The Sustainable Energy Solutions Guide for Minnesota Resorts

Written by Andrea Schuweiler

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Introduction

Tourism is a $10.5 billion industry in Minnesota as of 2008.[1] As such an important segment of the Minnesota economy, the tourism industry needs to continually assess and adjust to its market. As tourists are increasingly viewing local environmental and social stewardship as a responsibility of the businesses they support, it is important that the Minnesota tourism industry finds ways to address this market demand.[2]

In 2008, the University of Minnesota Tourism Center conducted a survey on sustainable practices in the Minnesota tourism industry. The survey found that respondents participate in some sustainable tourism practices but have significant opportunities to increase practices related to energy, among others.[3] Furthermore, other research demonstrates that tourism businesses are most likely to implement sustainable practices that have a minimum investment and result in operational cost reductions.[4] Therefore, this resource guide focuses on innovative energy uses that have a minimum initial investment and/or reduce operational costs.

The Sustainable Energy Solutions Guide for Minnesota Resorts arrives at a pivotal time for Minnesota tourism. In 2007, the State of Minnesota passed legislation directing Explore Minnesota Tourism to develop a Travel Green Program. As a result of this legislation, Explore Minnesota Tourism created a task force to explore ways to implement a Travel Green Program in Minnesota. The task force recommended a program to increase environmental practices of Minnesota tourism businesses and connect consumers to businesses implementing "green" practices.[5] One task force recommendation was to educate tourism businesses about "being green" through best environmental practices in print, online and through education sessions.[6] *The Sustainable Energy Solutions Guide* addresses part of those recommendations by educating resorts on alternative energy options.

The Sustainable Energy Solutions Guide for Minnesota Resorts is directed specifically towards Minnesota resorts. While there are a variety of information sources available for energy conservation, this is the first that provides specific information tailored towards a market such as Minnesota resort tourism. Minnesota's approximately 900 resorts vary in size and provide a variety of accommodations and recreational opportunities.[7] However, they are similar in that they usually provide nature-based recreational opportunities, especially boating and fishing, are located in secluded areas, feature cabin-like accommodations and are not open during the winter.

Many tourists come specifically to Minnesota for its nature-based activities such as fishing and other lake activities. Therefore, the success of the tourism industry in Minnesota largely depends on its natural resources. As such, many resort owners recognize that they must preserve the natural environment around them to remain a desirable destination. While the source book is aimed at Minnesota resorts, the information can be easily adapted for similar regions and industry sectors.

How to Use This Guide

The Sustainable Energy Solutions Guide is designed to provide cost-effective energy alternatives specifically for Minnesota resorts. The guide performs three primary resource functions:

1. background information on individual energy solutions,
2. economic information such as cost savings and payback periods for each suggested energy solution, and
3. links to businesses and other websites that provide more detailed information on the different energy solutions discussed in this source book.

By considering and implementing the energy solutions presented in the order they are presented, you will implement the most cost-effective strategies first. The first sections on **energy audits** and monitoring will help you to establish a baseline of your energy usage. The **guest education** section will help you to gain awareness and support from your guests and employees so that they understand the benefits of future strategies. From there, the **energy conservation strategies** will be the foundation of your sustainable energy solutions. Conservation strategies are usually easy, have a minimal capital investment, and are the most cost-effective way to reduce your overall energy use and environmental impact. Once you have thoroughly implemented your conservation strategies, the **renewable energy** section will help you think about what type of renewable energy source is possible and profitable for your resort.

Throughout the guide you will find "Do-It-Yourself Tips" designed for you to implement sustainable energy solutions where costly installation charges may be prohibitive. These "Do-It-Yourself Tips" are a great way to implement sustainable energy solutions while saving a bit of money and/or time.

Monitoring

Monitoring the changes you see in your resort from implementing energy initiatives will help you to determine what steps are effective and what your next steps will be. The following are steps to help you with the monitoring process. You will also find a sample monitoring chart in Appendix A that you may use or adapt for your project.

1. Determine which variables you are going to use to measure your effectiveness. These should be based on the project goal. For example:

Table 1. Monitoring Examples

Goal:	Monitoring option:
decrease utility bills	monthly utility bill
increase occupancy	occupancy rate
increase interest in resort	website hits, phone call inquiries
decrease staff maintenance time	light bulbs replaced per month, maintenance hours worked

2. Establish a baseline. Obtain 3-12 months of data before you implement your project. For example, obtain a year's worth of utility bills before implementing an energy savings strategy. Note: with utility bills you can use your previous year's data which can be found on monthly utility statements. A year's worth of data for utility bills is essential due to the seasonality of Minnesota resorts.

   You may also find it useful to use an online carbon calculator designed for businesses. Establishing how much carbon you are saving from your environmental efforts will help you realize the environmental benefits of your actions as well as serve as an important marketing tool. A few online carbon calculators can be found below:
   http://www.terrapass.com/business/email.html
   http://www.climatetrust.org/content/calculators/Business_&_Org_Calculator.pdf

3. Set a goal. Setting a goal will help you determine if your energy savings strategy is having the impact you want it to have and will also help you decide what steps you should take.

4. Implement your project and monitor the results for at least 3 months to a year.

5. Evaluate the success of your project. For example, if you install 30 CFL light bulbs, you will want to monitor the kWh usage on your utility bill for about 3 months, then compare each month to the same month from the previous year. Now ask yourself: How much did I reduce my electricity usage? How much money did I save? Did I meet my goal?

Energy Audit

An energy audit is the first step in assessing how much energy your resort uses. An energy audit will help you establish a baseline of energy usage which will help you evaluate the effectiveness of future energy savings initiatives. An energy audit will also tell you where your resort is most and least efficient. By targeting the least efficient areas first, you will see more dramatic results than by randomly trying to increase efficiency.

Do-It-Yourself Energy Audit

You can find directions on how to do an energy audit yourself at The U.S. Department of Energy, Energy Efficiency and Renewable Energy site: Do-It-Yourself Energy Audit.[i] This site is technically designed for homes, but can easily be adjusted for your resort. The Do-It-Yourself Energy Audit will save you money and provide a rough estimate of where you can make energy improvements, but it will take a considerable amount of time and may not be as detailed as a professional energy audit.

Professional Energy Audit

Professional energy auditors complete a thorough evaluation of your energy usage. When considering a professional energy audit, look for a company that will perform

1. a calibrated blower door test, and
2. a thermographic inspection.

A calibrated blower door test measures the air tightness of your building. By determining the amount of air leakage from the building, you also gain a better understanding of the effectiveness of any air-sealing job. A thermographic inspection uses infrared video and still cameras to measure surface temperatures in your building. This test allows the energy auditor to check the effectiveness of insulation in a building's construction. The results help the inspectors determine whether a building needs insulation and where in the building it should go.[8]

Many utility companies offer free or discounted professional energy audits. As this is often the least expensive professional energy audit option, you should check with your utility company first. Non-profit organizations, such as Minnesota Waste Wise[ii] also offer discounted professional energy audits.

[i] http://www.eere.energy.gov/consumer/your_home/energy_audits/index.cfm/mytopic=11170
[ii] http://www.mnwastewise.org/

Education

Education is an important component of creating a more environmentally friendly resort. First, education will help your resort gain support and cooperation from your staff and clientele. Second, it will increase overall awareness of your resort and help you to build a competitive advantage. Finally, with support from staff and guests you will increase the overall effectiveness of your environmental initiatives. Marketing, on-site education and employee education are some of the ways you can educate people about the steps you are taking.

Marketing

To gain maximum benefit from consumer demands for environmentally friendly products you will want to advertise all of the wonderful things that you are doing at your resort. In this way, marketing is an opportunity for you to educate potential tourists about your environmental initiatives before they even arrive at your resort. Marketing your environmental efforts is one of the most essential ways that you will establish yourself as an environmental leader, create a competitive advantage, and increase your bookings. The following are some ways to market your environmental initiatives:

1. The easiest way to market your environmentally friendly products is probably through your webpage. Consider adding an entire page showcasing your environmental initiatives and link it to your home page so that anyone looking at your resort can easily see the steps you are taking. Adding this information to your webpage may also increase the chance that someone doing a simple search for environmental initiatives will come across your website.

2. If you are a member of a resort association or resort search engine, consider adding a sentence about your environmental initiatives to your paragraph description so that when potential guests are looking for a resort they will immediately recognize yours as an environmentally conscious one.

3. Consider listing your resort in a "green lodging" search engine such as It's A Green Green World[iii] to increase your exposure and connect to consumers interested in environmentally friendly lodging options.

4. Consider marketing to environmental organizations that hold annual conferences or workshops. Environmentally minded organizations will want to stay at a resort that is an example for sustainability and you could potentially increase your clientele.

5. Consider other marketing opportunities as they become available, the most important thing is that you are showcasing the environmental initiatives that you are making.

[iii] http://www.itsagreengreenworld.com/public/worldareas.html?gclid=CNLawvbZnJUCFQGbnAodVnQdaw

On-Site Education

You will want to engage your guests in on-site education. Tell guests about the initiatives you are taking towards sustainability by adding a sign where they check in or by placing a sign or information booklet in their room. This information will help them to better understand the steps you are taking and will help you to gain their support. On-site education is also a great way to off-set potential concerns over guest comfort since they will be more supportive of an initiative if they understand its purpose.

Once your guests understand what you are doing and why, you may invite them to take a role in reducing energy consumption too. This may be the easiest and least expensive way to begin reducing energy consumption. A simple sign such as the ones in Appendix B that ask guests to turn off lights or recycle is a great place to begin engaging your guests. After placing the signs in guest rooms you will want to monitor their effectiveness. For example, if a sign asks guests to turn off the lights, you will want to see if you have a noticeable reduction in energy usage or have the cleaning staff monitor how often lights are on and off when they enter a room.

Employee Education

It is very important that your employees understand the what, where, why and how of your environmental initiatives so that you can count on their cooperation and so that they can explain the resort's environmental initiatives to guests. Getting your employees engaged in environmental initiatives is a good way to gain their support and ensure that they will be working with you to advance the sustainability of your resort. The following are some ways you can educate and engage your employees:

1. Hold a meeting to explain to the staff the initiatives you are taking, why you are taking them, how they will impact your business and the environment and any other relevant information.

