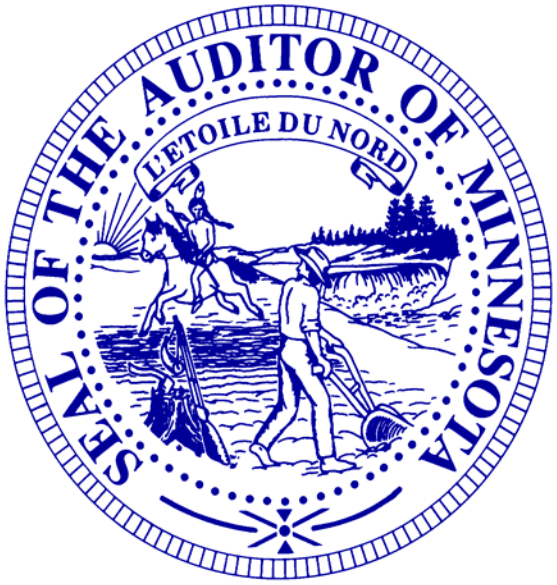
State of Minnesota

Office of the State Auditor



Rebecca Otto
State Auditor

Best Practices Review:

Reducing Energy Costs in Local Government

Description of the Office of the State Auditor

The mission of the Office of the State Auditor is to oversee local government finances for Minnesota taxpayers by helping to ensure financial integrity and accountability in local governmental financial activities.

Through financial, compliance, and special audits, the State Auditor oversees and ensures that local government funds are used for the purposes intended by law and that local governments hold themselves to the highest standards of financial accountability.

The State Auditor performs approximately 160 financial and compliance audits per year and has oversight responsibilities for over 3,300 local units of government throughout the state. The office currently maintains five divisions:

Audit Practice - conducts financial and legal compliance audits of local governments;

Government Information - collects and analyzes financial information for cities, towns, counties, and special districts;

Legal/Special Investigations - provides legal analysis and counsel to the Office and responds to outside inquiries about Minnesota local government law; as well as investigates allegations of misfeasance, malfeasance, and nonfeasance in local government;

Pension - monitors investment, financial, and actuarial reporting for approximately 730 public pension funds; and

Tax Increment Financing - promotes compliance and accountability in local governments' use of tax increment financing through financial and compliance audits.

The State Auditor serves on the State Executive Council, State Board of Investment, Land Exchange Board, Public Employees Retirement Association Board, Minnesota Housing Finance Agency, and the Rural Finance Authority Board.

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Best Practices Review:
Reducing Energy Costs in Local Government

July 2, 2008

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Preface

In 2004, the Minnesota State Legislature gave the Office of the State Auditor the responsibility of conducting best practices reviews that "examine the procedures and practices used to deliver local government services, determine the methods of local government service delivery, identify variations in cost and effectiveness, and identify practices to save money or provide more effective service delivery." The best practices reviews are to include recommendations to "improve the cost-effectiveness of services."[1] This responsibility, previously carried out by the Legislative Auditor, is modeled after the national studies conducted by the British Audit Commission in England and Wales to find "state of the art" techniques for the delivery of local government services.

The State Auditor determines a topic for the best practices review with the assistance of an Advisory Committee composed of representatives from the Association of Minnesota Counties, the League of Minnesota Cities, the Association of Metropolitan Municipalities, the Minnesota Association of Townships, the Minnesota Municipal Utilities Association, and the Minnesota Association of School Administrators.[2]

The Advisory Committee met with the State Auditor to identify a topic for the best practices review. The topic selected was, "Reducing Energy Costs in Local Government." The topic is timely given rising energy costs, and the growing public awareness concerning energy use. This review is intended to be a resource for local governments to help them make informed decisions about how to reduce energy costs.

The Office of the State Auditor extends sincere thanks to the Advisory Committee for their assistance in identifying a topic for this review, and to the local government officials who participated in the survey and provided information. We also thank the engineers, architects, consultants and other professionals associated with the projects and technologies for their assistance with this review.

[1] Minn. Stat. § 6.78.
[2] *Id.*

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Methodology and Approach

The goal of this review is to highlight best practices in reducing energy costs. To gather information, a survey was conducted by the Office of the State Auditor with local governments in Minnesota.[3] The survey provided an opportunity for local governments to identify energy-related initiatives of interest to them. The survey responses provide information on what local governments in Minnesota are doing to reduce energy costs. This review presents case studies, and financial and informational resources to assist local governments in reducing energy costs.

The Office of the State Auditor conducted an initial literature review to find examples of systems, services, policies and programs being used by local governments to reduce energy costs.

In total, 1,027 local governments (28 percent) participated in the Best Practices Survey: 87 percent of counties, 22 percent of cities, 32 percent of townships and 20 percent of special districts. In addition, 34 percent of school districts responded.[4] Participation in the survey was voluntary.

Entities engaging in best practices were identified from the survey responses. Follow-up phone interviews were conducted. Based on these interviews, an additional questionnaire was sent to these entities, sometimes including the contractors or professionals that were involved in the project, to obtain detailed information on a specific best practice. Finally, several sites were visited to gather additional information for the case studies.

[3] *See*: Appendix 1 for Best Practices in Reducing Energy Costs Survey.
[4] All school districts were surveyed. However, charter schools were not included in the survey responses.

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Summary of Survey Responses

The survey results obtained by the Office of the State Auditor demonstrate that local governments in Minnesota are using a variety of strategies and resources, including assessing energy use, installing energy-efficient products, using services and implementing energy policies to reduce energy costs.

Energy-Efficient Products

Local government respondents' most common energy-efficient investment is high-efficiency lighting. Energy-efficient doors and energy-control devices for heating and cooling systems are the next most common energy-efficient investments.

Among county and school district respondents, the two most common investments are high-efficiency lighting and boiler-efficiency testing, analysis or tune-ups. Seventy percent of county respondents and 74 percent of school district respondents have invested in high-efficiency lighting through retrofits or routine replacement. In addition, 63 percent of school district respondents and 56 percent of county respondents acknowledged investing in boiler analysis, testing and tune-ups. For townships, the two most commonly reported investments are energy-efficient doors and windows. Energy-efficient windows and energy-control devices for heating and cooling systems are common investments for special districts.

Energy Audits[5]

Energy audits are an effective way to identify areas of improvement to reduce energy costs. Energy audits are commonly provided to local governments by local utility companies or private contractors. Fifty-three percent of school district respondents had energy audits performed on one or more facilities. Thirty percent of counties and 17 percent of cities also had energy audits performed.

Energy Policies

Local governments in Minnesota are implementing a variety of policies to conserve and manage energy. Temperature-setting policies for heating and cooling systems are the

[5] There is currently no statewide standard for energy audits provided by utility companies; however, the Minnesota Office of Energy Security has begun a review of energy audit services provided by Minnesota utilities for commercial and institutional buildings. This review was initiated under the direction of The Next Generation Energy Act of 2007, which amended Minn. Stat. 216C.31 to read: "The commissioner shall develop state programs of energy audits of residential and commercial buildings including the training and qualifications necessary for the auditing of residential and commercial buildings under the auspices of a program created under section 216B.241." Other methods include the Minnesota B3 benchmarking system and commissioning or recommissioning processes which are recommended by the Minnesota Department of Commerce as cost-effective alternatives. More information on the Minnesota B3 benchmarking system is in the Resources section of this review.

most common policies. Policies requiring employees to power down equipment during non-business hours are the next most common.

School district and county respondents use energy management training and employee awareness campaigns to reduce energy usage. Nearly 40 percent of school district and 32 percent of county respondents indicated they provide energy management training for staff. Nearly 40 percent of school district and 22 percent of county respondents organized employee awareness campaigns to reduce energy usage in the workplace. Only 5 percent of cities, special districts and townships reported providing energy management training for staff. Additionally, less than 10 percent of cities, townships and special districts reported using employee awareness campaigns to reduce energy usage in the workplace.

Obstacles to Reducing Energy Costs

The survey asked about obstacles that local governments face in reducing energy costs. Listed below are the common obstacles beginning with the most frequently to the least frequently cited.

Obstacles to Reducing Energy Costs in Local Government

1. Cost/lack of funds
2. Conflict with other budget priorities
3. Lack of time/expertise to design and plan the project
4. Lack of informational resources to implement a project
5. Unavailability of contractors with related expertise
6. Lack of "political will" within the decision-making process
7. Length of time needed for approval by governmental body
8. Length of project implementation time

Financial Resources and Incentives

Financial resources are available to help local governments in Minnesota reduce energy costs. The survey indicates that respondents are using a variety of resources to overcome the financial obstacles they face in reducing energy costs. One example is the State of Minnesota's Energy Investment Loan Program, which buys down up to 50 percent of loan principal to 0 percent interest for certain energy-related investments with a simple payback of 10 years or less.[6] Over 15 percent of all survey respondents indicated they have used one of the financing resources and incentives listed below, from the most frequently to the least frequently cited.

Financial Resources and Incentives[7]
1. Utility rebate programs
2. Utility grant programs
3. State loan programs
4. Utility loan programs
5. State grant programs
6. Federal programs
7. Government or utility production incentives and State solar-electric rebate program

[6] Minn. Stat. § 216C.09.

[7] The Resources section of this review provides links to financing resources for energy-efficiency-related projects in local government.

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RECOMMENDATIONS

The Office of the State Auditor developed the following steps to guide local governments in reducing energy costs. These steps were identified as useful processes in the best practice examples highlighted in this review, and developed using recommendations from the U.S. Department of Energy and ENERGY STAR®.[8]

Steps for Implementing Best Practices

Step 1: Assess Energy Use and Identify Areas for Improvement

Understanding current energy use is an important step in identifying ways to reduce energy costs. There are several ways for local governments to assess energy use.

Energy audits

Energy audits are technical assessments of operating performance and energy efficiency used to identify areas for improvement. Energy audit providers typically develop a report, explaining technical assessments and offering suggestions for facility improvements. Local governments may contract with a private company or work with a local utility energy audit service. Another option to consider is the use of free or low-cost services available to local governments. (*See* the Resources section.) For example, the Minnesota Retired Engineers Program (RETAP) provides energy use reduction services for local governments.[9]

Benchmarking

Benchmarking is the process of evaluating a facility's energy and operational performance by comparing it to a similar facility, or by using an energy model to compare actual facility performance with a set standard. Minnesota law provides that all public buildings should be benchmarked through the Minnesota B3 Benchmarking system.[10] Local governments in Minnesota should consider assessing building performance with the Minnesota B3 Benchmarking system, and using the information obtained through that process to identify areas for improvement. An explanation of this system and a link to the Minnesota B3 Benchmarking website is included in the Resources section of this review. In addition, the Resources section provides links to several other tools available for local governments to use in benchmarking facility performance such as the ENERGY STAR® Portfolio Manager.[11]

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[8] ENERGY STAR®, http://www.energystar.gov/index.cfm?c=guidelines.guidelines_index and Department of Energy, Energy Efficiency and Renewable Energy, http://www.eere.energy.gov/consumer/industry/aplan.html.

[9] Minnesota Pollution Control Agency, http://www.pca.state.mn.us/oea/p2/retap.cfm/.

[10] 2002 Minn. Laws ch. 398 § 8.

[11] ENERGY STAR®, http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager/.

Commissioning and Recommissioning
Commissioning usually begins in the design phase of a building project and lasts at least one year after the project is completed; however, this process can be started at anytime. Commissioning is a systematic process of verifying the installation, operation and maintenance of building systems. It is done to ensure that the building operates efficiently and meets the building owner's and occupant's needs and expectations. Recommissioning is similar and focuses on reassessing a building's equipment and operational functions to optimize performance. Recommissioning is recommended by the Minnesota Department of Commerce as a more comprehensive alternative to typical energy audits.[12]

Internal Measurement and Auditing Procedures
Regular internal measurement of energy use and costs is an important part of continuous energy management. Providing maintenance staff with training and resources to measure energy use is an effective way to reducing energy costs. The Resources section of this review provides links to trainings, workshops, and resources for measuring energy use and costs.

Step 2: Develop and Implement a Plan

Developing a plan with realistic and clearly defined goals is an important step to reducing energy costs. Some local governments may have energy management staff in place that have developed plans to reduce energy costs. Other local governments do not have these resources and will need to develop a plan to identify goals, install products and implement services, and monitor outcomes. A plan for implementing energy-related projects that reduce energy costs may include:

I. Energy Project Team
- Form an energy project team with established roles and responsibilities.
- Define these roles and responsibilities in a project plan.

