	$129,993	$129,993	$84,121	$84,121
25	$139,106	$139,106	$88,335	$88,335
26	$148,857	$148,857	$92,759	$92,759
27	$159,292	$159,292	$97,405	$97,405
28	$170,456	$170,456	$102,283	$102,283
29	$182,403	$182,403	$107,406	$107,406
30	$195,187	$195,187	$112,784	$112,784
IRR	11.6241%	7.8539%	9.9732%	6.1853%
NPV	$155,716.50	-$134,199.53	$39,120.54	-$250,795.49
Annualized	$15,534.62	($13,388.04)	$3,902.75	($25,019.91)

CHAPTER 5: SUMMARY AND CONCLUSIONS

The thesis analyzed using solar power to replace 87 percent of electrical grid supplied power for a turkey growout facility in Fresno, California. The original intent was to look at two different system capacities. One that would produce the majority of the power required and another smaller system to produce enough to cover the peak energy needed. In the end, one system was proposed due to the availability of land for mounting the system. The focus then became trying to maximize the available financial advantages for installing a system through tax credits, grants and rebates and comparing those scenarios with different levels of electrical rate inflation over time.

The system is projected to have a useful life of 30 years with an inverter replacement planned for year 15. Four NPV evaluations were conducted using differing levels of rebates and electrical rate inflation levels. Scenario 1 (S1) assumes an electrical rate increase of 7 percent and rebates of 55 percent. Scenario 2 (S2) assumes an electrical rate increase of 7 percent and rebates of 30 percent. Scenario 3 (S3) assumes an electrical rate increase of 5 percent and rebates of 55 percent. Scenario 4 (S4) assumes an electrical rate increase of 5 percent and rebates of 30 percent. The evaluations conducted showed the most financially attractive options were available when the tax credits, grants and rebates were maximized. This was the case at both electrical rate inflation scenarios. The most positive results were shown in S1 and S3. S2 also showed positive results at the 10 and 13 percent discount rate. Under the conditions of these three scenarios, the project should be pursued.

These same three scenarios produced favorable results at the 13 percent discount rate when looking at reducing live production ranch costs. The system effectively locked in electrical rates below current rates for the 30 year life of the system. This reduced live production ranch cost by as much as 11.73 percent. This reduction in utility cost is directly reflected in the cost to produce a pound of meat. It also gives the company an advantage over the competition when used as a marketing tool due to the use of green technology in company production practices. Due to the environmentally conscious consumer that buys our product, we will be able to market our use of environmentally friendly technology in addition to being California grown product.

Future research should focus on emerging technologies, enhanced rebate opportunities and evaluating different sized systems. The technology in this area is constantly changing and improving. All of this emerging technology will soon find a place in the production of energy. As production of system components becomes more efficient, costs will continue to fall which will benefit consumers. Government focus on green technology may provide more financing options in the future as well. This research can also be used to evaluate different sized systems. The focus of this project was a large system. These same principles can be used to evaluate a smaller system that could be used to cover only peak power usage where rates are highest.

A practical shortcoming of the research involves this emerging technology relative to the amount of facilities that could possibly benefit from this type of system. Since there are so many locations within the company and the technology is changing so quickly, each facility would have to do a similar analysis with current quotes using the latest available information. It may be difficult to use a standardized application of the research if the system technology dramatically changes. Another shortcoming of the research was that the data did not allow an accurate calculation of the difference between electric supply generated by the solar power system and the actual use of the ranch on an equivalent time basis, such as monthly. Therefore, the credit for power generated that is not used by the ranch may be overvalued due to the winter power rate used for the credit is less than the weighted average rate of $.1285 used in the analysis. Alternatively, in months where the solar power system does not generate enough supply to cover all ranch needs, the electricity savings may be undervalued because the actual rate charged is more than the weighted average rate of $.1285 used in the analysis. As a result, the Net Present Value analysis values could be lower or higher.

The decision to proceed with the project will be influenced by the availability of capital for projects which could be directly affected by current economic conditions. There may also be other projects of higher priority due to regulatory or safety issues within the company.

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