2. Some tourism accommodation sites have found success with engaging employees by creating a "green team." The green team is responsible for motivating the staff, coming up with new ideas, implementing new initiatives, etc .

3. Brainstorm with your employees. They may have some great ideas and they'll be happy that their suggestions were considered.

Energy Conservation

The most cost effective way to reduce your environmental impact and your energy bills is to simply use less energy. Although that seems like an easy task, it may be challenging to know where to begin and what strategies will be the most cost effective. As such, the energy conservation strategies presented in this section begin with the least expensive options and continue through to more expensive options. As you begin implementing different energy conservation strategies remember to monitor your energy savings.

Although energy conservation usually requires an initial investment, the long-term savings make it a profitable venture. Furthermore, there are a variety of financial incentives available that minimize the initial investment. For a general listing of energy conservation incentives available in Minnesota see: MN Incentives for Energy Efficiency.[iv]

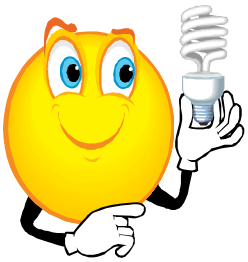
In This Section:

Lighting

Lighting is a great place to start saving energy because it's easy to do and requires a minimal investment. A reduction in lighting costs can result in substantial savings for your resort.

[iv] http://www.dsireusa.org/library/includes/map2.cfm?CurrentPageID=1&State=MN&RE=0&EE=1

Compact Florescent Light bulbs (CFLs)



While the cost-savings and environmental benefits of compact florescent light bulbs (CFLs) have been widely publicized, just over 40% of the Minnesota lodging/camping industry sector has switched their bulbs to CFLs.[9] A couple of the reasons that resorts have not switched to more energy efficient lighting may be the additional upfront cost and disposal uncertainties. Recently there have been many concerns over the mercury contained in CFLs and its negative impacts on the environment. Ironically, CFLs actually help to prevent a greater amount of mercury from being released into our environment. A power plant releases 10 mg of mercury in the air to produce the electricity to power an incandescent light bulb and only 2.4 mg of mercury to run a CFL for the same period of time. Even if you take into account the 4 to 5 mg of mercury contained in a CFL, the net mercury contained in a CFL is less than that released due to an incandescent bulb.[10]

Table 2 provides a cost comparison of CFLs with traditional incandescent light bulbs. **As you can see, the CFL light bulb will save you $44.87 or 79% throughout its lifetime.** This savings does not take into account additional savings from cooling (these bulbs don't get as hot as incandescent bulbs so your air conditioning won't have to work as hard) and maintenance (someone's valuable time can be used for things much more important than changing that incandescent bulb over and over again).

Table 2. Incandescent bulb vs. Compact Fluorescent Light (CFL) bulb[11]

	Incandescent Light	CFL Bulb
Cost of light bulb	$1.25[12]	$2.5[13]
Lifetime of bulb	1000 hours	10,000 hours
Watt	60	13
# of bulbs needed to power light for 10,000 hours	10	1
Capital cost for 10,000 hours of light	$12.50	$2.50
Assuming life of Incandescent Bulb		
Cost of Electricity ($/kWh)	.0742[14]	.0742
x Hours of Operation (hr)	1000	1000
x Watts (kw/1000)	.06	.013
= Cost to power bulb	$4.45	$0.96
+ Capital Cost	$1.25	$2.50
Total cost after 1000 hours	$5.70	$3.46
Assuming life of CFL bulb		
Cost of Electricity ($/kWh)	.0742	.0742
x Hours of Operation (hr)	10,000	10,000
x Watts (kw/1000)	.06	.013
= Cost to power bulb	$44.52	$9.65
+ Capital Cost	$12.50	$2.50
Total cost after 10,000 hours	$57.02	$12.15

Payback Period

The payback period is when future savings equal the capital cost needed to achieve those savings. A simple payback period can be determined by dividing the additional capital cost by the annual savings as in the following formula:

Payback Period = Additional Capital Cost / Annual Savings

For example, let's assume that a light is on for 1000 hours per year – that's about 4 hours per day for 8 ½ months (a typical resort season). Based on our previous calculations, the additional capital cost for a CFL is $1.25 and the yearly savings is $3.49.

Therefore the payback period = $1.25 / $3.49 = .36 of a year *or* about 4 months

Although CFLs may have an additional upfront cost, the payback period is about four months and one bulb can save you more than 75% over its lifetime. You can use the Light Output Equivalency table below to help you replace your incandescent light bulb with an appropriate CFL.

Table 3. Light Output Equivalency

Light Output	Incandescent light bulbs	CFLs
Lumens	Watts	Watts
450	40	9-13
800	60	13-15
1100	75	18-25
1600	100	23-30
2600	150	30-52

Disposal

CFLs do contain a small amount of mercury and must be recycled. In fact, it is illegal to throw anything with mercury into the trash.[15] Luckily, CFLs can last up to ten years (assuming 1000 hours of usage per year), so you won't have to worry about this very often.

The Minnesota Pollution Control Agency website provides information on Minnesota locations that recycle compact fluorescent light bulbs and other hazardous wastes Household Hazardous Waste: Local Collection Programs.[v] CFLs are considered universal waste so you shouldn't have a problem recycling them at these sites; however, you may want to call first to make sure.

Several retail stores host special CFL recycling events or accept CFL's for recycling at anytime. For example, a collaborative effort of MN energy suppliers and Menard's home improvement store offers free recycling of compact fluorescent light bulbs at any of Menard's Minnesota

[v] http://www.pca.state.mn.us/waste/hhw/hhw-localprograms.html

locations. Use the store locator to locate the site closest to you: Menard's Store Locator.[vi] The Home Depot also offers free CFL recycling at all of its Minnesota locations. You can find a Home Depot near you at Home Depot Store Locator[vii]

Tungsten Halogen Lighting

Tungsten halogen lights are a form of incandescent lighting. Tungsten halogen lighting may be a good alternative to CFLs if you do not have any viable recycling options as they do not contain mercury and can be disposed of in the trash. These light bulbs are about 20-30% more efficient than traditional incandescent lighting and last about twice as long. However, their adaptability is somewhat limited as most halogen light bulbs require a special lamp or are designed for floodlights.

Light Emitting Diode Bulb (LED)

LED bulbs are the most efficient and longest lasting light sources available.[16] They are ten times more efficient than CFLs and 40 times more efficient than incandescent bulbs. However, they are expensive, have limited applicability and do not always produce the quality of light we are accustomed to with incandescent or CFL lights. LEDs can be a smart purchase if you are looking to replace an entire fixture as they are commonly built into the fixture. They are also a good purchase for lights that are on 24 hours a day such as exit lights as your payback period will reduce with more usage.

There is a limited selection of LED bulbs that fit into a traditional light fixture. Table 4 provides a comparison of an LED bulb (comparable to a 15 watt CFL bulb), a traditional incandescent bulb and a CFL bulb. **As you can see, the LED bulb will save you $326.34 over an incandescent bulb and $27.10 over a CFL bulb throughout its lifetime.** However, since the LED lasts about 60 years (based on 1000 hours of usage per year), the payback period is almost 9 years when compared to an incandescent bulb and almost 44 years when compared to a CFL bulb. Considering the long payback period, LED bulbs fitted for traditional light fixtures may not yet be a competitive option.

[vi] http://www.menards.com/storeLocator.do
[vii] http://www.homedepot.com/webapp/wcs/stores/servlet/StoreFinderView?langId=-1&storeId=10051&catalogId=10053&URL=http%3A//www6.homedepot.com/ecooptions/

Table 4. LED bulb vs. incandescent and CFL[17]

	Incandescent Light	CFL Bulb	LED
Cost of light bulb	$1.25[18]	$2.5[19]	$39.99[20]
Lifetime of bulb	1000 hours	10,000 hours	60,000 hours
Watt	60	13	1.3
# of bulbs needed to power light for 60,000 hours	60	6	1
Capital cost for 10,000 hours of light	$72.00	$15.00	$39.99
Assuming life of Incandescent Bulb			
Cost of Electricity ($/kWh)	.0742[21]	.0742	.0742
x Hours of Operation (hr)	1000	1000	1000
x Watts (kw/1000)	.06	.013	.0013
= Cost to power bulb	$4.45	$0.96	$0.10
+ Capital Cost	$1.25	$2.50	$39.99
Total cost after 1000 hours	$5.70	$3.46	$40.09
Assuming life of CFL bulb			
Cost of Electricity ($/kWh)	.0742	.0742	.0742
x Hours of Operation (hr)	10,000	10,000	10,000
x Watts (kw/1000)	.06	.013	.0013
= Cost to power bulb	$44.52	$9.65	$0.96
+ Capital Cost	$12.50	$2.50	$39.99
Total cost after 10,000 hours	$57.02	$12.15	$40.95
Assuming life of LED Bulb			
Cost of Electricity ($/kWh)	.0742	.0742	.0742
x Hours of Operation (hr)	60,000	60,000	60,000
x Watts (kw/1000)	.06	.013	.0013
= Cost to power bulb	$267.12	$57.88	$5.79
+ Capital Cost	$75.00	$15.00	$39.99
Total cost after 60,000 hours	$342.12	$72.88	$45.78

Dimmer Switch

Dimmer controls provide variable lighting for incandescent and fluorescent lamps. As you dim these bulbs you reduce the output and wattage, helping to save energy. As an added bonus, many of your customers may find dimmer switches to be an attractive addition to their guest rooms and your resort common areas.

Dimmer controls increase the service life of incandescent lamps. However, dimming incandescent light bulbs reduces their overall efficiency. Dimming does not reduce the efficiency of fluorescent lighting; however, fluorescents require special dimming ballasts, so you must purchase fluorescents designed to be used with dimmers.[22] Dimmable CFL light bulbs are a relatively new technology and not easy to find. Local home improvement and hardware stores should begin regularly carrying them soon; until then there are many options to purchase dimmable CFL light bulbs over the internet. Dimmable CFL light bulbs are more expensive, so the payback period is about 2 years. The estimate is based on using the bulb at full strength so the payback period should be even less if the bulb is frequently dimmed (see Table 5).