II. Set Goals
- Set realistic clearly-defined goals for improvements and energy cost savings.

III. Timeline
- Establish a timeline with target dates for project development, implementation and achievement of goals.

[12] Bruce Nelson (P.E. Minnesota Department of Commerce, Office of Energy Security), in discussion with the Office of the State Auditor, May 2008; and email message to the Office of the State Auditor with attachments, May 8, 2008.

IV. Budget and Financial Resources
- Plan a budget for the entire project, including costs for equipment, installation, as well as measurement and verification processes such as professional commissioning services.

- Identify financial resources and incentives including grants, loans, rebates, and production incentives. (*See* the Financing Resources section.)

V. Implementation Procedures
- Have team members communicate with vendors through the implementation process to minimize disruptions to service delivery and ensure expectations are met, as well as familiarize themselves with the new technologies.

VI. Training Plan
- Include a training plan to ensure that facility managers, maintenance staff, and other employees are properly trained to service, maintain, and monitor new equipment.

- Set goals for continuing education and training for facility managers, maintenance staff and others with duties relating to the maintenance of new equipment.

- Join ENERGY STAR® for Local Governments or other programs to access training, resources and information.

VII. Measurement and Verification Processes
- Plan for measuring and verifying the energy savings.

Step 3: Measure and Verify Success

Monitoring the performance of implemented technologies and services is critical to achieving reduced energy costs. Simply installing technologies, or contracting for energy-related services does not ensure that energy cost savings will be realized. Measurement and verification processes should be in place to gather and track data on energy use and costs to compare actual results with the goals set during the planning process. These processes may include benchmarking performance, commissioning or internal measurement and verification studies. This information should be compiled into progress reports, which can be used to make needed adjustments, as well as to communicate project success. (*See* Step 5.)

Step 4: Evaluate Plans and Procedures

In addition to monitoring the performance of technologies and services, local governments implementing energy-related improvements should review planning and implementation processes. A review process will allow local governments to identify best practices, learn from mistakes and set new goals. ENERGY STAR® states that reviewing and evaluating planning, as well as implementation processes, allows managers to do the following:

- Measure the effectiveness of projects and programs implemented.
- Make informed decisions about future energy projects.
- Recognize individuals and teams for accomplishments.

Step 5: Recognize and Communicate Success

Recognizing and communicating the success of energy-related initiatives can attract positive attention to your local government, motivate employees and create momentum for future projects. Internal recognition of individuals, teams and departments can set a standard for success and encourage others to participate in energy-related initiatives. External communication about the success of energy-related initiatives, such as to other government agencies and the public, can bring positive attention to your community and support for future projects.

The ENERGY STAR® website provides a list of ideas on how to communicate the success of energy-related initiatives with the public through the media, websites and newsletters.[13] In addition, several agencies and organizations in Minnesota recognize energy-related initiatives in local government including the Minnesota Office of Environmental Assistance, which organizes several award and recognition programs for energy-related projects.[14] More information on organizations that provide recognition for energy-related initiatives in local government can be found in the Resources section of this review.

[13] ENERGY STAR®, http://www.energystar.gov/index.cfm?c=guidelines.guidelines_index.
[14] Minnesota Office of Environmental Assistance, http://www.pca.state.mn.us/oea/.

INTRODUCTION

Energy costs have increased significantly over the last few years. The cost of fuel for vehicles and natural gas for heating continues to rise. These increases put pressure on local government budgets and have the potential to impact service delivery. Public awareness around energy issues has also increased, putting pressure on local officials to make changes. Local governments that take steps to reduce energy use or to produce energy can hedge against rising energy costs in the future. Reducing energy costs can stabilize or reduce operating costs.

In Minnesota, there are large variations in the size and function of local governments. Therefore, approaches to reducing energy costs will vary amongst local governments due to the differing amounts and types of infrastructure.

Reducing energy costs can be accomplished in many different ways. First, an energy audit should be conducted to assess energy use, and identify site-specific strategies to reduce energy costs. Energy audits include various types of energy studies, ranging from a walk-through inspection of a facility to a technical analysis of building systems.

Policy changes to eliminate wasteful practices in daily routines can be an effective way to reduce energy costs, and can be accomplished at little or no cost. Some examples include not allowing public vehicles to idle, lighting areas in public facilities only when they are occupied, offering telecommuting opportunities to staff, or adjusting temperature controls to reduce consumption.

Retrofits of more efficient technologies and products can be accomplished with moderate costs. Retrofitting can include replacing light fixtures, installing occupancy sensors for lighting and thermal conditioning, installing a geothermal heating and cooling system, or installing energy-efficient windows and doors. For example, in today's buildings, the conversion of energy into light is extremely inefficient. The use of advanced lighting technologies can greatly improve lighting efficiency, reduce consumption, and thereby reduce costs.[15]

Incorporating energy-efficient strategies into a new facility can have a significant impact on reducing energy costs. Early planning for energy efficiency allows for a whole-building approach: All of the building systems can be designed to achieve the greatest efficiency. Energy-efficient strategies and systems are site dependent. The design and build of a new local government building incorporating energy-efficient and sustainable design is a significant investment, but it can yield great returns.

Producing energy is another method of reducing energy costs. Energy production takes advantage of a resource, such as wind, rapidly-moving water, or the sun, to generate electricity. Two technologies for producing electricity discussed in this review are a wind generator and photovoltaic panels.

[15] U.S. Department of Energy, Building Technologies Program: Lighting R&D, http://www.1.eere.energy.gov/buildings/printable_versions/lighting.html.

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SYNOPSIS OF CASE STUDIES

The Office of the State Auditor identified various initiatives being pursued by local governments in Minnesota as best practices that could be used to help reduce energy costs. The best practices detailed in the following sections of this review include:

Lighting Retrofit Projects, which are cost-effective investments with paybacks typically occurring within 10 years. The lighting retrofit projects highlighted in this review include a metal halide to T-8 light fixture retrofit in a public works facility, lighting audit and redesign in a parking ramp, and the retrofit of county traffic signals from incandescent bulbs to LEDs (pgs. 17-28).

Geothermal Systems, which are energy-efficient alternatives to conventional heating and cooling systems. This review includes case studies of geothermal systems in two school buildings (pgs. 29-34).

Passive and Active Solar Energy Systems, which are designed to capture the sun's energy for indoor thermal conditioning, lighting, water heating or the production of electricity. Passive solar energy systems capture or trap the energy from the sun without the use of mechanical or electrical equipment. Active solar energy systems collect, absorb and distribute the sun's energy using mechanical or electrical equipment. This review includes case studies of a passive solar energy system in a city police precinct facility and an active solar system in a city maintenance facility (pgs. 35-44).

Wind Energy Systems, which harness energy from the wind to generate electricity. This review includes a case study of a wind energy system at a school (pgs. 45-49).

Displacement Ventilation Systems, which provide improved air quality, thermal comfort and reduced energy costs compared to conventional indoor air handling systems. This review includes a case study of displacement ventilation systems in a school district (pgs. 51-56).

Leadership in Energy and Environmental Design (LEED) Certification: New Building Design, which involves a comprehensive rating system for energy efficient, environmentally-sustainable building practices. The LEED registered projects highlighted in this review include a school building and a county criminal justice center (pgs. 57-67).

Energy Performance Contracts, which allow local governments to finance facility upgrades with expected energy savings, guaranteed by a qualified energy services company. The energy performance contract featured in this review involves energy-related improvements to a highway maintenance facility (pgs. 69-74).

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CASE STUDY

METAL HALIDE TO T-8 LIGHT FIXTURES PUBLIC WORKS FACILITY

Location: City of Minnetonka, MN
Contact: Brian Wagstrom, Director of Public Works
E-mail: bwagstrom@eminnetonka.com
Website: http://www.eminnetonka.com/public_works.cfm

Background

Recognizing a growing need to reduce energy use and costs, the City of Minnetonka contracted with an energy management consulting firm to identify possible improvements. The consulting firm conducted energy audits on several city facilities, creating a list of energy saving opportunities with detailed information on costs, savings and estimated payback periods. (*See* Appendix 2.) The City decided to "start with the low-hanging fruit," according to Public Works Director, Brian Wagstrom. In 2007, the City completed a comprehensive lighting retrofit in the truck bay of the Public Works Facility. Encouraged by the initial success of this project, the City is currently considering implementing lighting retrofits in six other facilities.

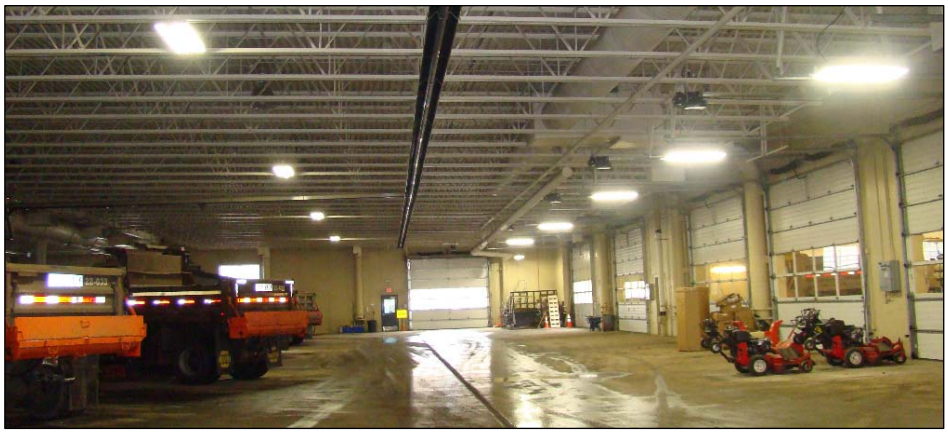
Facility Overview

The City of Minnetonka's Public Works facility is the storage and maintenance garage for city snow plows and street maintenance equipment. The garage also stores several Hennepin County trucks.

Project Detail

The truck bay lighting retrofit, completed in 2007, focused on replacing metal halide light fixtures with more energy-efficient super T-8 electronic ballast fixtures. Light fixture placement throughout the truck bay was redesigned to provide more light in servicing areas and to allow for greater use of natural light. The redesign resulted in an overall reduction in the light fixture count.

Comparison of Truck Bay Lighting Applications			
	Old System	**New System**	**Difference**
Number of Fixtures	58	39	(19)
Type	Metal Halides	Super T-8 Electronic Ballast	-
Per Fixture Wattage	460	200	(260)
Total Wattage	26,680	7,800	(18,880)



Truck Bay, City of Minnetonka Public Works Facility

Additional Energy-Saving Features

- **Motion sensors:** Motion sensors in individual light fixtures shut off the lights when the area is not being used and turn them on when there is motion in the area, according to adjustable time intervals.

- **Use of natural light:** Taking advantage of natural light reduces the need for artificial light. Only two out of six fluorescent tubes are in use in light fixtures located near natural lighting sources.

- **Light reflective floors:** The floors in the maintenance garage are painted a cream color to reflect the natural light to reduce the need for artificial light. The light colored floors show more dirt than dark cement floors and must be cleaned frequently.

Cost-Benefit Analysis

Costs	Rebates	Net Costs	Annual Energy Savings	Estimated Payback
$38,338	$12,287	$26,051	$13,311	2 yrs.

SUPPLEMENTAL INFORMATION

METAL HALIDE TO T-8 LIGHT FIXTURES

Metal Halide Fixtures to T-8 Fluorescent Fixtures

Metal halide fixtures are used in areas where light is provided from high ceilings, such as in gymnasiums, ice arenas, and public works facilities. T-8 light fixtures are a common energy-efficient replacement for metal halide light fixtures.

Benefits of Replacing Metal Halide Fixtures with T-8 Fixtures

Increased Energy Efficiency

- Replacing metal halide fixtures with T-8 fixtures can result in up to 50 percent energy savings. In addition, metal halides have a higher rate of light depreciation. In metal halide fixtures, the light output in terms of lumens will depreciate about 20 percent, whereas a T-8 light fixture will depreciate only about 10 percent.

- T-8 light fixtures can be controlled by occupancy sensors. Metal halide fixtures cannot be controlled using occupancy sensors because the fixtures must cool before being relit.