Table 5. Incandescent Light Bulb vs. Dimmable Compact Fluorescent (CFL) Bulb Cost[23]

	Incandescent Light Bulb	Dimmable CFL Bulb
Cost of light bulb	$1.25[24]	$7.66
Lifetime of bulb	1000 hours	8000 hours
Watt	60	15
# of bulbs needed to for 8000 hours	8	1
Capital cost for 8000 hours of light	$10.00	$7.66
Assuming life of Incandescent Bulb		
Cost of Electricity ($/kWh)	.0742[25]	.0742
x Hours of Operation (hr)	1000	1000
x Watts (kw/1000)	.06	.015
= Cost to power bulb	$4.45	$1.11
+ Capital Cost	$1.25	$7.66
Total cost after 1000 hours	$5.70	$8.77
Assuming life of CFL bulb		
Cost of Electricity ($/kWh)	.0742	.0742
x Hours of Operation (hr)	8000	8000
x Watts (kw/1000)	.06	.015
= Cost to power bulb	$35.62	$8.90
+ Capital Cost	$10.00	$7.66
Total cost after 10,000 hours	$45.62	$16.56
Payback Period = Additional Capital Cost / Annual Savings = 6.41 / 3.34 = 1.9 years		

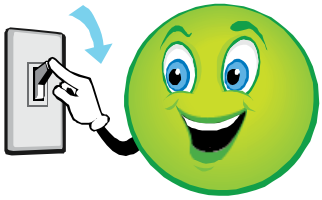
You may find that a dimmer switch is an appropriate addition to a chandelier or other light fixture that does not accommodate CFLs well. You may purchase a dimmer switch for anywhere from $15-$65 depending on the type of switch you choose and install it yourself. If you already have a dimmer switch, you may consider purchasing a dimmable CFL rather than a traditional incandescent bulb.

Occupancy Sensors

Occupancy sensors detect activity in a certain area. They automatically turn lights on when someone enters a room and turn them off when the last occupant leaves the room. Occupancy Sensors are appropriate for areas where lights are often left on when people leave a room such as public bathrooms, closets, supply areas and staff break rooms. You can find occupancy sensors at a home improvement store starting at about $25 (priced June, 2008). You may also consider using a lighting company to purchase and install occupancy sensors.

Do – It – Yourself Tip

Place a small sign by the light switch (such as those in Appendix B) that asks guests to turn the light off as they leave. Monitor the room to see if the sign is achieving your desired results.



Energy Efficient Products

Energy efficient products can be recognized by the Energy Star label. Energy Star is a certification program hosted by the U.S. Environmental Protection Agency and the U.S. Department of Energy. Qualified products are 10-25% more efficient than required by the federal standard and, obviously, this will save you money. These savings may be even greater if you are able to get a rebate for purchasing an Energy Star product. Before buying a new appliance, check the following website: Energy Star Rebate Finder[viii] to see what kinds of rebates you qualify for.

Energy Star Savings Examples:

Example: Refrigerator

Energy Star qualified refrigerators use at least 20% less energy than required by current federal standards.[26]

Table 6. Traditional Appliance vs. Energy Star Appliance[27]

Fridgidaire – 18.2 Cu. Ft Top-Mount	**Standard**	**Energy Star**
Purchase Cost	$399.99[28]	$449.99[29]
Cost to run appliance for one year		
Cost of Electricity ($/kWh)	.0742[30]	.0742
x Energy Consumption	479 kWh/year	383 kWh/year
= Yearly Energy Cost	$35.54	$28.42
Yearly cost savings in electricity = $7.12		
Payback Period = 7 years		
Cost to run appliance for its lifetime		
Cost of Electricity ($/kWh)	.0742	.0742
x Energy Consumption	479 kWh/year	383 kw·h/year
x Average Lifetime of Appliance	14 years[31]	14 years
= Total Energy Cost	$497.56	$397.88
Cost Savings in electricity = $99.68		
Total Cost Savings over lifetime of appliance= $49.68		

As you can see, the Energy Star refrigerator will save you $49.68 or 20% over its lifetime and has a payback period of 7 years. This savings does not take into account increases in electricity costs or possible rebates that you may receive.

[viii] http://www.energystar.gov/index.cfm?fuseaction=rebate.rebate_locator

Example: Air Conditioner

An Energy Star room air conditioner uses at least 10% less energy than a conventional model.[32] Yet the initial investment for a Energy Star Frigidaire 6000 BTU Window Air Conditioner vs. a traditional air conditioner of the same model is just $10 more ($169.99 vs. 159.99).[33] Given that the air conditioner will last about 10 years, the initial investment turns out to be just $1 more per year.[34]

Example: Vending Machine

Energy Star qualified vending machines use 50% less energy than conventional models and can save about 1700 kw·h/year.[35] Considering the average price of electricity in Minnesota, that translates to about $120/year in savings. Energy Star vending machines also come with software which puts the machine in low-energy lighting and refrigeration modes during times of inactivity (i.e. at night) saving a further 20%.[36] You can learn more about saving energy with Energy Star Vending Machines and access a handy savings calculator at: Energy Star Vending Machines.[ix]

Example: Windows

Energy Star qualified windows reduce heating and cooling costs thus saving you money. Energy star windows have an annual savings of about $352 over single-paned windows and $75 over double-paned, clear glass windows.[37] For labeling energy-efficient windows, Energy Star has established minimum energy performance rating criteria by climate. Minnesota is located in the Northern climate zone and so be sure to look for energy star windows that are certified for the Northern climate zone. You can learn more about energy efficient windows at Energy Star - Windows.[x]

[ix] http://www.energystar.gov/index.cfm?c=vending_machines.pr_vending_machines
[x] http://www.energystar.gov/index.cfm?c=windows_doors.pr_windows

Guest Room Management System

A guest room management system controls the lighting, electrical loads, and air conditioning so that they can only be on when a guest is in the room. This may be the ideal solution to resort owners who frequently find that large amounts of energy are wasted when lighting, appliances and air conditioners are left on when the guest is not in the room. Guest Room Management Systems are a significant investment and you may find that this is an appropriate investment if other alternatives are neither appealing nor feasible (such as posting a sign as suggested in the guest education section). Two of the frequently used guest room management systems in 2008 are Entergize and INNCOM.

Entergize

Entergize reduces energy consumption by about 25-45% and the payback period is about 2-3 years. The Entergize Guest Room Management System controls lighting, electrical loads and HVAC (heating, ventilating and air conditioning) systems. The Entergize Master Entry Wall Control Switch (MCS) is the main system control device. As the guest enters the room she inserts her room keycard into the MCS. This triggers a transmitter that sets the entire system to the occupied mode. The guest now has normal control of the room's electrical and HVAC systems. When the guest leaves the room she takes her keycard from the MCS. After a 30 second delay, another transmission is sent setting the System to the unoccupied mode. In this mode the room's HVAC systems operating temperature ranges are set back and the power to the Switches and Plugs is turned off. The MCS works in conjunction with thermostats, wall switches, plugs, PTAC Control Unit, thermostat control unit, and sliding door sensor.

The Entergize system is not preferred with:

- some types of radiant heating due to the longer warm-up period of these heating devices
- Non-keycard entry (unless you also want to invest in a keycard entry system).

You may purchase the Entergize system directly from the company for about $270 per room and install it yourself (Entergize[xi]). Green Business Tech, a Minnesota company, also installs the program for about $400-$600 per room, which includes the price of the system (Green Business Tech[xii]). Installation takes about one hour per room.

Do – It – Yourself Tip

If you don't think a guest room management system is right for your resort, try a less expensive alternative.

Plug all appliances in each room into a single power strip. If a room is unoccupied, you can cut off all of the power to the room by simply unplugging the power strip. Set it up by the door so guests flip just one switch when they enter or exit. Make sure to keep excess cord neatly tied to avoid a potential eyesore or fire hazard. A sign near the switch explaining the environmental benefits provides education and increases guest cooperation.

[xi] http://www.entergize.net/index.php
[xii] http://www.greenbusinesstech.com/

INNCOM

INNCOM uses a computer system to control the heating and cooling of a room based on reservations. The reservations computer tells the INNCOM computer when a guest will be checking in and the system automatically heats or cools the room for the guest just prior to check-in. INNCOM also has occupancy sensors so it can work similar to the Entergize system, but does not require the guest to insert a key card to operate.

The INNCOM system may be appropriate if you are concerned about proper guest room temperature upon arrival and have heating and air conditioning but do not have a keycard system. You may purchase the INNCOM system directly from the company (INNCOM[xiii]) and install it yourself; INNCOM offers on-site training to the facility to ensure the system is installed correctly. Green Business Tech also installs the INNCOM program (Green Business Tech). The cost can range from $300 to $750 per room. Depending on your occupancy rate, location and energy costs, the payback period is about 2-3 years.

Spotlight on The Inn on Lake Superior

The Inn on Lake Superior is located in Duluth, Minnesota. Though The Inn is not a resort, they are taking steps to become more environmentally friendly and are saving money doing it.

Their **biggest payback** was the conversion of incandescent light bulbs to CFLs. The cost to purchase new light bulbs for the entire hotel was $4400, but after submitting a rebate form and receiving a check from MN Power for $3950; their total out-of-pocket expense was just $450.

They are increasing their lighting savings by installing occupancy sensors in public bathrooms and break areas. They are using Leviton[xiv] to install occupancy sensors for just $19.98 each.

They also practice **simple energy saving strategies** like keeping guest room drapes closed in the summer to save on cooling costs and open in the winter to save on heating costs.

They've **involved the staff** through the development of The Green Team and they've involved their customers by soliciting their opinions whenever possible and promoting their green initiatives on their website home page and "green" page. Nikki Anderson, the manager of The Inn on Lake Superior, says it's essential that customers believe your business is implementing "green" practices for their environmental benefits and not simply for your bottom-line.

The Inn on Lake Superior has gained a lot of **publicity for their green efforts** and estimate that they've seen an increase in hotel bookings of at least 5%.You can learn more about the steps the Inn is taking at: http://www.theinnonlakesuperior.com/index.php.