Metal Halide Light Fixture

Motion Sensor

Super T-8 Electronic Ballast Fixture

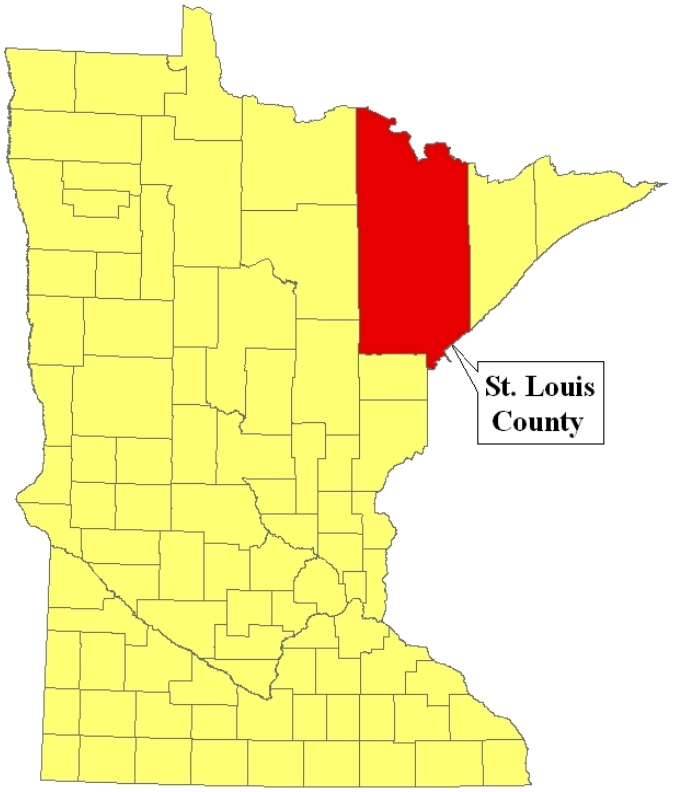
CASE STUDY

LIGHTING AUDIT AND REDESIGN PARKING RAMP

Location: St. Louis County, MN
Contact: Tony Mancuso, St. Louis County Property Management
E-mail: mancusot@co.st-louis.mn.us
Website: http://www.co.st-louis.mn.us/

Background

Several years ago, St. Louis County considered retrofitting the existing light fixtures in a parking ramp due to inefficiency and security concerns. In addition, the existing sodium lights had to be left on 24 hours a day, seven days per week, because they were not compatible with occupancy sensors. Prompted by these concerns, St. Louis County officials conducted a lighting audit in the parking ramp and then completed a comprehensive lighting retrofit of the facility in 2006.



Facility Overview

This St. Louis County parking ramp is located adjacent to the courthouse in downtown Duluth. The 5-level, 257-space ramp is built into the hill and connected to the courthouse by a skywalk. The ramp was constructed in 1985 using pre-stressed concrete planks mounted on poured concrete columns and supports. The original, high-pressure sodium light fixtures were flush mounted (buried) on the ceiling surface between the concrete "T" bars, limiting their light coverage area.

Project Detail

The County worked with a local electrical contracting company on a lighting audit to determine how to reduce overall energy use. The staff pressure washed and painted the stairwells, ceilings, and walls. The stairwells, ceilings, and walls were painted gloss

white to reflect and spread the light within the parking ramp. The overhead "buried" sodium high-pressure lights were lowered and replaced with metal halide fixtures with round "acorn" diffusers to increase fixture coverage. This change reduced the wattage load by two-thirds and the fixture count by 38 percent. High-pressure sodium lights in stairwells were replaced with fluorescent wall packs. LED exit lights were installed to replace the florescent fixtures. Daylight sensors were added to turn off fixtures in areas that received ample ambient daylight. Timers and occupancy sensors were installed to shut off fixtures during non-use times. The lighting audit and redesign resulted in a considerable reduction in the light fixture count and overall energy use in the parking ramp.

Comparison of Parking Ramp Lighting Applications			
	Old System	**New System**	**Difference**
Number of Fixtures	101	63	(38)
Type	High-Pressure Sodium	Metal Halide	-
Total Wattage	16,400	3,945	(12,455)

Cost-Benefit Analysis

Cost	**Energy Savings[16]**	**Estimated Payback**
$10,500	Electrical bills reduced from an average of $975/month to $200/month	1.5 yrs.

Lessons Learned

"Do your homework and analysis. Never use high-pressure sodium lighting for anything other than street lights, as the human eye does poorly with yellow hues and does much better in the white spectrum. Use daylight sensors and timers, as they are very cost effective. Lower the overhead lights and get them out of the shadow producing areas for better coverage, as this really cuts the fixture count. Clean and paint the interior surfaces – this is "free" light, as it lowers wattage requirements and fixture counts."

-Tony Mancuso, St. Louis County Property Management

[16] The energy savings are the change in energy costs resulting from the project, including the lighting retrofit, and the painted walls. The County also installed a solar panel on the roof of the parking ramp. The 5 kW photovoltaic application provides approximately $66 per month in energy savings for the parking ramp, which is reflected in these numbers.

SUPPLEMENTAL INFORMATION

T-12 to T-8 LIGHT FIXTURES

T-12 Fluorescent Bulbs to T-8 Fluorescent Bulbs

Switching T-12 fluorescent light bulbs to T-8 bulbs is a cost-effective retrofit. Fluorescent fixtures are commonly used in a range of facilities, including public works buildings, fire stations, classrooms, and offices. Typical tube-shaped fluorescent light bulbs are classified by diameter size. A T-12 fluorescent bulb has a diameter of 1.5 inches while a T-8 bulb has a smaller diameter of 1.1 inches. The Minnesota Pollution Control Agency provides important information regarding how to safely dispose of light bulbs, including an interactive map to disposal sites in your area:
http://www.pca.state.mn.us/waste/index.html

T-8 bulbs are about 30 percent more energy efficient than T-12 bulbs.

Benefits of Replacing T-12 Bulbs with T-8 Bulbs

1. **Increased Energy Efficiency**
   - T-8 bulbs are approximately 30 percent more energy efficient than T-12 bulbs.

2. **Decreased Maintenance Costs**
   - T-8 bulbs generally have a longer lifespan than T-12 bulbs, which results in decreased maintenance costs due to less frequent need for replacement. More specifically, T-12 bulbs have an average life of 12,000 hours, whereas T-8 bulbs have an average life of 20,000 hours.

3. **Low-Cost Installation**
   - Retrofitting of T-12 bulbs with T-8 bulbs is relatively easy and low-cost because most T-12 bulbs have the same two-pin base as the T-8 bulbs. Retrofits cost approximately $20 per bulb, including parts and labor. Payback periods for retrofitting T-12 bulbs with T-8 bulbs average 2 to 3 years for commercial applications, and 5 to 7 years for industrial applications.[17]

Recommendations

Lighting is site specific. Conducting lighting audits, or redesign studies is an important step to ensuring that appropriate lighting applications are chosen for a given space.

[17] Alliant Energy, http://www.alliantenergy.com/.

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CASE STUDY

LED TRAFFIC SIGNALS
COUNTY ROADS

Location: Washington County, MN
Contact: Ted W. Schoenecker, P.E., Transportation Planning Manager
Email: ted.schoenecker@co.washington.mn.us
Website: http://www.co.washington.mn.us/

Background

In 1997, Washington County began installing Light Emitting Diode (LED) traffic signals as an alternative to incandescent fixtures for all new county traffic signals and pedestrian indication lights. In 1998, the county retrofitted all existing red traffic lights and "Don't Walk" signs with LEDs, using rebates and an interest free loan from Northern States Power Company (NSP).[18] The county used the annual savings from the LED traffic signals to repay the NSP loan. In 2004, Washington County used rebates and incentives from Xcel Energy to retrofit all county-owned signals with green LEDs.[19] In 2006, all remaining overhead indication lights were replaced with LED fixtures.

Project Detail

The County owns 63 LED traffic signals and 6 overhead flashers. After retrofitting the red traffic lights and "Don't Walk" signs in 1998 and 2004, the County estimates that the retrofit reduced energy costs by 50 percent.

[18] Northern States Power Company is now a subsidiary of Xcel Energy.
[19] Check with your local utility company for information on current incentives for retrofitting to LED traffic signals.

Cost-Benefit Analysis

Costs	Annual Energy Savings	Actual Payback
Red LED light, $115 Green LED light, $300	County estimates 50 percent energy savings	4.25 yrs.

The cost of purchasing LED traffic signals has decreased since the initial traffic signal retrofits began in Washington County. The average payback period on LED traffic signals at today's cost is 2 to 4 years. A red LED traffic signal currently costs approximately $37 and a green light is $79.

SUPPLEMENTAL INFORMATION

LED TECHNOLOGY

Benefits of LED Traffic Signals

1. Longer Lifespan

- The life of a standard LED is approximately 8 to 10 years. An incandescent bulb has a life of approximately 2 to 4 years.[20] The initial cost of LED traffic signals is greater than that of incandescent fixtures; however, the increased energy efficiency and longer lifespan of LED traffic signals results in payback periods well within the life of the fixtures. The payback period varies according to the project. The Department of Energy studies show paybacks ranging from 2 to 7 years.

2. Reduced Energy and Maintenance Costs

- LED traffic signals use 6 to 25 watts in typical operating conditions, while incandescent signals use 70 to 150 watts. The improvement in energy efficiency makes LED traffic signals 80 to 90 percent more energy efficient than incandescent signals.[21]
- Installing LED signals can result in reduced maintenance costs due to the longer lifespan.

3. Safety Improvements

- Unlike incandescent signals, LED traffic signals do not have reflectors behind the bulbs. Therefore, "phantom effects" are reduced, creating improved safety for drivers and pedestrians.
- Incandescent traffic signals have only one filament, whereas LED traffic signals have a matrix of dozens of small, light emitting diodes. If an individual diode stops working in an LED fixture, the signal will continue to operate.

4. Brighter Bulbs

- With incandescent traffic signals, brightness is concentrated in the center of the light. LED traffic signals have equal luminosity across the surface of the light contributing to greater illumination overall.
- Because the LED lights do not emit heat like incandescent bulbs, the lights do not burn and darken thus allowing greater illumination.

5. Meets federally-mandated ENERGY STAR® specifications for traffic signals

- LED traffic signals have become the standard for manufacturing signal applications in the U.S. All traffic signals manufactured after January 1, 2006 must meet ENERGY STAR® specifications. At this time, LED traffic signals are the only type of fixture that meets the mandated specifications.[22]

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[20] Department of Energy, Energy Efficiency and Renewable Energy, http://www.eere.energy.gov/state_energy_program/project_brief_detail.cfm/pb_id=1040.
[21] ENERGY STAR®, http://www.energystar.gov/; Consortium for Energy Efficiency, http://www.cee1.org/.
[22] The Energy Policy Act of 2005. *See:* http://www.energystar.gov/index.cfm?c=traffic.pr_traffic_signals.

On the Horizon

In Minnesota, local governments are experimenting with new uses for LED light fixtures:

- The City of Brooklyn Park is scheduled to install 8 LED street lights outside an operations and maintenance facility, at a cost of $700 per light fixture. The project is examining whether it is feasible to replace over 4,000 of the City's street lights with energy-efficient LED fixtures.

- The City of Minnetonka is installing LED lights in a vehicle fueling station at the Public Works Facility. City officials are using this small project to determine whether it is cost effective to install LED lights in other city facilities.

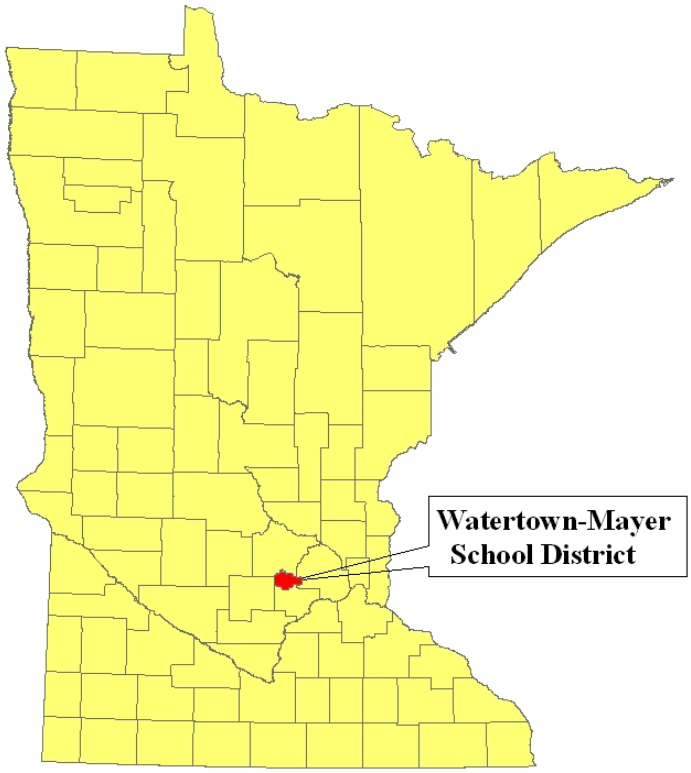
- The City of St. Paul is currently testing LED street lights. The existing street light applications cost approximately $70 per light, with an average life expectancy of 24,000 hours. The LED street lights the City is testing cost $400 to $500 each, with an average life expectancy of 50,000 hours. In addition to the energy savings, the City anticipates considerable savings in maintenance costs. Officials estimate that it currently costs $100 per hour to change a light, with the entire job taking 30 to 60 minutes.[23]

[23] Star Tribune article, "LED Street lights: Bright idea for St. Paul?" published on April 6, 2008, http://www.startribune.com/local/stpaul/17340884.html.