[xiii] http://www.inncom.com/
[xiv] http://www.leviton.com/OA_HTML/ibeCZzpHome.jsp?minisite=10026&respid=22372

Renewable Energy

Renewable energy is generated from natural resources such as sunlight, wind, and geothermal heat. Renewable energy usually has a minimal impact on the environment and reduces our dependence on fossil fuels. Adding renewable energy to your business can improve your image and result in a cost savings. However, before implementing any renewable energy system, you should take all possible steps to make your business more efficient. Energy efficiency is often less expensive than renewable energy and will decrease the size of the renewable energy system that you need.

A general guideline to remember is that spending $1 on improving efficiency will save $3-$5 in renewable energy system costs.[38] For example, a small solar panel can supply enough energy to run a 15 watt CFL, but four solar panels would be needed to power a 60 watt incandescent light.[39]

Installing renewable energy requires investment, but can save you money in energy costs over the course of the systems' lifetime. Financial incentives are available from the federal government and the state of Minnesota that decrease your initial investment. For a general listing of renewable energy incentives see: http://www.dsireusa.org/.

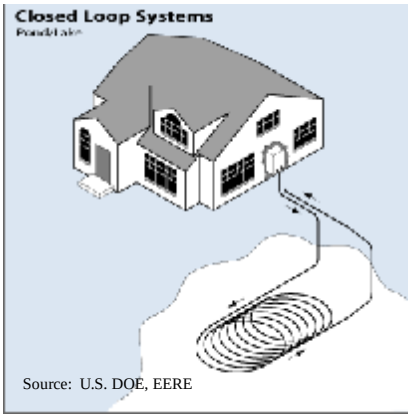
In This Section:

Geothermal Power

Geothermal power is energy generated by heat stored beneath the Earth's surface. With geothermal power, the heat from beneath the surface is usually transferred to the surface for use in heating buildings, although in some applications the heat is converted to electricity. Although geothermal power is considered renewable energy, large-scale, long-term exploitation can deplete or diminish its energy-producing potential.[40]

Geothermal Heat Pump (GHP)

A geothermal heat pump (GHP), also known as a ground-source heat pump (GSHP) is the most commercially accepted form of geothermal power used on a small scale basis. A GHP works by pumping cool air from the earth's interior to a building to provide air conditioning in the summer and pumping warm air from the earth's interior to a building in the winter to provide heat. A GHP works because the Earth's interior temperature remains relatively constant during most of the year.[41] Hotels in North America report energy savings of 40%-70% in the winter and 30-60% in the summer.[42] The payback period for a GHP ranges from 5 to 10 years and the system itself lasts 25-50 years.[43]



The 4 Things You Must Know about GHPs:

1. There are 4 types of GHPs. Three of these, horizontal, vertical and pond/lake, are closed-loop systems and the remaining is an open-loop system.
   1.1. In horizontal systems, pipes are laid out in horizontal trenches four to six feet deep. Installation costs are lower than the vertical system but are not as efficient. Even with the lower efficiency, a horizontal system is usually the most cost-effective option where sufficient land is available.[44]
   1.2. In a vertical system, pipes are inserted vertically into the ground 100-400 feet deep. This system is more efficient than the horizontal system because the deeper earth stays at a more constant temperature. This system is used where soil is not appropriate for trenching or there is limited available space for trenches.[45]
   1.3. In a pond/lake system, a supply line pipe is run underground from the building to the water. For buildings located near a body of water this may be the lowest cost option. As most resorts are located next to a lake, this system is worth looking into.[46]
   1.4. In an open-loop system, well or surface body water is used as the heat exchange fluid. Once the water has circulated through the system, it is returned to the ground via a well, recharge well or surface discharge.[47] This system is best when your facility is served by its own water well.
2. GHPs require electricity to run. However, they use 25-50% less electricity than a conventional electric HVAC system.
3. A desuperheater supplements a GHP. Rather than inserting the waste heat from summer air-conditioning back into the ground, the desuperheater uses it to heat water, essentially providing free hot-water heating during air-conditioning periods and improving the overall efficiency of the system.
4. GHP systems are not do-it-yourself projects. They require the tools, equipment and expertise of properly trained contractors.

Installing a GHP at your resort may be feasible if:

1. Your property has adequate geothermal resources.
   Almost everywhere in the U.S. has been found to be suitable for a GHP.
2. You have adequate space and soil for a GHP system.
   You can find adequate space and soil conditions in most places for a GHP system; however, your space and soil conditions will impact the type of GHP system appropriate for your resort. For example, soil with poor heat transfer properties requires more piping than soil with good heat transfer properties.
3. Your building requires both summer air conditioning and winter heating.
   Although it may be possible to install a system without both of these needs, it will probably not warrant the additional capital cost.

Consider a cost comparison of a gas furnace air-source AC to a standard efficiency GHP model and a highly efficient GHP (Table 7). A GHP saves 25-50% in yearly energy costs. Individual installation costs vary significantly and therefore are not estimated in the table. However, many studies have found the payback period to be 10 years or less.[48] To gain a more accurate estimate for your resort, you will need to get an installation cost estimate.

Table 7. Geothermal Heat Pump (GHP) cost comparison[49]

25,000 sq. foot Building			
Performance	Gas Furnace Air-source AC	Recommended Level GHP	Best Available GHP
Heating / Cooling Efficiency	11.0 *EER / 90% AFUE**	14.1 EER/ 3.3 COP***	25.8 EER / 4.9 COP
Annual Cooling Energy Use	37,700 kWh	30,700 kWh	20,400 kWh
Annual Heating Energy Use	1970 therms	12,600 kWh	10,900 kWh
Annual Energy Cost[xv]	$4468	$3213	$2322

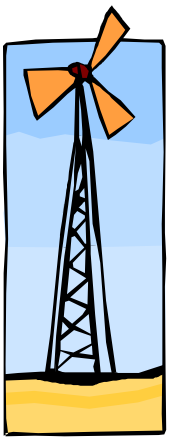
* Energy Efficiency Ratio
** Annual Fuel Utilization Efficiency
*** Coefficient of Performance

There are a variety of additional sources that provide information on GHPs that you should explore prior to installation. Some of the most useful include

1. The U.S. Department of Energy, Energy Efficiency and Renewable Energy Geothermal Heat Pumps[xvi] site provides information on various types of GHPs.
2. Rafferty, Kevin (2001). *An Information Survival Kit For the Prospective Geothermal Heat Pump Owner*. Access at: http://geoheat.oit.edu/ghp/ghptable.htm
3. International Ground Source Heat Pump Association, http://www.igshpa.okstate.edu/index.htm. This sight provides basic information on GHPs and where to find licensed contractors.

[xv] Annual Energy Cost based on $0.848/therm (EIA average) and $0.0742/kWh.
[xvi] http://www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12640

Wind Power



Wind Power has become a mainstream, cost-effective electricity generation option. In 2007, the wind energy industry increased its production by 5200 megawatts; enough to power 1.5 million homes.[50] This increase in wind energy production has made wind energy easier to acquire and more socially acceptable than before.

You can use wind to power your resort by purchasing wind power from your utility provider or by installing your own wind turbine. Each has it advantages and disadvantages for your business (Table 8).

Purchase Wind Energy

Many energy providers offer the option to purchase an allocated amount of energy exclusively from wind power. The various wind programs work by selling a block of energy, usually 100kWh, for a fee of about $.60 to $2.50 per 100kWh. You may purchase as many blocks of energy as you desire, up to your monthly usage. Purchasing wind power allows you to gain marketing benefits from running your resort on renewable energy without the drawbacks of owning your own system. However your marketing power may not be as strong as if the wind power was actually on your site.

To buy wind energy, check your local utility provider's website.

Table 8. Purchase vs. Install Wind Power Advantages and Disadvantages

	Purchase Wind Energy from Utility	Install Wind Turbine at Resort
Advantages	- Does not require initial investment - Wind Power will not cause a negative aesthetic or noise problem - Can purchase exactly the amount of wind power needed to power your resort in both the winter and summer months	- Will save money over the course of the turbine's life - Provides positive marketing opportunity as some guests will see the wind turbine as a measure of your environmental commitment - May provide more energy security in areas where electric utility company is unreliable
Disadvantages	- Additional, though minimal, cost to electric bill - Do not benefit from marketing advantages of turbine on your site - Do not benefit from net metering opportunities or to sell excess electricity generated	- Substantial Initial Investment - Some guests may find wind turbine to be aesthetically displeasing or the noise to be distracting - Only produces energy when wind is blowing (In Minnesota, wind blows more in winter than summer while most resorts are closed for the winter)

Install Wind Turbine

If you are considering adding a wind turbine to your property, the following information will help you understand the process better and make a more informed decision.

1. Wind is the single most important attribute of a successful wind energy system. Power in the wind is a cubic function of wind speed; therefore, a doubling of wind speed increases the power of the wind turbine by eight times.
2. Swept Area is the area of the wind that is swept by a wind turbine rotor. The swept area is the area of a circle: $A = \pi R^2$, where R = the rotor's radius. Relatively small increases in blade length produce a correspondingly large increase in swept area and, thus, in power.[51] Often times the swept area is a more important indicator of energy production than the rated power of the wind turbine.
3. Wind speeds increase with height; therefore, the taller your tower, the faster the wind speed and the greater your power. Doubling tower height increases wind speed by about 10%. Tower height also minimizes obstructions. A wind turbine should be installed with the bottom of the rotor blades at least 30 feet above any obstacles within 300 feet of the tower.[52]
4. You can use the following formula to obtain a preliminary estimate of wind turbine performance:

   $AEO = 0.01328 \times D^2 \times V^3$

   Where,

   AEO = Annual energy output, kWh/year

   D = Rotor diameter, feet

   V = Annual average wind speed, mph

When to consider installing wind power at your resort:

1. You have one acre or more of property,[53]
2. Your area has an average wind speed of at least 10 mph.
   Minnesota wind speeds can be found in Appendix C. It is usually not economical to measure the wind speed in your area if you are installing a small wind turbine (10kw or less) as the cost to measure the wind is quite expensive. However, a larger wind turbine (more than 10 kw) investment warrants the extra time and costs of measuring the wind on your property for about a year.[54]
3. Utility-supplied electricity is at least $0.11/kwh.
   As the average price of electricity in Minnesota is $0.0742/kwh the payback period for a wind turbine will be considerably longer than if electricity were $0.11/kwh or more and as such may not be the most feasible option for your business.[55]
4. There are good incentives for the sale of excess electricity or for the purchase of wind turbines. Find incentives at www.desireusa.org.
   4.1. Minnesota statute 216B.164, Cogeneration and Small Power Production requires all electric utilities in Minnesota to offer net metering for facilities with a capacity of less than 40 kilowatts. Net metering allows customers to only pay for their "net" electricity (i.e. the power consumed from the electricity company minus the power generated by their wind turbine).
   4.2. Minnesota offers sales and property tax exemptions for wind power

4.3. The federal government offers a corporate tax credit of 2.0¢/kWh for wind energy for ten years
4.4. The Business energy tax credit offered by the federal government provides businesses with a 10% tax credit and 5-year accelerated depreciation for the cost of equipment used to generate electricity.

Table 9 provides a cost comparison of two small wind turbines based on class 2 and class 3 winds. The comparison illustrates that wind power in Minnesota has a lengthy payback period but is recoverable, especially so at higher wind speeds. You may find a specific spreadsheet that will enable you to determine a more accurate payback period for your wind project at http://www.bergey.com/, selecting "technical stuff" on the right-hand menu and scrolling to "cash flow model". Calculations for Table 9 can be found in Appendix D.

Table 9. Wind Turbine Cost Comparison by wind speed class[56]

		BWC XL.1	**BWC XL.1**	**BWC Excel**	**BWC Excel**
Wind speed		12.5 mph (class 2 @ 164 ft)	14.3 mph (class 2 @ 164 ft)	12.5 mph (class 2 @ 164 ft)	14.3 mph (class 2 @ 164 ft)
Cost of Wind Turbine[xvii]		$6000[57]		$55,000[58]	
Approximate Lifetime		20-30 years		30-50 years	
Power		1000 Watt		10 kW	
Rotor Diameter		8.2 feet		22 feet	
Swept Area		52.8 sq. feet		380.1 sq. feet	
Annual Energy Output (AEO)		1744 kWh/year	2611 kWh/year	12554 kWh/year	18795 kWh/year
Payback Period		26 years	20 years	29 years	23 years
Average Monthly Savings on Energy Bill	Year 1	$11	$16	$78	$116
	Year 10	$18	$26	$126	$189
	Year 20	$29	$43	$206	$308
	Year 30	$47	$70	$335	$502

[xvii] Includes the cost of the turbine, tower, wiring and all necessary parts

Installing a wind turbine on your property is a large investment that will require additional research. There are a variety of additional sources that provide information on wind power that you should explore prior to installation. Some of the most useful include:

1. Small Wind Electric Systems, U.S. Department of Energy, Energy Efficiency and Renewable Energy. Found at Small Wind Electric Systems: A Minnesota Consumer's Guide.[xviii] You should read this if you are considering installing wind power at your resort.
2. Wind Power by Paul Gipe. This book is quite lengthy, but provides all of the information you need to understand and install wind power at your facility. This book also provides information on purchasing used wind turbine equipment which may result in lower costs. You should read this if you plan to install wind power at your resort.
3. The American Wind Energy Association: www.awea.org. This website provides a variety of wind power information, as well as recommendations for reliable installers.

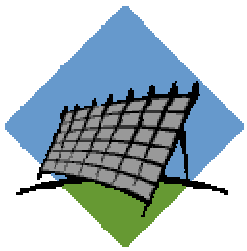
Do – It – Yourself Tip

You can find directions to make a 7-foot diameter wind turbine capable of producing 300-400 watts out of a brake-drum at http://www.scoraigwind.com/. This plan is for experienced shop workers only.

You may also consider purchasing a wind turbine kit. With a wind turbine kit, you are not so much building the turbine as you are providing final assembly and installation. However, since assembly and installation accounts for 25-35% of the costs, a wind kit can result in substantial savings. This is not normally available for wind turbines greater than 16 feet in diameter.

[xviii] http://www.eere.energy.gov/windandhydro/windpoweringamerica/filter_detail.asp?itemid=314

Solar Power



Solar power harnesses the energy of the sun to produce usable forms of energy. Solar power can be converted directly into electricity or can be used to provide heat for hot water. Solar thermal energy uses a collector panel to absorb heat which in turn produces hot water. A solar electric system uses sunlight to generate an electric current which in turn is used to power a building.[59] Both forms of solar power are increasing in popularity and decreasing in cost.

The 3 Things You Must Know about Solar Energy:

1. Access to the sun is the single most important attribute of an efficient solar system. Obstacles such as trees, houses, utility poles and future potential obstacles need to be considered. Shadows at any time dramatically reduce the performance of solar electric systems and must be avoided.[60]
2. The best location for a solar electric system is facing south; however systems that face east or west can also sometimes be acceptable. A system that automatically follows the sun is more expensive but is the most efficient.
3. A 1 kW system will provide about 1000 kWh of energy annually.[61]

When to consider installing solar power at your resort:

1. Your property has good solar resources.
   Minnesota has a good source of solar radiation, comparable to Houston, Texas or Miami, Florida. Minnesota's average solar radiation can be found at: Average Minnesota Solar Radiation.[xix] Solar power is produced with greatest efficiency during summer months, ideal for resorts only open in the summer or with summer high seasons.
2. You have adequate roof, wall or yard space.
   One watt requires about one square foot of space. A 1 kW watt system will require 80-300 square feet of space depending on the system.[62]
3. Utility-supplied electricity is at least $0.11/kwh.
   As the average price of electricity in Minnesota is $0.0742/kwh the payback period for solar power will be considerably longer than if electricity were $0.11/kwh or more and as such may not be the most feasible option for your business.[63]
4. There are good incentives for the sale of excess electricity or for the purchase of solar power. Find incentives at www.desireusa.org.
   4.1. Minnesota statute 216B.164, Cogeneration and Small Power Production requires all electric utilities in Minnesota to offer net metering for facilities with a capacity of less than 40 kilowatts. Net metering allows customers to only pay for their "net" electricity (i.e. the power consumed from the electricity company minus the power generated by their wind turbine).
   4.2. Minnesota offers sales and property tax exemptions for solar power
   4.3. Minnesota offers a solar electric rebate of $2 – $2.25 per watt for solar electric systems installed by NABCEP (North American Board of Certified Energy Practitioners)

[xix] http://www.state.mn.us/mn/externalDocs/Commerce/MN_Solar_Map_110802025502_solarmap5.pdf

certified PV installers and other licensed contractors which makes the systems slightly more affordable. For more information see: Minnesota Solar Electric Rebate Program[xx]

4.4. The business energy tax credit offered by the federal government provides businesses with a 10% tax credit and 5-year accelerated depreciation for the cost of equipment used to generate electricity.

Installing solar power on your property is a large investment that will require additional research. There are a variety of additional sources that provide information on solar power that you should explore prior to installation. Some of the most useful include:

1. The Minnesota Department of Commerce Energy Info Center: Solar Power.[xxi] This site includes various booklets and information sources on implementing solar energy in Minnesota.
2. The U.S. Department of Energy, Energy Efficiency and Renewable Energy Consumer Site,[xxii] provides information on solar power as well as other tips for energy efficiency and renewable energy.
3. The American Solar Energy Society's Go Solar[xxiii] page provides a variety of resources for those interested in pursuing solar energy. It's "What does Solar Cost" link provides a calculator that will tell you the cost, savings and payback of a solar energy system.

Solar power can be utilized in a variety of applications. Two of the most common applications, solar hot water heaters and solar electricity, are presented below.

Solar Hot Water

As water heating in the average hospitality business accounts for 12% of total energy costs, solar hot water can result in substantial savings.[64] Most often solar water heaters are designed as household size heaters which are ideal for resort cabins and can be added slowly to the most used cabins. A solar hot water heater would be most efficient on winterized cabins so the solar power can be utilized throughout the year.

Do – It – Yourself Tip

You can find a solar hot water system for about $2000 that can easily be installed with 2 people in about one day. Check out http://www.hot2o.com/ for more information.

As with any renewable energy, conservation will be cheaper and decrease the size of the solar hot water heater needed. Begin by:

1. decreasing your water consumption by installing flow restrictors on shower heads and faucets,
2. insulating your current water heater and hot-water pipes and
3. lowering the thermostat on your water heater to 120ºF.[65]

[xx] http://www.state.mn.us/mn/externalDocs/Commerce/Solar_Electric_Rebate_Program_110802025911_RebateInstructions.pdf

[xxi] http://www.state.mn.us/portal/mn/jsp/content.do?subchannel=-536881511&programid=536885396&id=-536881350&agency=Commerce&sp2=y

[xxii] http://www.eere.energy.gov/consumer/

[xxiii] http://www.ases.org/index.php?option=com_content&view=article&id=162&Itemid=7

Once you've implemented water conservation strategies, you can think about purchasing the right solar hot water heater. There are a variety of solar hot water heaters available and you may find Solar Water Heating[xxiv] a valuable guide in determining the right one for you.

Table 10 provides a comparison of different hot water heaters. Solar hot water heaters cost the least to run over the course of their lifetime; however, the initial investment is significantly higher. Accordingly, the payback period ranges from 7 – 56 years depending on your current system. A solar hot water heater is an excellent alternative to electric tanks but may not be economical compared to gas tanks or tankless heaters.

Table 10. Water Heater Comparison[66]

	Conventional 40 gal. natural gas tank (therms)	Conventional 40 gal. electric tank (kWh)	Tankless natural gas (therms)	Solar Hot Water Heater
Cost	$269 - $370	$184 – 270	$600-$650	$2500-$4000
Estimated Annual use	131- 138	5107 – 5347	110	n/a
Estimated Annual Energy Cost	$111 - $118	$373 - $390	$94	$34
Expected Product Lifetime	6-12 years	6-12 years	20-30 years	15-40 years
Estimated Lifetime Energy Cost	$3341 – $3534	$11,184 – $11,709	$2827	$1020
Payback period of Solar Hot Water Heater	29-43 years	7-10 years	32-56 years	n/a

Solar Electricity

Solar electric systems, also known as photovoltaic (PV) systems, convert sunlight into electricity. Solar electricity is a good option for Minnesota resorts as the energy is produced when it is needed most and, as of 2008, good incentives are available.