CASE STUDY

GEOTHERMAL HEATING AND COOLING SYSTEM SCHOOL BUILDINGS

Location: Watertown-Mayer School District, MN
Contact: Karsten Anderson, Superintendent
E-mail: kanderson@wm.k12.mn.us
Website: www.wm.k12.mn.us



Background

The Watertown-Mayer School District made the decision to use energy-efficient heating and cooling systems while planning for a new elementary school and a major remodel of the combined middle and high school facility. The architect coordinated efforts with the Weidt Group, an energy design consulting firm that works in association with Xcel Energy's Conservation Improvement Plan initiatives.[24] The School District decided to install geothermal heating and cooling systems.

Facility Overview

The new Watertown-Mayer Elementary School, opened in 2007, is an 86,400 square-foot facility with a geothermal system for heating and cooling, and a high-efficiency condensing boiler for backup and as a supplement. The boiler is used for building warm-up and supplemental heat on days when the temperature is extremely cold. The building also has direct digital controls for the heating and cooling systems.

The Watertown-Mayer Middle School and High School is a 2-story, 273,250 square-foot facility. The facility was remodeled in 2007 and 2008, and now includes a geothermal system and a high-efficiency, condensing boiler for backup. The geothermal

[24] The Minnesota Conservation Improvement Plan (CIP), administered by the Minnesota Department of Commerce, requires energy utilities to use a portion of their revenues for energy conservation programs and incentives. More information on the CIP program is provided on the Minnesota Department of Commerce website: http://www.commerce.state.mn.us.

system provides heating and cooling for the High School. In the Middle School, the geothermal system is used for cooling, and a high-efficiency boiler is used for heating.

Project Detail[25]

The New Elementary School

- Type of geothermal system installed: Vertical, closed-loop water-to-water heat pump[26]
- Number and depth of holes: 216 wells, each 200 feet deep
- Size of well field: Approximately 1.75 acres; located in the outfields of the baseball fields
- Ton capacity: 250 tons

> *"The State of Minnesota should provide further incentives for local governments to install energy-efficient systems. The energy rebates from utilities certainly help, but school districts are often put into the difficult position of choosing between energy efficiency and other items that may have more popular appeal. At Watertown-Mayer, we were able to keep the energy-efficient systems as a part of our projects, but too often districts are 'forced' into making other choices."*
>
> -Karsten Anderson, Superintendent, Watertown-Mayer School District

The Existing Middle and High School

- Type of geothermal system installed: Vertical, closed-loop water-to-water heat pump
- Number and depth of holes: 468 wells, each 200 feet deep
- Size of well field: Approximately 4 acres located in existing athletic fields
- Ton capacity: 600 tons

Cost-Benefit Analysis[27]

The Watertown-Mayer School District implemented several energy-efficient systems and strategies into the Elementary School, and Middle and High School buildings. The cost-benefit analysis provides information on the geothermal systems only.

[25] Project details were provided by Cuningham Group Architecture.
[26] A water-to-water heat pump is designed to use hot water heating for thermal conditioning. Other types of water-source heat pumps include water-to-air and hybrid systems.
[27] Information for the cost-benefit analysis was provided by the Weidt Group and Karges-Faulconbridge, Inc.

Elementary School

Cost[28]	Annual Energy Savings[29]	Estimated Payback[30]
$487,000	$38,100	11.6 yrs.

Total Cost Breakdown

Equipment: $726,000
HVAC system[31] (including piping, ductwork, and labor): $1,738,000
Geothermal wells: $457,000

Total Geothermal System Cost: $2,921,000

Middle School and High School

Cost[32]	Annual Energy Savings[33]	Estimated Payback[34]
$1,180,000	$198,400	5.9 yrs.

Total Cost Breakdown

Equipment: $1,510,000
HVAC system[35] (including piping, ductwork, and labor): $5,287,000
Geothermal wells: $1,115,000

Total Geothermal System Cost: $7,912,000

[28] This is the additional cost for installing a geothermal system compared to a code-based, conventional system.
[29] Annual energy costs are compared to a code-based, air-cooled chiller with an 80 percent efficient gas boiler.
[30] This is the estimated payback after an Xcel Energy incentive for all strategies implemented in the building. The total verified Xcel Energy incentive was $113,000. It is estimated that 40 percent of the incentive is associated with the geothermal system.
[31] HVAC equipment costs would be included in both geothermal and conventional heating and cooling systems.
[32] This is the additional cost for installing a geothermal system compared to a code-based, conventional system.
[33] Annual energy costs are compared to a code-based, air-cooled chiller with an 80 percent efficient gas boiler.
[34] This is the estimated payback after an Xcel Energy incentive for all strategies implemented in the building. The estimated Xcel Energy incentive for all strategies is $157,000; however, the incentive may change when the systems and strategies are verified. It is estimated that 70 percent of the incentive is associated with the geothermal system.
[35] HVAC equipment costs would be included in both geothermal and conventional heating and cooling systems.

Lessons Learned

1. Consider hiring the mechanical/electrical engineer under a contract separate from the architect to obtain more flexibility to contract with an engineering company with preferred experience and expertise.

2. Purchase mechanical and electrical equipment from one supplier to minimize problems caused by the use of different kinds of equipment and points of contact.

3. Negotiate with contractors to complete refinements, or adjustments to the system as early as possible to avoid stalling other parts of the project.

4. Request that the utility company provide accurate and timely billing statements to obtain information that is useful in monitoring and adjusting geothermal systems.

–Karsten Anderson, Superintendent, Watertown-Mayer School District

SUPPLEMENTAL INFORMATION

GEOTHERMAL HEATING AND COOLING SYSTEMS

Geothermal heat pumps, sometimes referred to as geoexchange systems or ground-source heat pumps (GHPs), are energy-efficient alternatives to conventional heating, cooling and ventilation (HVAC) systems. Geothermal heat pumps take advantage of the relatively constant temperature below the earth's surface.

In a closed-loop geothermal system, an environmentally-sound water and antifreeze solution circulates in a sealed ground loop pipe to absorb the heat from the ground in the winter.[36] Heat is extracted from the water using a refrigerant process, transferred, and then used for indoor heating. In the summer, the process is reversed and heat from indoor spaces is deposited in the ground as the liquid fluid circulates in the sealed ground loop pipe.[37] Geothermal ground loops can be installed vertically or horizontally. Vertical loops, which are typically more expensive than horizontal loops, are used where bedrock and limited topsoil interfere with installation. In Minnesota, installation of horizontal loops is possible in most areas.

Geothermal systems cost more to install than conventional heating and cooling systems. However, the reduced energy and maintenance costs result in a payback period of usually less than 15 years.[38, 39] According to the U.S. Department of Energy (DOE), geothermal systems in schools can reduce energy consumption by 25 to 50 percent, with payback for investments occurring in less than 8 years for most applications. Geothermal systems in large buildings can be 50 percent more efficient than conventional HVAC systems.

The payback period for geothermal systems is typically less than 15 years.

The Minnesota Department of Commerce recently released a study using models to analyze the economic, technical and environmental impacts of geothermal heat pumps in the state.[40] The study examined the differences in energy consumption, user costs, and amounts of pollution generated for geothermal systems and conventional HVAC systems. The study compared these systems in residential, commercial and institutional applications for both new and existing buildings. The study identified current installations, financial incentives, manufacturers and installers, economic development potential, and barriers to cost-effective mass implementation. The study found that, based on the current energy rates installation of geothermal systems reduces total

[36] The design of geothermal systems is either open-loop or closed-loop. Closed-loop systems are more common than open-loop systems, and will be the focus of this review.
[37] The U.S. Department of Energy website provides animations that demonstrate how geothermal systems work: http://www1.eere.energy.gov/geothermal/animations.html
[38] International Ground Source Heat Pump Association (IGSHPA), http://www.igshpa.okstate.edu/.
[39] A Minnesota Department of Commerce study found paybacks for some applications exceeding 20 years.
[40] "Performance, Emissions, Economic Analysis of Minnesota Geothermal Heat Pumps," Minnesota Department of Commerce, April 2008, http://archive.leg.state.mn.us/docs/2008/mandated/080477.pdf.

annual energy (natural gas and electricity) and maintenance costs required to operate conventional HVAC systems for each of the building types in the study.

Studies like these can provide useful insight into the potential performance of geothermal systems and the expected payback periods based on a set of technical assumptions. The actual payback for installed geothermal systems will depend on individualized factors, including the amount of energy consumption, the price of electricity, and the cost of operating an alternative system.

Recommendations

Guidelines for Selecting a Geothermal Contractor

1. **Experience and quality**
   - Make sure the companies manufacturing and installing the geothermal system have experience.
   - Find a reputable company using your local utility, the International Ground Source Heat Pump Association (IGSHPA) or the Geothermal Heat Pump Consortium. In addition, professional builders associations may be able to provide recommendations.
   - Request references and contact past customers to confirm the quality of work.
2. **Training**
   - Work with a manufacturer and an installation company with certification of manufacturer training, accreditation from IGSHPA or an IGSHPA professional on staff.

CASE STUDY

PASSIVE SOLAR ENERGY SYSTEM
POLICE PRECINCT FACILITY

Location: Minneapolis, MN
Contact: Paul Miller, Senior Property Manager, City of Minneapolis
Email: paul.miller@ci.minneapolis.mn.us
Website: http://www.ci.minneapolis.mn.us/police/about/3rd-precinct.asp

Background

The City of Minneapolis explored energy-efficient design ideas to be included in the remodeling of the Third Police Precinct Facility. The building was particularly well-suited for a solar-wall application because of a south facing wall. The concept appealed to the City because it was simple, involved little maintenance, and seemed to be low-risk.

Facility Overview

The original Third Police Precinct Facility, a 15,000 square-foot, two-story structure with a basement, was built in 1986. The new Third Police Precinct Facility, which opened in 2003, includes a three-story addition with a finished basement, and a complete remodel of existing office space. A passive solar energy system was incorporated into the structure. The total facility space is now nearly 40,000 square feet, with occupancy for approximately 200 people.

Project Detail

The passive solar energy system in the facility includes the following features:

SolarWall®
A south facing solar wall is used to pre-heat outside air for indoor thermal conditioning. It is located on the southern exterior part of the building, is 42 feet wide and 18 feet high, covering approximately 756 square feet.

Minneapolis Third Police Precinct Building

SolarWall® Minneapolis Third Police Precinct Building

Glazed windows, or low-emissive (low-e) glass windows
The windows in the facility are glazed/low-emissive windows that reduce heat loss and contribute to efficient indoor air conditioning.

Daylight fixtures
Skylight fixtures provide daylight for the interior of the building, reducing the number of lighting fixtures needed.

Exterior

Interior

Cost-Benefit Analysis

An official analysis of energy use and savings has not yet been performed by the City. However, they plan to examine the building's energy efficiency in the near future. The City cites the general energy efficiency of the building and statistics on SolarWall® applications as evidence of the cost-effectiveness of the solar-wall application. The final design of the facility exceeded the efficiency standards set by the State energy code by 30 percent, and the passive solar design features contributed to this level of energy efficiency. The cost of the SolarWall® was $22,000.

Benefits of SolarWall®[41]

- There is a typical investment payback period of 0 to 3 years in new construction, and 3 to 7 years in retrofit applications.
- The SolarWall® contributes 1.5 to 3.5 therms per square-foot of energy per year.
- Each square foot of SolarWall® surface can generate over 160 Btu/hr of heat (500 watts/square meter). A 1,000 square-foot SolarWall® heater will provide over 160,000 Btu/hr of thermal energy on a sunny day.
- Installation is easy.
- The SolarWall® is nearly maintenance free.

[41] SolarWall®, http://solarwall.com/; Department of Energy, http://www.eere.energy.gov/states/alternatives/efficient_heat_cool.cfm.

SUPPLEMENTAL INFORMATION

PASSIVE SOLAR ENERGY SYSTEMS

Solar energy systems harness the energy of the sun for heat and light. Passive solar energy systems capture or trap the energy from the sun without the use of mechanical or electrical equipment. Passive solar design strategies for lighting include building orientation and design features that optimize daylight sources for indoor lighting. One example is daylighting units, or skylight fixtures that direct sunlight down reflective walls into interior spaces. Passive solar design strategies for thermal comfort involve strategic placement and sizing of windows that open and close to adjust indoor air temperature. Glazed windows, or low-emissive (low-e) glass windows, covered with a thin film to reduce heat loss for more efficient thermal conditioning of indoor air are another example. Other components of a passive solar system include the use of thermal mass or building materials that retain heat from the sun and slowly radiate heat at night, and the use of a thermal chimney, designed to gather and exhaust warm air. Ventilation strategies, such as the use of perpendicular wing walls or solid partitions placed near windows to increase indoor ventilation**,** can also be incorporated into passive solar design. Control devices, such as roof overhangs or exterior shades, to regulate sunlight and heat during summer months, and solar walls to pre-heat air used in indoor thermal conditioning are additional examples.

Costs of Passive Solar Energy Systems

Passive solar energy systems are best suited for new construction, but can be integrated into existing buildings. The cost of incorporating them into the design of new buildings depends on the types of features that are included. For example, planning the placement and size of windows to optimize the use of daylight for heating and indoor lighting in new construction can be accomplished at little or no additional cost. Installing a thermal chimney will add costs for materials and installation. Adding these items to existing buildings, through retrofits, renovations or additions, increases costs. However, passive solar energy systems have little or no operating or maintenance costs, and will reduce energy use.

Benefits of Passive Solar Energy Systems

Economic Benefits

1. Reduced Energy Costs
   - Comprehensive passive solar energy systems, which incorporate strategies for thermal comfort and lighting, may reduce energy costs by 30 to 50 percent.[42]
   - Passive solar energy design strategies, such as thermal mass, can be used with traditional heating systems to reduce energy costs.
   - Passive solar energy systems provide protection from energy price fluctuations because less fuel is used.
2. Low Operating and Maintenance Costs
   - Passive solar energy systems have little or no maintenance costs because most are embedded in the building design. In addition, passive solar energy systems have few, if any, moving parts.

[42] U.S. Department of Energy, Energy Efficiency and Renewable Energy, http://www.eere.energy.gov/.

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CASE STUDY

ACTIVE SOLAR ENERGY MAINTENANCE FACILITY

Location: Minneapolis, MN
Contact: Paul Miller, Senior Property Manager, City of Minneapolis
Email: paul.miller@ci.minneapolis.mn.us
Website: http://www.ci.minneapolis.mn.us/sustainability/royalston.asp

Background

The City of Minneapolis installed photovoltaic systems in three facilities: Fire Station No. 6, the Royalston Maintenance Facility, and the Currie Equipment Facility. Together, these facilities have the potential to produce 30 kWh of electricity. This case study highlights the project at the Royalston Maintenance Facility.

Facility Overview

The Royalston Maintenance Facility was built to consolidate several facilities and shops around the city of Minneapolis. The 70,000 square-foot facility currently houses a paint shop, plumbing shop, carpentry shop, electrical shop, bricklayers shop, ramp maintenance shop, custodial services, and an administrative office. The building's energy needs include electrical power for 31 repair bays and 125 vehicle lifts. The facility was built to incorporate both passive and active solar energy systems.

Image Courtesy of the City of Minneapolis

Project Detail

The active solar energy system consists of a panel of sixteen 165-watt photovoltaic cells designed to generate 2.6kW of electrical power for the facility. The array is mounted on a mast arm that moves with the sun.

Cost-Benefit Analysis

Costs	Rebate[43]	Grant	Net Costs	Annual Energy Savings	Payback
$35,000	$5,280	$29,720	$0	6,270 kWh	N/A

The Royalston site uses approximately 720,000 kWh per year. The photovoltaic system produces approximately 6,270 kWh per year, or 1 percent of the total electricity for the facility.[44] In addition to a solar energy rebate from the Minnesota Department of Commerce, the City financed this investment using part of a $100,000 Great Cities Grant from the U.S. Environmental Protection Agency. The photovoltaic system began producing energy in January 2006.

"City staff was trained to clean the system periodically and brush off snow in the winter. The maintenance has been relatively painless."

-Matt Bye, Energy Manager, City of Minneapolis

Lessons Learned

1. Consider using a third-party solar developer who can take advantage of Federal investment tax credits and accelerated depreciation methods. These factors can reduce the cost to the City by upwards of 40 percent. A power purchase agreement (PPA) with the provider can enable payments for the energy to offset additional long-term costs.

2. Consider the use of a long-term, low-interest loan to offset the upfront costs.

3. Consider rebates and grant opportunities to use in the financing of photovoltaic systems.

-Matt Bye, Energy Manager, City of Minneapolis

[43] See the Minnesota Department of Commerce website for more information on the State of Minnesota's solar energy rebates program, as well as other financial incentives for solar energy applications: http://www.commerce.state.mn.us.

[44] This number was provided by the City of Minneapolis on April 29, 2008. It may differ from the number quantifying the energy produced by the photovoltaic application on the City of Minneapolis website. Matt Bye (Energy Manager, City of Minneapolis), email message to the Office of the State Auditor, April 24, 2008.

SUPPLEMENTAL INFORMATION

ACTIVE SOLAR ENERGY SYSTEMS

Active solar energy systems collect, absorb and distribute the sun's energy using mechanical or electrical equipment. Active solar technologies can be used to convert sunlight to electricity or can be used for heating. The following discussion summarizes the primary types of active solar energy systems in use in local government.[45]

Photovoltaic Systems
Panels made of semiconductors collect and convert sunlight into electricity. Photovoltaic applications range from small consumer applications, such as personal electronic equipment chargers, to large commercial solar electric systems. Photovoltaic installations can be used to provide electricity for a variety of purposes in local government, including lighting and signage. The cost of photovoltaic systems is high, and the payback can be as long as 20 years. However, grant programs and financial incentives are available for local governments in Minnesota.

Solar Water Heating
Solar water heaters capture the sun's thermal energy in water or heat-transfer fluid for use in buildings or swimming pools. Solar water heaters installed in buildings usually have two main components: solar collectors and a storage tank for holding the water or heat-transfer fluid. These applications have been shown to be particularly useful in Minnesota where the demand for water heating is high due to the cold climate. A single-panel solar hot water heating system in Minneapolis has the greatest energy savings of any U.S. city, other than Phoenix.[46]

Solar Space Heating
Active solar space heating systems typically consist of solar collectors, distribution equipment and an energy-storage system. To create indoor heat, solar collectors gather the thermal energy of the sun. Fans or pumps transfer and distribute the heat for indoor thermal conditioning. In addition, energy-storage systems hold heat to be used for indoor heat when the sun is not shining.

Active solar space heating systems vary by size and type of technology. Consequently, payback periods vary widely depending on the size and the specific type of technology used.

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[45] More information on these and other developing solar technologies can be found on the U.S. Department of Energy website, http://www1.eere.energy.gov/solar/.

[46] Carl Nelson, Emily Stiever, John Kearney, Green Institute and Clean Energy Resource Teams (CERTS), "Solar Pioneers, A Case Study of Southeast Como Neighborhood Solar Thermal Project," December 2007. The study notes that more expensive solar hot water heaters are needed in Minnesota than in Phoenix because of the need to withstand the freezing climate.

On the Horizon

Solar water heaters for swimming pools are particularly cost effective because there is no need for a storage tank. The sun's thermal energy is collected and transferred directly to swimming pool water. Pool water is pumped through a filter for cleaning to the solar collector where it is heated. After the water is filtered and heated, it is returned to the pool.

According to the Minnesota Department of Commerce, solar pool heating is 70 to 80 percent efficient, and maintenance costs are typically low in comparison to other methods of heating. The cost of a solar pool heating system typically ranges from $2,000 to $10,000 for purchase and installation. Payback for the investment usually occurs within 1.5 to 7 years, depending on climate, initial investment and financial incentives. Solar pool heating systems can be financed through Minnesota's Energy Conservation Financing Program, a financing program that will match funds 50-50 with zero percent interest loans. Although solar pool heaters have been found to be cost effective, currently there are no known public applications in Minnesota. There are two solar pool heating systems planned in Wisconsin public schools this year. Anticipated costs and energy savings are listed below.

High School Pool
Size of system: 1,920 square feet
Cost: $155,000
Energy saved: 4,895 therms displaced

Anticipated grant: $50,000
Anticipated installation date: July 2008

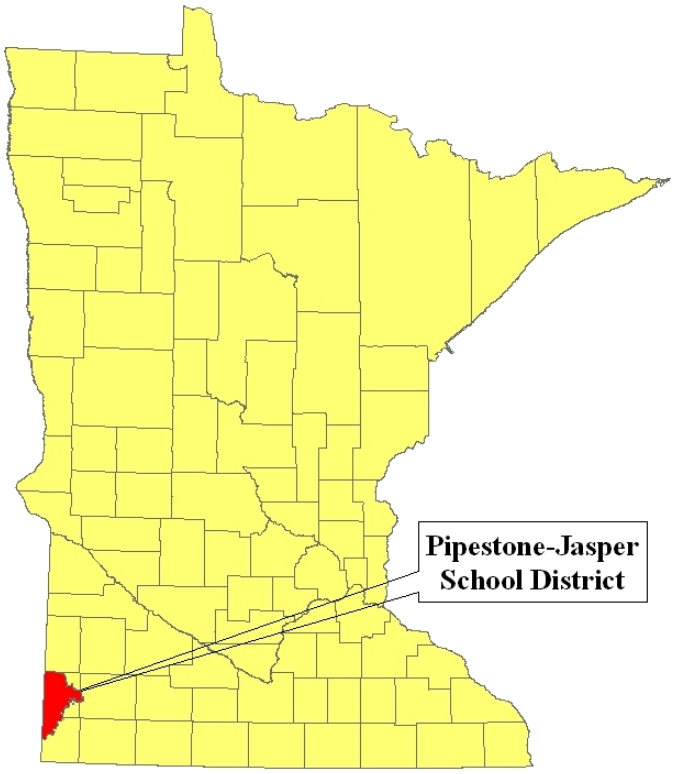
Middle School Pool
Size of system: 1,280 square feet
Cost: $106,000
Energy saved: 4,010 therms displaced

Anticipated grant from Focus on Energy: $37,100
Anticipated installation date: June 2008

CASE STUDY

WIND ENERGY SYSTEM SCHOOL BUILDING

Location: Pipestone-Jasper School District, MN
Contact: Jim Lentz, Superintendent, Pipestone-Jasper School District
E-mail: jim.lentz@pas.k12.mn.us
Website: http://www.pas.k12.mn.us/



Background

The Pipestone-Jasper School District is a good site for wind energy production. It is located in Pipestone County on Buffalo Ridge. A regional analysis of wind energy capacity shows that Buffalo Ridge, a glacier deposited crest with an average elevation of 1950 feet, has more wind energy potential than any other area in the state.

The School District applied for an Xcel Energy Renewable Development Grant to finance a wind energy system for the new middle/high school. The intentions of investing in the wind energy system were twofold: to provide energy for the school and to use the wind energy system as an educational tool for the science curriculum.

Facility Overview

The Pipestone-Jasper Middle/High School is an 180,000 square-foot facility, used by 925 students and faculty. The school is situated on 55 acres of land located on the western edge of the City of Pipestone.

Project Detail

The wind turbine is located in the northwest section of the property. A 900kW wind turbine provides 34 percent of the electricity needs of the school. The system began generating energy in late 2003, and the District began selling wind energy to Sioux

Valley Energy for $.033/kWh. The District receives a discount on its energy bill for the amount of wind energy they produce each month. From January 1 to December 31, 2007, the wind energy system produced 1,880,880 kWh, which resulted in energy savings of $55,474 for the School District.

Cost-Benefit Analysis

Costs	Grant	Net Costs	Actual Payback
$928,649	$752,835	$175,814	3.8 yrs.

Lessons Learned

After considering several options, the Pipestone-Jasper School District paid $60,000 for a 5-year maintenance agreement with a local company.

Pipestone-Jasper School District recommends that local governments purchase a maintenance agreement to cover servicing and repairs for the wind energy system from the start of operation. Having a maintenance agreement takes pressure off of school district staff for the service and repair of the wind energy system. Negotiate with several companies before committing to an agreement. Local governments should build cost of service increases into power purchase agreements. These arrangements ensure that, if a utility company raises the retail price of power sold to customers, they must also increase the price they pay the wind energy producer.

-Jim Lentz, Superintendent, Pipestone-Jasper School District

SUPPLEMENTAL INFORMATION

WIND ENERGY SYSTEMS

Wind energy systems use the kinetic energy of the wind to generate mechanical or electrical power. Small-scale, mechanical wind turbines or windmills were commonly found in rural areas where energy was harnessed for purposes such as to grind grain or pump water. Today, although small-scale turbines are still in use, electrical wind turbines are generally large-scale systems used to provide energy to generate electricity.