Consider an estimated cost comparison of two different sized solar electric systems (Table 11). The initial investment of a larger system is more but the cost per watt is less. As is illustrated, solar power in Minnesota is significantly less expensive when state and federal incentives are applied. The payback period is somewhat lengthy but is recoverable. You may find a spreadsheet that will enable you to determine a more accurate cost and payback period for your solar project at My Solar Estimator.[xxv] A spreadsheet for Table 8 can be found in Appendix E.

Do – It – Yourself Tip

Solar outdoor lighting is an easy and inexpensive way to add solar power to your resort. You may purchase a variety of lights that have built in solar power at your local home improvement store or online. Lamps cost about $25.00 per lamp, or sets start at about $50.00 for six.

[xxiv] http://www.state.mn.us/mn/externalDocs/Commerce/Solar_Water_Heating_121702033404_solarhotwater.pdf
[xxv] http://www.findsolar.com/index.php?page=rightforme

Table 11. Solar Electric Cost Comparison[67]

	2 kW	10 kW
Cost per Watt	$10	$9
Cost for Installation	$20,000	$90,000
Net Cost after MN rebate & federal tax credit	$10,760	$46,800
Average Annual Utility Savings	$279	$1584
Payback Period	23 years	18 years
Payback Period including property appreciation	17 years	12 years
Approximate Lifetime	20 years	20 years

Spotlight on Inn Serendipity

The Inn Serendipity is a Bed & Breakfast located in Southern Wisconsin. Although not a resort, their renewable energy initiatives are a great example for all those in the tourism industry.

Inn Serendipity seeks to be "fossil fuel free" through conservation and renewable energy. The Inn Serendipity has added several renewable energy projects incrementally as their budget has allowed. They now utilize a 10 kW Bergey Wind Turbine, a 680-watt photovoltaic (PV) system, a thermal system for domestic hot water and active solar heated straw bale greenhouse. They now produce more energy per year than they use. By selling their excess energy back to the utility company they are able to decrease their payback period. However, Lisa Kivirist, one of the owners of Inn Serendipity, emphasizes that "There's no point doing this if your own operation isn't as energy efficient as possible."

Inn Serendipity chose not to do the installation for their renewable energy systems themselves but was able to save on installation costs by hosting an educational workshop through the Midwest Renewable Energy Association (MREA). They provided the materials while the MREA experts supervised the installation of their system. Programs like this are available as long as you have patience, as the workshops are planned far in advance.

The Inn Serendipity has noticed a marked increase in conscious consumers who seek out their bed & breakfast specifically for its sustainable initiatives. You can find "The Good Life Guide" with detailed information on renewable energy at the Inn Serendipity as well as learn more about other sustainable initiatives taken at Inn Serendipity at http://www.innserendipity.com/.

Appendix A

Monitoring Chart

		Electric Usage (kWh)	Gas Usage (therms)	Occupancy Rate	Website Hits
2008	January				
	February				
	March				
	April				
	May				
	June				
	July				
	August				
	September				
	October				
	November				
	December				
	Total				
2009	January				
	February				
	March				
	April				
	May				
	June				
	July				
	August				
	September				
	October				
	November				
	December				
	Total				

Appendix B

Guest Involvement Sign Examples

Minnesota Resort recognizes that our natural resources are precious and in limited supply. We are trying to do our part to reduce our impact on the environment by minimizing energy consumption. You can help us by turning your lights, TV and air conditioning off when you leave the room. Mother Nature thanks you!

Help save energy!

If you choose to open the windows for fresh air, please MAKE SURE THE AIR CONDITIONER IS OFF

. . . Mother earth thanks you

(This A/C unit is meant to cool off this bedroom only. If it is hot and humid outside, when you first turn this unit on, put the temperature at Medium and close the bedroom door to de-humidify the room. After 30 minutes or so, turn it to High. Otherwise you will get lots of condensation dripping into your room – ick! – and it may just frost over, whereupon you'll have to thaw it out before trying to cool down your room again. Just a tip.)

Adapted from Crow Wing Crest Lodge

Please help us help the environment!

In an effort to do our part to help the environment, Northern Lights Resort has made the following improvements to the resort:

- Changed to compact fluorescent light bulbs (we are in the process of changing over our bulbs)
- Changed to natural cleaning products
- Low flow shower heads
- Water saver toilets

Please help by:

- Turning off lights, TV's & Radios when you are not in the cabins
- Recycling plastic, glass, tin & aluminum in the containers provided for you in your cabin

Courtesy of Northern Lights Youth Quest & Outfitting

Appendix C

Wind Energy Speeds

This wind map shows Minnesota's various wind power classes based on the average yearly wind speed. A wind power class represents a range of wind speed. For example, as can be seen in Table 12, if your resort is located in a Wind Power Class of 2, your average wind speed ranges between 9.8 mph and 11.5 mph at 33 feet and between 12.5 and 14.3 mph at 164 feet. You can also approximate your wind speed at Minnesota Wind Speed Map or at Average Wind Speed.

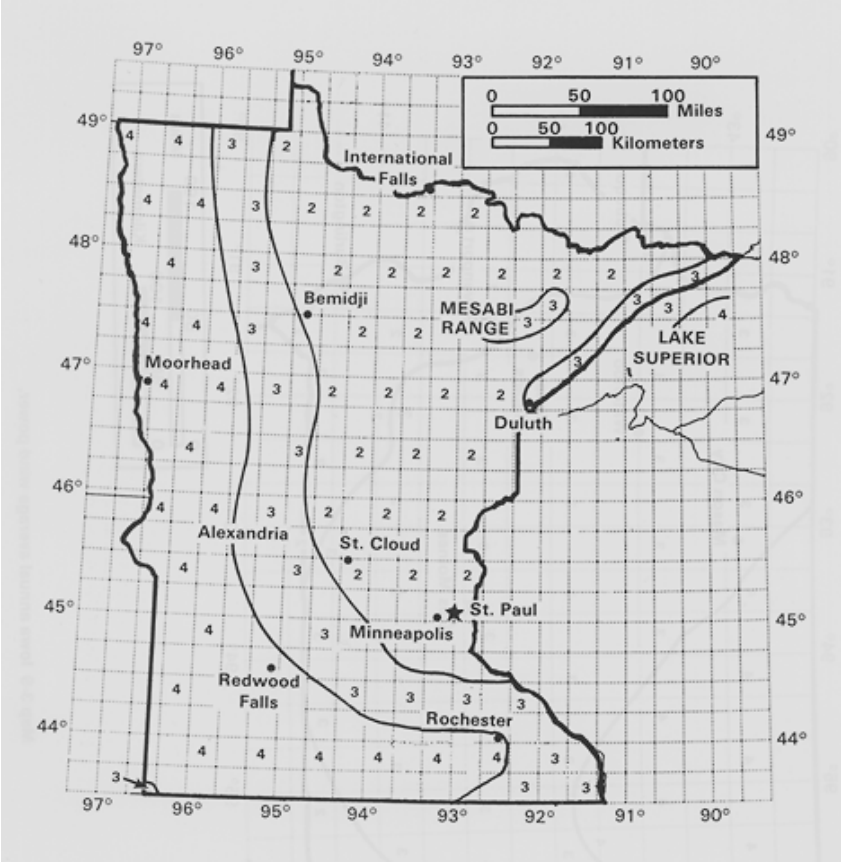


Table 12. Wind Power Class

Wind Power Class*	Wind Speed at 10 m (33 ft)		Wind Speed at 50 m (164 ft)	
	Wind Power Density (W/m^2)	Speed m/s (mph)	Wind Power Density (W/m^2)	Speed m/s (mph)
1	0	0	0	0
	100	4.4 (9.8)	200	5.6 (12.5)
2				
	150	5.1 (11.5)	300	6.4 (14.3)
3				
	200	5.6 (12.5)	400	7.0 (15.7)
4				
	250	6.0 (13.4)	500	7.5 (16.8)
5				
	300	6.4 (14.3)	600	8.0 (17.9)
6				
	400	7.0 (15.7)	800	8.8 (19.7)
7				
	1000	9.4 (21.1)	2000	11.9 (26.6)

Note: The Wind Power Class column is offset from the other columns to represent that each wind power class represents a range of average wind power density and speed.

Source: National Renewable Energy Laboratory, http://www.nrel.gov/

Appendix D

Wind Turbine Financial Considerations

BWC 10 kW GridTek System Cash Flow (Class 2Winds)

Assumptions (Inputs)

Total Installed Cost ($):	**$6,000**
Allocation to Business (%):	**0**
Annual Energy Output (kWh):	**1,744**
Electricity Cost ($/kWh):	**$0.0742**
Electricity Inflation Rate (%):	**5**
Loan Downpayment (%):	**100**
Down Payment ($):	**$6,000**
Amount of Loan ($):	**$0**
Interest Rate (%):	**10**
Loan Term (Years):	**8**
Month Installed:	**0**
Net Federal Tax Rate (%):	**35**
Net State Tax Rate (%):	**0**
O & M Cost ($/kWh):	**$0.005**
O & M Inflation Rate (%):	**3**
State Rebate (%):	**0**
State Tax Credit (%):	**0**
Federal Tax Credit (%):	**0**

Results

Loan Payments

Monthly Payment ($):	**$0**
Value of Interest Deduction ($):	**$0**
Net Monthly Payment ($):	**$0**

Ave. Monthly Savings on Bill

Year 1 ($):	**$11**
Year 10 ($):	**$18**
Year 20 ($):	**$29**
Year 30 ($):	**$47**

Internal Rate of Retrurn

Years 1 - 30:	**1.7%**

Conservative assumption of no scrap value.

Spreadsheet courtesy of Bergey Windpower

Annual Cash Flow Model

Year	Net Energy	O&M Costs	Net Deprec.	Net Loan Payments	Annual Cash Flow	Total Cash Flow
0					($6,000)	($6,000)
1	$129	$0	$0	$0	$129	($5,871)
2	$136	$0	$0	$0	$136	($5,735)
3	$143	$0	$0	$0	$143	($5,592)
4	$150	$0	$0	$0	$150	($5,442)
5	$157	$0	$0	$0	$157	($5,285)
6	$165	($10)	$0	$0	$155	($5,130)
7	$173	($10)	$0	$0	$163	($4,967)
8	$182	($11)	$0	$0	$171	($4,796)
9	$191	($11)	$0	$0	$180	($4,615)
10	$201	($11)	$0	$0	$189	($4,426)
11	$211	($12)	$0	$0	$199	($4,227)
12	$221	($12)	$0	$0	$209	($4,018)
13	$232	($12)	$0	$0	$220	($3,798)
14	$244	($13)	$0	$0	$231	($3,567)
15	$256	($13)	$0	$0	$243	($3,324)
16	$269	($14)	$0	$0	$255	($3,068)
17	$282	($14)	$0	$0	$268	($2,800)
18	$297	($14)	$0	$0	$282	($2,517)
19	$311	($15)	$0	$0	$297	($2,221)
20	$327	($15)	$0	$0	$312	($1,909)
21	$343	($16)	$0	$0	$328	($1,582)
22	$361	($16)	$0	$0	$344	($1,237)
23	$379	($17)	$0	$0	$362	($875)
24	$397	($17)	$0	$0	$380	($495)
25	$417	($18)	$0	$0	$400	($96)
26	$438	($18)	$0	$0	$420	$324
27	$460	($19)	$0	$0	$441	$766
28	$483	($19)	$0	$0	$464	$1,230
29	$507	($20)	$0	$0	$487	$1,717
30	$533	($21)	$0	$0	$512	$2,229
31	$559	($21)	$0	$0	$538	$2,767
32	$587	($22)	$0	$0	$565	$3,333
33	$617	($22)	$0	$0	$594	$3,927
34	$647	($23)	$0	$0	$624	$4,551
35	$680	($24)	$0	$0	$656	$5,207
36	$714	($25)	$0	$0	$689	$5,896
37	$749	($25)	$0	$0	$724	$6,620
38	$787	($26)	$0	$0	$761	$7,381
39	$826	($27)	$0	$0	$799	$8,181
40	$868	($28)	$0	$0	$840	$9,021

BWC 10 kW GridTek System Cash Flow (Class 3 Winds)

Assumptions (Inputs)

Total Installed Cost ($):	**$6,000**
Allocation to Business (%):	**0**
Annual Energy Output (kWh):	**2,611**
Electricity Cost ($/kWh):	**$0.074**
Electricity Inflation Rate (%):	**5**
Loan Downpayment (%):	**100**
Down Payment ($):	**$6,000**
Amount of Loan ($):	**$0**
Interest Rate (%):	**10**
Loan Term (Years):	**8**
Month Installed:	**0**
Net Federal Tax Rate (%):	**35**
Net State Tax Rate (%):	**0**
O & M Cost ($/kWh):	**$0.005**
O & M Inflation Rate (%):	**3**
State Rebate (%):	**0**
State Tax Credit (%):	**0**
Federal Tax Credit (%):	**0**

Results

Loan Payments

Monthly Payment ($):	**$0**
Value of Interest Deduction ($):	**$0**
Net Monthly Payment ($):	**$0**

Ave. Monthly Savings on Bill

Year 1 ($):	**$16**
Year 10 ($):	**$26**
Year 20 ($):	**$43**
Year 30 ($):	**$70**

Internal Rate of Retrurn

Years 1 - 30:	**4.2%**

Conservative assumption of no scrap value.

Spreadsheet courtesy of Bergey Windpower

Annual Cash Flow Model

Year	Net Energy	O&M Costs	Net Deprec.	Net Loan Payments	Annual Cash Flow	Total Cash Flow
0					($6,000)	($6,000)
1	$194	$0	$0	$0	$194	($5,806)
2	$203	$0	$0	$0	$203	($5,603)
3	$214	$0	$0	$0	$214	($5,389)
4	$224	$0	$0	$0	$224	($5,165)
5	$235	$0	$0	$0	$235	($4,929)
6	$247	($15)	$0	$0	$232	($4,697)
7	$260	($16)	$0	$0	$244	($4,453)
8	$273	($16)	$0	$0	$257	($4,197)
9	$286	($17)	$0	$0	$270	($3,927)
10	$301	($17)	$0	$0	$284	($3,644)
11	$316	($18)	$0	$0	$298	($3,346)
12	$331	($18)	$0	$0	$313	($3,032)
13	$348	($19)	$0	$0	$329	($2,703)
14	$365	($19)	$0	$0	$346	($2,357)
15	$384	($20)	$0	$0	$364	($1,993)
16	$403	($20)	$0	$0	$382	($1,611)
17	$423	($21)	$0	$0	$402	($1,209)
18	$444	($22)	$0	$0	$422	($786)
19	$466	($22)	$0	$0	$444	($342)
20	$490	($23)	$0	$0	$467	$125
21	$514	($24)	$0	$0	$490	$615
22	$540	($24)	$0	$0	$515	$1,131
23	$567	($25)	$0	$0	$542	$1,672
24	$595	($26)	$0	$0	$569	$2,242
25	$625	($27)	$0	$0	$598	$2,840
26	$656	($27)	$0	$0	$629	$3,469
27	$689	($28)	$0	$0	$661	$4,129
28	$723	($29)	$0	$0	$694	$4,824
29	$759	($30)	$0	$0	$730	$5,553
30	$797	($31)	$0	$0	$767	$6,320
31	$837	($32)	$0	$0	$806	$7,125
32	$879	($33)	$0	$0	$847	$7,972
33	$923	($34)	$0	$0	$890	$8,862
34	$969	($35)	$0	$0	$935	$9,796
35	$1,018	($36)	$0	$0	$982	$10,778
36	$1,069	($37)	$0	$0	$1,032	$11,810
37	$1,122	($38)	$0	$0	$1,084	$12,894
38	$1,178	($39)	$0	$0	$1,139	$14,034
39	$1,237	($40)	$0	$0	$1,197	$15,231
40	$1,299	($41)	$0	$0	$1,258	$16,488

BWC Excel System Cash Flow (Class 2 Winds)

Assumptions (Inputs)

Total Installed Cost ($):	**$55,000**
Allocation to Business (%):	**0**
Annual Energy Output (kWh):	**12,554**
Electricity Cost ($/kWh):	**$0.0742**
Electricity Inflation Rate (%):	**5**
Loan Downpayment (%):	**100**
Down Payment ($):	**$55,000**
Amount of Loan ($):	**$0**
Interest Rate (%):	**10**
Loan Term (Years):	**8**
Month Installed:	**0**
Net Federal Tax Rate (%):	**35**
Net State Tax Rate (%):	**0**
O & M Cost ($/kWh):	**$0.005**
O & M Inflation Rate (%):	**3**
State Rebate (%):	**0**
State Tax Credit (%):	**0**
Federal Tax Credit (%):	**0**

Results

Loan Payments

Monthly Payment ($):	**$0**
Value of Interest Deduction ($):	**$0**
Net Monthly Payment ($):	**$0**

Ave. Monthly Savings on Bill

Year 1 ($):	**$78**
Year 10 ($):	**$126**
Year 20 ($):	**$206**
Year 30 ($):	**$335**

Internal Rate of Retrurn

Years 1 - 30:	**0.4%**

Conservative assumption of no scrap value.

Spreadsheet courtesy of Bergey Windpower

Annual Cash Flow Model

Year	Net Energy	O&M Costs	Net Deprec.	Net Loan Payments	Annual Cash Flow	Total Cash Flow
0					($55,000)	($55,000)
1	$932	$0	$0	$0	$932	($54,068)
2	$978	$0	$0	$0	$978	($53,090)
3	$1,027	$0	$0	$0	$1,027	($52,063)
4	$1,078	$0	$0	$0	$1,078	($50,985)
5	$1,132	$0	$0	$0	$1,132	($49,853)
6	$1,189	($73)	$0	$0	$1,116	($48,737)
7	$1,248	($75)	$0	$0	$1,173	($47,563)
8	$1,311	($77)	$0	$0	$1,234	($46,330)
9	$1,376	($80)	$0	$0	$1,297	($45,033)
10	$1,445	($82)	$0	$0	$1,363	($43,670)
11	$1,517	($84)	$0	$0	$1,433	($42,237)
12	$1,593	($87)	$0	$0	$1,506	($40,731)
13	$1,673	($89)	$0	$0	$1,583	($39,147)
14	$1,756	($92)	$0	$0	$1,664	($37,483)
15	$1,844	($95)	$0	$0	$1,749	($35,734)
16	$1,937	($98)	$0	$0	$1,839	($33,895)
17	$2,033	($101)	$0	$0	$1,933	($31,962)
18	$2,135	($104)	$0	$0	$2,031	($29,931)
19	$2,242	($107)	$0	$0	$2,135	($27,796)
20	$2,354	($110)	$0	$0	$2,244	($25,552)
21	$2,472	($113)	$0	$0	$2,358	($23,194)
22	$2,595	($117)	$0	$0	$2,478	($20,716)
23	$2,725	($120)	$0	$0	$2,605	($18,111)
24	$2,861	($124)	$0	$0	$2,737	($15,374)
25	$3,004	($128)	$0	$0	$2,877	($12,497)
26	$3,154	($131)	$0	$0	$3,023	($9,474)
27	$3,312	($135)	$0	$0	$3,177	($6,297)
28	$3,478	($139)	$0	$0	$3,338	($2,959)
29	$3,652	($144)	$0	$0	$3,508	$549
30	$3,834	($148)	$0	$0	$3,686	$4,235
31	$4,026	($152)	$0	$0	$3,874	$8,109
32	$4,227	($157)	$0	$0	$4,070	$12,179
33	$4,439	($162)	$0	$0	$4,277	$16,456
34	$4,661	($166)	$0	$0	$4,494	$20,950
35	$4,894	($171)	$0	$0	$4,722	$25,672
36	$5,138	($177)	$0	$0	$4,962	$30,634
37	$5,395	($182)	$0	$0	$5,213	$35,847
38	$5,665	($187)	$0	$0	$5,477	$41,324
39	$5,948	($193)	$0	$0	$5,755	$47,079
40	$6,246	($199)	$0	$0	$6,047	$53,126

BWC Excel System Cash Flow (Class 3 Winds)

Assumptions (Inputs)

Total Installed Cost ($):	**$55,000**
Allocation to Business (%):	**0**
Annual Energy Output (kWh):	**18,795**
Electricity Cost ($/kWh):	**$0.0742**
Electricity Inflation Rate (%):	**5**
Loan Downpayment (%):	**100**
Down Payment ($):	**$55,000**
Amount of Loan ($):	**$0**
Interest Rate (%):	**10**
Loan Term (Years):	**8**
Month Installed:	**0**
Net Federal Tax Rate (%):	**35**
Net State Tax Rate (%):	**0**
O & M Cost ($/kWh):	**$0.005**
O & M Inflation Rate (%):	**3**
State Rebate (%):	**0**
State Tax Credit (%):	**0**
Federal Tax Credit (%):	**0**

Results

Loan Payments

Monthly Payment ($):	**$0**
Value of Interest Deduction ($):	**$0**
Net Monthly Payment ($):	**$0**

Ave. Monthly Savings on Bill

Year 1 ($):	**$116**
Year 10 ($):	**$189**
Year 20 ($):	**$308**
Year 30 ($):	**$502**

Internal Rate of Retrurn

Years 1 - 30:	**2.7%**

Conservative assumption of no scrap value.