Electrical wind turbines typically come in one of two designs: vertical-axis ("egg beater" design) or horizontal-axis (propeller design). The horizontal-axis turbine is the most common design used today. Both measure energy output in terms of kilowatt-hours. For example, a 10-kW turbine has the potential to produce 10,000 kWh of power per year with winds averaging 12 miles per hour.

Wind turbines vary in size and energy production. Rotor diameters in utility-scale wind turbines typically range from 50 to around 90 meters.[47] Small-scale wind turbines have diameters of 8 meters or less. The energy output of a single wind turbine is dependent on the size of the rotor and the speed of the wind. Turbines have power ratings ranging from 250 watts to 5 megawatts.[48]

Costs and Benefits of Wind Energy Systems

The cost of utility-scale wind turbines varies widely. The American Wind Energy Association reports that small-scale, electrical wind energy systems cost $3,000 to $5,000 per kilowatt of energy generating capacity. The Association also reports that typical payback for investments in wind-energy systems range from 6 to 15 years. Specific payback periods depend on the financing structure of the initial investment, the availability of financial incentives such as rebates and tax credits, budgetary considerations, and environmental conditions. In addition, owners of wind turbines may sell energy to local utility companies in return for monetary compensation or a discounted price on energy costs. These types of arrangements also impact the length of payback periods for investments in wind energy systems.

The American Wind Energy Association states that typical payback for investments in wind energy systems range from 6 to 15 years.

Sources of financing for wind energy systems in local government may include internal funds, as well as grants and loans for renewable energy projects.[49] In addition, rural electric cooperatives and municipal electric utilities may apply for

[47] One meter is equal to approximately 3.28 feet.
[48] American Wind Energy Association, http://www.awea.org/.
[49] See the Resources section of this review for more information on grants and loans for wind energy systems in local government.

Clean Renewable Energy Bonds (CREBS), which provide the equivalent of an interest-free loan to finance a wind energy system.[50, 51]

Some local governments cooperate with outside investors to finance the cost of purchasing and installing wind energy systems. These arrangements enable investors to take advantage of the federal production tax credit (PTC), while allowing local governments to finance wind energy systems with reduced upfront costs. Investors typically maintain primary ownership of wind energy systems for up to 10 years, which is the time limit for the PTC. After this period, investors sell their portion of the wind energy system to the local government. With this arrangement, referred to as the "Minnesota Flip Business Model," local governments are able to receive the economic benefits associated with producing wind energy with limited upfront capital costs.

Local governments considering investment in wind energy systems should first determine if they have suitable wind resources.

Wind Energy in Minnesota

Minnesota ranks 9th in the nation for wind energy potential.[52] Minnesota produces more wind energy than any state except California and Texas. Wind energy production is encouraged through State legislation, including the Conservation Improvement Program (CIP), which sets renewable energy objectives for utility companies.[53] Minnesota's renewable energy standards serve as a directive to utilities to develop programs and incentives to advance renewable energy production and use in Minnesota. The State has financial incentives in place for producers of wind energy.[54]

Local governments considering investment in wind energy systems should first determine if they have suitable wind resources. The Windustry website provides information on wind resource assessment techniques: http://www.windustry.org/taxonomy/term/119.

[50] Environmental Law and Policy Center, http://www.elpc.org/.
[51] See the Resources section of this review for more information on grants, loans, CREBS and available rebate programs for wind energy systems in local government.
[52] The Minnesota Department of Commerce provides wind maps that show wind resources across all regions in Minnesota: http://www.state.mn.us/portal/mn/jsp/content.do?contentid=536887066&contenttype=EDITORIAL&agency=Commerce.
[53] Minn. Stat. § 216B.241.
[54] Further information on financial incentives and tools for local governments can be found in the Resources section of this review.

Benefits of Wind Energy Systems

- Paybacks for investment in wind energy systems range from 6 to 15 years.
- Excess wind energy can be sold to local utilities, resulting in reduced energy costs and potential profit for owners of wind energy systems.
- Various financial incentives are available for wind energy systems including grants, tax credits and rebates.[55]
- Using wind energy, instead of fossil fuels, will insulate your local government from fluctuating energy costs.

[55] See the Resources section for more specific information on financial incentives and resources for wind energy systems in local government.

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CASE STUDY

DISPLACEMENT VENTILATION SYSTEMS SCHOOL BUILDINGS

Location: Anoka-Hennepin School District, MN
Contact: Louis Klingelhoets, Director of Buildings and Grounds
E-mail: louie.klingelhoets@Anoka.k12.mn.us
Website: http://www.anoka.k12.mn.us/

Background

The Anoka-Hennepin School District needed to replace aging ventilation systems in several buildings due to costly maintenance, non-availability of repair parts and equipment failures. They began installing displacement ventilation systems in area schools.

Facility Overview

Full displacement ventilation systems are in use in Evergreen Park Elementary, Mississippi Elementary and University Avenue Elementary in the Anoka-Hennepin School District.

Partial displacement ventilation systems are in place at Adams Elementary, Champlin Elementary, Coon Rapids Middle School, Jackson Middle School, Johnsville Elementary, L.O. Jacob Elementary, Morris Bye Elementary, Riverview Elementary, and Roosevelt Middle School. Partial systems are less expensive and were used where there were budgetary restrictions and where at least some part of the existing systems was adequate.

Project Detail

The displacement ventilation systems installed in Anoka-Hennepin schools have occupancy load sensors which automatically reduce temperature and fresh air intake when the room is unoccupied, resulting in energy savings. The ductwork used in the systems is more compact than conventional ventilation systems and other types of displacement ventilation systems. The compactness was important because several of the schools needing ventilation retrofits were low-profile buildings with limited space.

Alternative funds, Health and Safety funds, and general Capital Improvement funds were used to finance the project.

Cost-Benefit Analysis

Costs[56]	Rebate[57]	Annual Energy Savings	Payback
$1.2 million	$25,000	See below	N/A

The School District has not conducted a study of the annual energy savings for displacement ventilation systems. However, the U.S. Department of Energy states that displacement ventilation systems typically reduce energy costs by 15 percent compared to conventional mixing systems.[58] According to the School District, installing a conventional system in one of the area schools would have cost approximately $200,000 more than the cost for installing the displacement ventilation system.

Image by Armstrong Torseth Skold & Rydeen, Inc.
Dr. Bonnie Johnson, Principal (left) and Kindergarten Teacher, Rachel Palmer (right) at University Avenue Elementary School in Blaine, Minnesota.

[56] Estimated cost for one school.
[57] This is an estimate of the rebate for one school.
[58] William Kingrey (P.E. Energy Engineer, Department of Energy, Energy Efficiency and Renewable Energy Information Center), in discussion with the Office of the State Auditor, June 9, 2008; and email message to the Office of the State Auditor with attachments, June 10, 2008.

Lessons Learned

"To find a replacement for the existing classroom univent system, we conducted an exhaustive investigation of ventilation systems and testing. The positive displacement system selected offered the best solutions to a wide variety of obstacles and indoor air quality concerns unmatched by any systems that I have seen yet today. I have also learned that not all positive displacements systems are the same, some require secondary fans, others require increased fan capacities, thus requiring larger ductwork. The system is energy efficient and cost effective. It provides a high degree of comfort and it is less disruptive to classroom activities."

-Louis Klingelhoets, Director of Buildings and Grounds, Anoka-Hennepin School District

SUPPLEMENTAL INFORMATION

DISPLACEMENT VENTILATION SYSTEMS

Positive displacement ventilation systems provide improved air quality, thermal comfort, and increased energy efficiency.

Displacement ventilation or positive displacement ventilation systems provide improved air quality, thermal comfort, and increased energy efficiency. These systems have been in use in Scandinavian countries since the 1970s, only recently becoming more common in the United States, particularly for classroom applications.[59] Most buildings in the U.S. use conventional "mixing" ventilation systems. Mixing systems introduce air at high velocity, near the ceiling level, at a temperature of approximately 20 degrees Fahrenheit below the desired room temperature. The new, conditioned air mixes or churns with the existing air to reach the desired room temperature. Mixing systems provide little protection from drafts for building occupants because the air supply is coming in at the ceiling level, a significant distance away from occupants and draft sources. In displacement ventilation systems, the air supply temperature is 62 to 67 degrees Fahrenheit compared to 50 to 55 degree temperature in conventional systems. Displacement ventilation systems introduce air at a low velocity, at floor level, close to occupants and draft sources. New air rises from the floor level, displaces the old air and pushes it to the ceiling level where it is removed from the space. (*See* illustration below.)

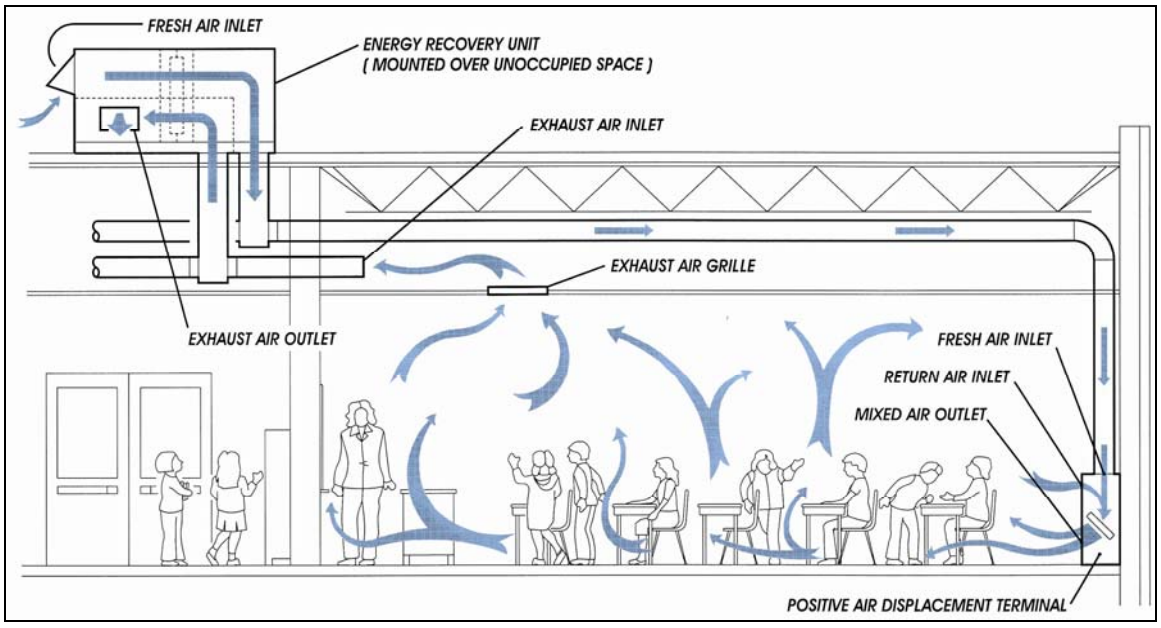

Image from Armstrong Torseth Skold & Rydeen, Inc.

According to the U.S. Department of Energy, displacement ventilation systems typically reduce energy costs by 15 percent when compared to conventional mixing systems.[60] Further economic advantages may be realized from reduced maintenance

[59] U.S. Environmental Protection Agency, http://www.epa.gov/iaq/schooldesign/hvac.html.
[60] U.S. Department of Energy, Energy Efficiency and Renewable Energy, http://www.eere.energy.gov/.

costs due to a more effective, simplified and durable system design. The energy savings from displacement ventilation systems are mostly from building cooling. Therefore, it is likely that more energy savings can be achieved in warm climates. However, studies show that displacement ventilation systems can reduce energy costs in Minnesota's climate. Efficiency is site specific: Climate, humidity, building design and other factors will have an impact.

Benefits of Displacement Ventilation Systems

1. Energy and Cost Savings

- Energy costs are reduced.
- Displacement ventilation systems can result in cooling energy savings of 15 to 50 percent over conventional systems.[61]
- Displacement ventilation systems are reported to reduce maintenance costs.
- Additional economic benefits may result from using airside economizers when outside conditions are appropriate.[62]
- Rebates are available from some local utilities.[63]

2. Superior Air Quality

- Displacement ventilation systems provide improved air quality and increased efficiency of contaminant removal.

3. Improved Acoustics and Comfort

- Introducing air supply at a lower velocity and higher temperature results in greater thermal comfort for occupants.
- The operation of displacement ventilation systems are quieter than conventional systems.