Spreadsheet courtesy of Bergey Windpower

Annual Cash Flow Model

Year	Net Energy	O&M Costs	Net Deprec.	Net Loan Payments	Annual Cash Flow	Total Cash Flow
0					($55,000)	($55,000)
1	$1,395	$0	$0	$0	$1,395	($53,605)
2	$1,464	$0	$0	$0	$1,464	($52,141)
3	$1,538	$0	$0	$0	$1,538	($50,604)
4	$1,614	$0	$0	$0	$1,614	($48,989)
5	$1,695	$0	$0	$0	$1,695	($47,294)
6	$1,780	($109)	$0	$0	$1,671	($45,623)
7	$1,869	($112)	$0	$0	$1,757	($43,866)
8	$1,962	($116)	$0	$0	$1,847	($42,020)
9	$2,060	($119)	$0	$0	$1,941	($40,078)
10	$2,163	($123)	$0	$0	$2,041	($38,037)
11	$2,272	($126)	$0	$0	$2,145	($35,892)
12	$2,385	($130)	$0	$0	$2,255	($33,637)
13	$2,504	($134)	$0	$0	$2,370	($31,266)
14	$2,630	($138)	$0	$0	$2,492	($28,775)
15	$2,761	($142)	$0	$0	$2,619	($26,156)
16	$2,899	($146)	$0	$0	$2,753	($23,403)
17	$3,044	($151)	$0	$0	$2,893	($20,509)
18	$3,196	($155)	$0	$0	$3,041	($17,468)
19	$3,356	($160)	$0	$0	$3,196	($14,272)
20	$3,524	($165)	$0	$0	$3,359	($10,913)
21	$3,700	($170)	$0	$0	$3,531	($7,382)
22	$3,885	($175)	$0	$0	$3,710	($3,672)
23	$4,080	($180)	$0	$0	$3,899	$228
24	$4,284	($185)	$0	$0	$4,098	$4,326
25	$4,498	($191)	$0	$0	$4,307	$8,632
26	$4,723	($197)	$0	$0	$4,526	$13,158
27	$4,959	($203)	$0	$0	$4,756	$17,914
28	$5,207	($209)	$0	$0	$4,998	$22,912
29	$5,467	($215)	$0	$0	$5,252	$28,164
30	$5,740	($221)	$0	$0	$5,519	$33,683
31	$6,027	($228)	$0	$0	$5,799	$39,482
32	$6,329	($235)	$0	$0	$6,094	$45,576
33	$6,645	($242)	$0	$0	$6,403	$51,979
34	$6,977	($249)	$0	$0	$6,728	$58,707
35	$7,326	($257)	$0	$0	$7,070	$65,777
36	$7,693	($264)	$0	$0	$7,428	$73,205
37	$8,077	($272)	$0	$0	$7,805	$81,010
38	$8,481	($281)	$0	$0	$8,201	$89,210
39	$8,905	($289)	$0	$0	$8,616	$97,826
40	$9,350	($298)	$0	$0	$9,053	$106,879

Appendix E

Solar Power Cost Estimates

2 kW System

Spreadsheet courtesy of Find Solar: www.findsolar.com

How It Pencils Out...

Building Type:	Commercial/Business
State & County:	MN - Ramsey
Utility:	XCEL
Utility Type:	Investor-Owned Utility
Assumed Average Electric Rate: Please check against your bill	$0.0742/kWh
Assumed Average Monthly Electricity Usage: Please check against your bill	750 kWh/month
Your Average Monthly Electricity Bill: (Assumed rate x average monthly useage)	$ 56 / Month
Tiered Rates Apply:	No
Time-of-Use Metering Offered:	No
Net-Metering Available:	Yes - See Notes
ESTIMATED SYSTEM SIZE	
The system size best for your situation will vary based upon product, building, geographic and other variables. We encourage you to work with a Solar Pro who can better estimate the system size best for your situation. We estimate your building will need a system sized between 1.60 kW and 2.40 kW of peak power. This estimate assumes the mid-point of this range.	
Solar Rating:	**Good** (4.584 kWh/sq-m/day)
Solar System Capacity Required:	2.00 kW of peak power (DC watts)
Roof Area Needed:	200 sq-ft
ESTIMATED SYSTEM COST	
This is only an estimate based upon many assumptions. Installation costs can vary considerably. We encourage you to work with a Solar Pro who can provide you with a more detailed cost estimate. We estimate that a 2.00 kW peak power system will cost between $16,000 and $24,000. This estimate assumes the mid-point of this cost range.	
Assumed Installation cost: (before rebates, incentives or tax credits). See the Cost Notes, below!	**$20,000** $10/watt
Expected XCEL Utility Rebate: (Limited to not exceed state max. incentive amount)	($ 0)
Expected MN State Rebate ($2/watt installed) (Maximum: $20000)	($ 3,240)

MN State Tax Credit/Deduction	($ 0)		
Federal Tax Credit: (Installation type: Business)	($ 6,000)		
Income Tax on Tax Credit:	$ 0		
YOUR ESTIMATED NET COST:	**$ 10,760**		
Monthly Payment (6.5% apr, 30 years):	$ 68		
SAVINGS & BENEFITS			
Increase in Property Value:	**$2,780**		
Exempt from Property Tax:	**YES**		
Accelerated (5 yr) Depreciation: (Installation type: Business)	**YES**		
First-year Utility Savings:	**$139**		
Average Monthly Utility Savings: (over 25-year expected life of system)	**$23**		**Assumed Utility Inflation Rate: 5%**
Average Annual Utility Savings: (over 25-year expected life of system)	**$279**		
25-year Utility Savings:	**$6,966**		
Return on Investment (ROI): (with Solar System ave. cost set as asset value)	**147%**		
Return on Investment (ROI): (with Property appreciation set as asset value)	**569%**		
Internal Rate of Return (IRR):	**-1.0% - 3.0%**		
Years to Break even: (Includes property value appreciation)	**17 years**		
Years to Break even: (Assuming no property value appreciation)	**23 years**		
Greenhouse Gas (CO2) Saved: *over 25-year system life*	**46.0 tons** **(92,000 auto miles)**		

10 kW System

Spreadsheet courtesy of Find Solar: www.findsolar.com

SOLAR How It Pencils Out....

Building Type:	Commercial/Business
State & County:	MN - Ramsey
Utility:	XCEL
Utility Type:	Investor-Owned Utility
Assumed Average Electric Rate: Please check against your bill To recalculate, enter a value and press "enter" on your keyboard -	$0.0742/kWh
Assumed Average Monthly Electricity Usage: Please check against your bill To recalculate, enter a value and press "enter" on your keyboard -	4000 kWh/month
Your Average Monthly Electricity Bill: (Assumed rate x average monthly useage)	$ 297 / Month
Tiered Rates Apply:	No
Time-of-Use Metering Offered:	No
Net-Metering Available:	Yes - See Notes, below!

ESTIMATED SYSTEM SIZE

The system size best for your situation will vary based upon product, building, geographic and other variables. We encourage you to work with a Solar Pro who can better estimate the system size best for your situation. We estimate your building will need a system sized between 8.00 kW and 12.00 kW of peak power. This estimate assumes the mid-point of this range.

Solar Rating:	**Good** (4.584 kWh/sq-m/day)
Solar System Capacity Required:	10.00 kW of peak power (DC watts)
Roof Area Needed:	1,000 sq-ft

ESTIMATED SYSTEM COST

This is only an estimate based upon many assumptions. Installation costs can vary considerably. We encourage you to work with a Solar Pro who can provide you with a more detailed cost estimate. We estimate that a 10.00 kW peak power system will cost between $72,000 and $108,000. This estimate assumes the mid-point of this cost range.

Assumed Installation cost: (before rebates, incentives or tax credits). See the Cost Notes, below! To recalculate, enter a value for assumed cost/watt installed and press "enter" on your keyboard.	**$90,000** $9/watt
Expected XCEL Utility Rebate: (Limited to not exceed state max. incentive amount)	($ 0)
Expected MN State Rebate ($2/watt installed) (Maximum: $20000)	($ 16,200)
MN State Tax Credit/Deduction	($ 0)
Federal Tax Credit: (Installation type: Business)	($ 27,000)

Income Tax on Tax Credit:	$ 0		
YOUR ESTIMATED NET COST:	**$ 46,800**		
Monthly Payment (6.5% apr, 30 years):	$ 296		
SAVINGS & BENEFITS			
Increase in Property Value:	**$15,800**		
Exempt from Property Tax:	**YES**		
Accelerated (5 yr) Depreciation: (Installation type: Business)	**YES**		
First-year Utility Savings:	**$790**		
Average Monthly Utility Savings: (over 25-year expected life of system)	**$132**		**Assumed Utility Inflation Rate: 5%**
Average Annual Utility Savings: (over 25-year expected life of system)	**$1,584**		
25-year Utility Savings:	**$39,590**		
Return on Investment (ROI): (with Solar System ave. cost set as asset value)	**254%**		
Return on Investment (ROI): (with Property appreciation set as asset value)	**752%**		
Internal Rate of Return (IRR):	**1.0% - 9.0%**		
Years to Break even: (Includes property value appreciation)	**12 years**		
Years to Break even: (Assuming no property value appreciation)	**18 years**		
Greenhouse Gas (CO2) Saved: *over 25-year system life*	**246.0 tons** **(492,000 auto miles)**		

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