[61] "Advanced HVAC Systems for Improving Indoor Environmental Quality and Energy Performance of California K-12 Schools," California Energy Commission, June 2006, http://www.archenergy.com/ieq-k12/Public/Proj4_Deliverables/D4.2g1_CHPSTrainingMats_2006-0602.doc.

[62] Airside economizers use outdoor air to meet air supply conditioning needs when climate is appropriate, or not extreme. *See*: http://www.epa.gov/iaq/schooldesign/hvac.html.

[63] Check with your local utility provider for information on rebates.

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CASE STUDY

LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN LEED CERTIFICATION CRIMINAL JUSTICE CENTER

Location: Blue Earth County, MN
Contact: Dennis McCoy, County Administrator
E-mail: dennis.mccoy@co.blueearth.mn.us
Website: http://www.co.blue-earth.mn.us/dept/justicecenter.php

Background

In 2003, a Department of Corrections Inspection Report to Blue Earth County stated that the jail was not meeting compliance standards for staffing and inmate housing. In response, Blue Earth County decided to build a new Criminal Justice Center that, upon completion, will apply to become LEED certified. In 2007, the County approved the construction contracts and broke ground. The new Blue Earth County Justice Center is expected to open in March 2009.

Facility Overview

The new 168,000 square-foot facility will include the following:

- Sheriff's Department
- County Attorney
- County Jail
- Corrections Department
- County Courts

Project Detail

LEED certification involves a holistic approach to design and building. It addresses both environmental soundness and energy efficiency. This case study discusses only the energy-efficiency aspects of the project.

Building Commissioning

> *"Commissioning helps the project save money during its ongoing operation and maintenance. Ultimately, everyone benefits when the building is operating at its peak performance through reducing occupant complaints and allowing staff to enjoy a healthier and more productive indoor environment."*
>
> -Kevin Flynn, EcoDEEP, project consultants

The commissioning process begins at the building design phase and continues into building operation. This process includes a review of the design by a third party, and the creation of a commissioning plan that will outline actions to ensure the building is designed and tested to perform at a high level of operational efficiency. It also includes verification of building systems installation processes, equipment and systems start-up and check-out, functional testing and test procedures of each system and product, and development of an operations manual and training of maintenance staff. Blue Earth County expects to achieve greater energy and operational efficiency through the use of an objective third-party commissioning process.

Thermal Comfort

The building will use various design strategies to provide thermal comfort while reducing energy costs. These design strategies include insulation at the thermal envelope, a geothermal heating and cooling system, variable air volume controls, a heat recovery system, and occupancy sensors to control variable air volume devices and ventilation rates. The building will also use shading, insulation, high quality glazing and thermal mass to manage interior surface temperatures of walls, ceilings, floors and windows.

Lighting

The project will use efficient lighting, daylight optimizing design, lighting controls, dual level switching, and occupancy sensors in the building. Ninety percent of all regularly occupied spaces will have individual occupancy controls.

Equipment and Appliances

ENERGY STAR®-rated equipment and appliances will be used for more than 70 percent of the equipment and appliances installed in the project, including office equipment, electronics and commercial food service equipment.

Image by Paulsen Architects

Water

The Justice Center will have low flow toilets, urinals, faucets, sinks and showerheads, and efficient dishwashers. Design models show projected annual cost savings attributable to reduced water usage at $1,661.

The project eliminates the use of potable water for irrigation by using drought-tolerant and resistant native and adapted vegetation. The landscaping system is set up to collect, harvest and store rainwater for irrigation purposes. The annual projected cost savings attributable to reduced water usage for irrigation is $2,534.

The project includes a storm water management plan designed to minimize the necessary storm water infrastructure needs. The system will also help to recharge local aquifers through on-site infiltration.

Cost-Benefit Analysis[64]

Energy models show that the total energy savings potential for the new Blue Earth County Criminal Justice Center is 42.6 percent compared to a building constructed to current code. The total estimated construction cost for the facility is $33.4 million. Following is the cost-benefit analysis for LEED certification only.

Cost	Estimated Payback
$117,126	1 yr.

[64] Summary of the design features, technologies and strategies was provided by EcoDEEP, design consultants on the Blue Earth County project and members of the U.S. Green Building Council.

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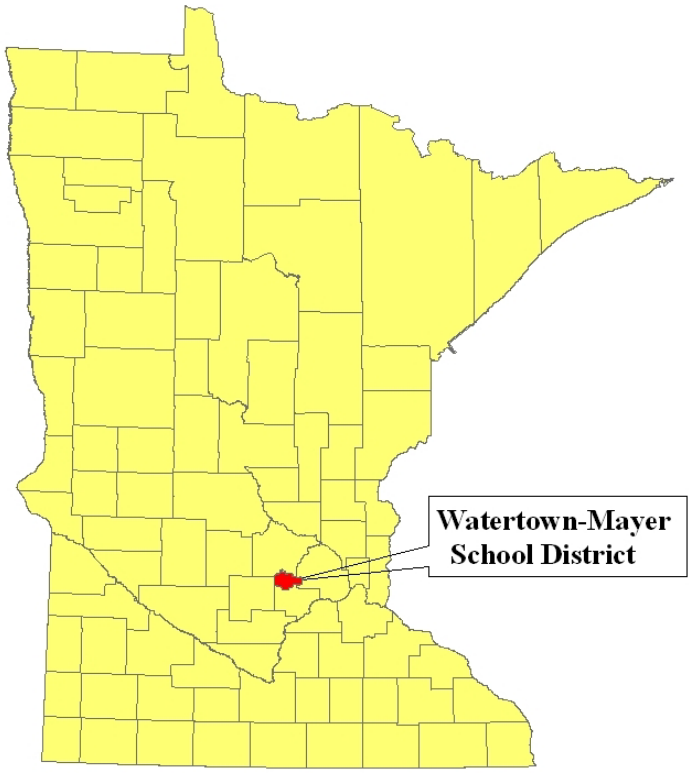
Case Study

LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN LEED CERTIFICATION SCHOOL DISTRICT

Location: Watertown-Mayer School District, MN
Contact: Karsten Anderson, Superintendent
E-mail: kanderson@wm.k12.mn.us
Website: www.wm.k12.mn.us



Background

The Watertown-Mayer School District made energy efficiency an early goal when planning for a new elementary school. An engineering firm with experience installing energy-efficient systems was selected for the project. The School District worked with Xcel Energy and the Weidt Group to design the building. The new Watertown-Mayer Elementary School opened on September 4, 2007. The Elementary School is a LEED registered project, with a certification goal of LEED Silver.[65]

Facility Overview

The school is a 2-story facility with 86,400 square-feet of space designed for 600 students. It is located on 20 acres of land in Watertown, Minnesota.

Project Detail

The Elementary School was designed to incorporate energy-efficient and environmentally-sound features and, upon completion, will apply to become LEED certified.

[65] Projects that meet designated levels of performance are awarded a LEED rating of Certified, Silver, Gold, or Platinum. LEED Platinum is the highest standard in the LEED system.

Building Commissioning

Building commissioning was arranged to test and verify operational efficiency. (*See* LEED Case Study for Blue Earth County Criminal Justice Center.)

Thermal Comfort/Air Quality

Energy-efficient systems include a geothermal heating and cooling system[66] and a displacement ventilation system. Energy models show that the displacement ventilation system could save $11,000 per year in energy costs compared to a mixing ventilation system.

Lighting

Compact fluorescent light fixtures were installed throughout the school. The building is designed to optimize daylight: 75 percent of occupied spaces receive daylight. Dual level switching and dimmers were installed in various areas to allow for partial lighting when appropriate. Occupancy sensors were installed throughout the facility to turn off lights when unneeded.

[66] *See*: Geothermal Case Study featuring Watertown-Mayer Elementary School.

Water Efficiency

The efficient use of water is expected to cut costs. Efficient plumbing fixtures, such as no-touch sinks and fountains, were used. Water-efficient landscaping techniques that reduce the need for irrigation were also used.

Cost-Benefit Analysis[67]

The total cost for the new Watertown-Mayer Elementary School building was $13.9 million. The School District received rebates of $113,830. The additional costs and payback for LEED certification were not broken out separately. However, energy models estimate the School District will save 59 percent, or $92,576 annually, in energy costs compared to a code-based facility.

[67] Information for the cost-benefit analysis was provided by the Weidt Group.

SUPPLEMENTAL INFORMATION

LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED)

Key Categories of LEED Evaluation

1. Sustainable Site Development
2. Water Savings
3. Energy Efficiency
4. Materials Selection
5. Indoor Environmental Quality

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System is a benchmarking program for the design, construction and operation of high performance buildings. The LEED system was introduced in 1998 by the Green Building Council to define and quantify the performance of energy-efficient, environmentally-sound buildings.[68] The system includes rating criteria for various types of projects including LEED for New Construction, LEED for Existing Buildings, LEED for Commercial Interiors, LEED for Core & Shell, LEED for Homes, and LEED for Neighborhood Development.

LEED in Government

Twenty-five percent of all LEED-certified projects are owned by federal, state or local government entities. As of February 2008, all 50 states had LEED projects and 26 states had adopted LEED-related legislation. In addition, more than 110 local governments had adopted LEED standards by incorporating them into local ordinances and resolutions. Other entities encourage the adoption of LEED standards by offering discounts on building permit fees.[69] The U.S. Green Building Council provides case studies of LEED buildings and policies, as well as summaries of LEED incentives and programs.

Twelve buildings in Minnesota are LEED-certified, including Westwood Elementary School in the City of Elk River. Minnesota has more than 100 projects that, upon completion, will apply to become LEED certified, including:

- Blue Earth County Criminal Justice Center,
- City of Moorhead, Library Green,[70] and
- Minnesota Ballpark Authority, Twins baseball stadium.

[68] The U.S. Green Building Council is a non-profit organization focused on green building design initiatives.
[69] U.S. Green Building Council, http://www.usgbc.org/.
[70] LEED for Neighborhood Development pilot project.

Some local governments have implemented policies to mandate or recommend LEED certification for new or existing building projects. In 2006, the City of Minneapolis passed a resolution requiring all City projects to follow LEED guidelines: "all new or significantly renovated municipal facilities (financed by the City of Minneapolis and utilized by the City's Charter Departments) of 5,000 square feet or greater, should be built to a LEED Silver level of quality with emphasis in LEED points related to 'Energy and Atmosphere,' unless otherwise directed by the City Council." [71]

Registration and Certification Fees

The costs associated with registering and certifying LEED projects are set according to project type and size, as well as U.S. Green Building Council membership status.[72] Registration fees for LEED projects are $450 for U.S. Green Building Council members and $600 for non-members. Certification fees range from $500 to $22,500.[73] LEED Platinum projects receive a rebate of all certification fees.[74]

LEED Certification Process

Obtaining LEED certification is a multi-step process. The first step, registering a project, requires meeting a set of preliminary criteria or minimum project standards. Next, the project earns points toward certification by incorporating sustainable building design and technologies. Projects that meet designated levels of performance are awarded a LEED rating of Certified (26 to 32 points), Silver (33 to 38 points), Gold (39 to 51 points), or Platinum (52 to 69 points), with a LEED Platinum rating being the highest standard for sustainability and performance.

[71] See: City of Minneapolis Resolution 2006R-381.

[72] U.S. Green Building Council members pay annual dues to access resources related to sustainable building practices. Membership benefits and due schedules are on the organization's website: http://www.usgbc.org/.

[73] Fee schedules for registration and certification are listed on the U.S. Green Building Council website: http://www.usgbc.org/.

[74] Rebates are available for Platinum certified projects in the following categories: LEED New Construction, LEED Existing Buildings, LEED Commercial Interiors, LEED for Core & Shell and LEED for Schools.

Benefits

In most cases, the economic benefits associated with LEED certification cover any additional costs of implementing the standards within the first few years of operation.[75] LEED-certified buildings are 10 to 64 percent more energy efficient than conventionally designed buildings. In addition, improved work environments in LEED-certified buildings have been shown to positively affect worker productivity and employee retention rates.[76] Economic benefits associated with LEED buildings are site specific.

Benefits of LEED Building

Economic

- Reduce energy and operating costs
- Increase value of assets and property
- Increase occupant productivity, retention rates
- Optimize life-cycle economic performance
- Stay ahead of building regulations
- Reduce liabilities

Health and Community

- Improve air, thermal, and acoustic environments
- Foster community recognition
- Minimize strain on local infrastructure

Environmental

- Minimize impact on ecosystem and biodiversity
- Reduce solid waste
- Improve air and water quality

Costs

The studies below show that the average additional cost of achieving LEED certification is less than 3 percent of total construction costs, with a payback period of less than 10 years.

- A 2006 study by Rebuild Colorado, a program of the Colorado Governor's Office of Energy Management and Construction, examined the cost of LEED certification for several new building projects. The study concluded that the additional cost for using LEED certification standards ranged from 1 to 6 percent of total construction costs.

- In 2004, the U.S. General Services Administration (GSA), which constructs buildings for the federal government, analyzed the direct and indirect costs of achieving LEED certified Silver and Gold ratings for a new federal courthouse and mid-rise federal office building modernization project. The study found that the additional project costs for LEED certification ranged from 2 to 5 percent of total project costs.

[75] Steve Winters and Associates, Inc., U.S. General Services Administration, LEED Cost Study Final Report, October 2004, http://www.wbdg.org/ccb/GSAMAN/gsaleed.pdf.
[76] U.S. Department of Energy, Energy Efficiency and Renewable Energy, http://www.eere.energy.gov/.

- A report released in 2004 by the property management firm, Davis Langdon, compared the cost per square foot of 45 LEED-certified projects with 93 projects with conventional construction plans. The report focused on libraries, classrooms and labs, and found no significant additional costs for achieving LEED certification.

- A 2003 study prepared for the State of California's Sustainable Building Task Force examined LEED registered projects in 25 office buildings and 8 schools. The study found additional project costs associated with LEED certification averaging less than 2 percent, or $3 to $5 per square foot. The financial benefits were about 10 times as large. The study also noted that the additional costs associated with LEED certification diminish as planners gain experience with the processes.

Recommendations

The costs associated with LEED certification processes decrease significantly when the standards are considered early in the project planning process. If consideration of LEED certification happens late in the planning process, additional costs may result from the need to redesign or change project plans.

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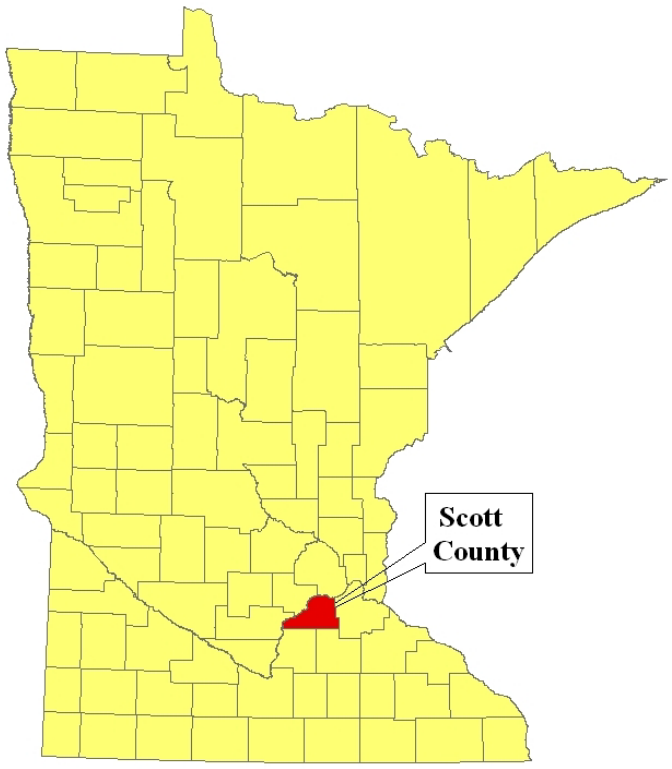
CASE STUDY

ENERGY PERFORMANCE CONTRACTS HIGHWAY MAINTENANCE FACILITY

Location: Jordan, MN
Contact: Donald M. Fehr, Facilities Manager
Email: dfehr@co.scott.mn.us
Website: www.co.scott.mn.us

Background

In 2004, Scott County contracted with an energy services company to audit their energy use and to identify possible facility upgrades at the County's 20-year-old Highway Maintenance Facility. The energy audit showed that the Highway Maintenance Facility was in need of several upgrades, including comprehensive lighting and mechanical system retrofits. The County contracted with the company that performed the energy audit to perform the work and finance it with a 15-year energy performance contract in 2005.[77] The County worked with the local energy services company, or ESCO, to develop, install, and arrange financing for the project.[78]



Facility Overview

The Highway Maintenance Facility is a 58,500 square-foot facility, with approximately 70 County employees. The office portion of the facility is 12,950 square feet, with the remainder being used for vehicle maintenance and storage.

[77] An energy performance contract allows building owners to finance projects with expected energy savings. Generally, the company arranging the financing conducts an energy audit, identifies investment costs and expected paybacks.
[78] National Association of Energy Service Companies, http://www.naesco.org/.

Project Detail

The improvements financed with the energy performance contract included retrofitting boilers with high-efficiency models, and installing energy management controls for the facility's HVAC system. Electrical system improvements included adding energy-efficient motors and variable frequency drives. Lighting retrofits were done in the office, shop and garage areas. Rooftop ventilation units were replaced. A diesel-powered generator was installed, which supplies the facility with energy during utility peak demand hours.

> *"Following the energy study, we discussed the possibility of pursuing the recommended improvements ourselves, but realized we did not have the required staff or expertise to complete the project. It would have required us to hire engineers to provide the services that the energy services company was offering, and then additional staff or consultants to implement the projects as well."*
>
> -Donald Fehr, Facilities Manager, Scott County

Cost-Benefit Analysis

Costs	2006 Energy Savings	Payback
$996,080	$46,066	15 yr. contract

The energy savings from the improvements are used to repay the financing of the project, and the energy service company covers any difference between the guaranteed energy savings and the actual savings. The energy performance contract exceeded the amount repayable by the guaranteed energy savings. The County chose to implement improvements beyond those guaranteed to repay the contract.

Summary of Savings for 2006[79]

Type of Savings	Guaranteed Savings	Actual Savings
Electricity	$6,536	$7,804
Electric Demand	1,079	1,239
Gas	19,784	24,158
Utility Rate Changes	10,534	11,704
Operational Savings	1,160	1,160
Total	**$39,093**	**$46,065**

The difference between the guaranteed and actual savings is realized by Scott County in reduced energy costs.

[79] The energy services company provides the County with annual updates on the actual performance and savings of the facility upgrades. The calculations for guaranteed savings were determined at the time of the contract using 2004 energy prices.

Lessons Learned

"All of the work completed could have been done through other methods, but it likely would not have happened. The constant struggle to compete with other worthwhile uses for ever shrinking funding leaves the retrofitting of boilers and air handlers undone. This method of guaranteed funding is an easy way to sell needed improvements without asking for additional funding. It also improves the indoor environment and employee satisfaction. I do not believe we would have done anything differently. The company did exactly what they said they would, and we are pleased with the outcome. We have contracted with them to study other County buildings."

-Donald Fehr, Facilities Manager, Scott County

SUPPLEMENTAL INFORMATION

ENERGY PERFORMANCE CONTRACTS

The primary benefit of energy performance contracts is that building owners are able to finance building improvements with little or no upfront costs.

Energy performance contracts allow building owners to finance improvement projects with expected energy savings.[80] Usually, a qualified Energy Services Company (ESCO) conducts an energy audit to identify areas for improvement. An ESCO is a company that develops, installs, and arranges financing for projects designed to improve the energy efficiency and maintenance costs over a specific period of time.[81] The results of the energy audit are presented to the building owner with information on investment costs and expected paybacks. The ESCO typically recommends bundles, or specific sets of improvements, to pursue and building owners decide which improvements to implement. The ESCO guarantees that the expected energy savings from the implemented improvements will meet or exceed the annual payments needed to repay the project costs within a given timeframe, usually 10 to 15 years for large projects.[82] If the expected energy savings are not achieved, the ESCO will pay the difference between the guaranteed and actual energy savings.

Energy performance contracts enable building owners to finance building improvements with little or no upfront costs. The ESCO generally arranges project financing through a preferred financial institution. A portion of the actual energy savings from facility upgrades is used to compensate the providers of these contracts for the cost of borrowing funds and for the risk associated with the investment. This arrangement has led to some debate about whether energy performance contracts are the most cost-effective way to finance facility improvements. A 2004 report from the Government Accountability Office found that upfront appropriations to finance building improvements are more cost-effective than energy performance contracts, mainly because building owners are not required to use cost savings to compensate energy service providers.[83]

Additional concerns about energy performance contracts involve the limited choice of brands and project contractors under some agreements. For example, if the ESCO also sells a particular line of products, the customer may have little choice about the brand of equipment or appliances installed and financed through the energy performance contract. Despite these concerns, energy performance contracts have become an increasingly popular way to finance facility improvement projects without upfront costs.

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[80] Local governments entering into energy performance contracts should complete the IC134 form in accordance with Minn. Stat. § 270C.66.

[81] National Association of Energy Service Companies, http://www.naesco.org/.

[82] Minnesota law requires that energy performance contracts in local government not exceed 15 years. See Minn. Stat. § 471.345.

[83] Government Accountability Office, "Capital Financing Partnerships and Energy Savings Performance Contracts Raise Budgeting and Monitoring Concerns," December 2004, http://www.gao.gov/new.items/d0555.pdf.

Recommendations

Guidelines for Selecting a Provider for Energy Performance Contracting*

1. Select a reputable provider
   - Ask for references and contact past customers for quality verification.
   - Work with a provider that can perform the range of services that will be needed, including energy audit functions, project design, installation and maintenance.

2. Look for a low bid and consider alternative options
   - Negotiate a contract that reasonably limits the profit for the ESCO, while establishing a win-win arrangement.
   - Compare the advantages and disadvantages of sharing savings in an energy performance contract with the fees and services included in other contractual agreements and financing arrangements.

3. Analyze bundles or different sets of improvement options
   - Consider bundling measures with quick and longer-term paybacks to balance risk.

4. Do not sacrifice quality for energy savings
   - Ensure that the energy services company is installing quality equipment that will meet the needs and preferences specific to your local government.

5. Test new products and technologies
   - Work with the provider to test the new equipment to ensure that the performance and quality meets the needs of your local government.

6. Seek warranties and training
   - Request that extended product warranties and personnel training be included in the bid specifications.

7. Organize a team of internal staff members
   - Have internal staff members form a team to work with the provider to choose appropriate energy measures, prepare bid specs, pre-qualify prospective bidders, and perform other tasks associated with the contract.

8. Be involved in the construction planning
   - Design project implementation in a way that allows your local government to continue service delivery and perform work tasks to the greatest extent possible.

9. Document and communicate results
   - Document energy and non-energy benefits and publicize its success to the community.

*Guidelines are summarized from the U.S. Department of Energy Efficiency and Renewable Energy: http://www1.eere.energy.gov/buildings/commercial/financing.html.

On the Horizon

The 2008 Minnesota Legislature passed legislation creating a new energy financing improvement program for local governments.[84] This program will help local governments access technical assistance and capital for projects to improve energy efficiency through a lease-purchase financing structure and a supplemental finance agreement. The program is designed to reduce energy costs by providing the following resources:

- Technical assistance to assess cost-effective energy-saving opportunities.
- Standard tax-exempt lease financing terms with private financial institutions.
- Guaranteed net positive cash flow provided by the State to backup investments with supplemental financing if improvements do not result in a net positive cash flow.

The Minnesota Office of Energy Security (OES) and the Minnesota Department of Commerce will administer the program. The program is expected to be launched by January 2009. For more information on this program, contact Jeremy DeFiebre, State Energy Office Operations Supervisor, Minnesota Office of Energy Security at Jeremy.Defiebre@state.mn.us.

[84] 2007 Minn. Laws ch. 356.

Resources for Local Governments

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Financing Resources

Alliance to Save Energy, Financing Energy Efficiency
This website includes a database of over 60 energy-efficiency funds and programs. It provides information about each fund, including interest rates, loan terms, minimum and maximum loan amounts, eligible sectors and technologies, contact information, and more. Most programs are loan funds, but the inventory also includes some loan guarantee and equity funds.
http://www.ase.org/section/topic/financingee

American Wind Energy Association
This national trade association provides resources related to wind energy project development, including financing information, wind energy publications, case studies, educational materials, and answers to technical and policy questions.
http://www.awea.org/

Clean Energy Resource Teams (CERTS)
CERTS includes 7 regional teams located throughout Minnesota. The teams study and assist in the implementation of renewable energy technologies and resources in each region. The CERTS website provides case studies of renewable energy initiatives in each region. In addition, a list of resources on renewable energy technologies is provided, including information on financing sources.
http://www.cleanenergyresourceteams.org/

Database of State Incentives for Renewables and Efficiency
This database of state incentives for energy efficiency and renewable energy is searchable. The website provides information on Minnesota-specific financial incentives, including production incentives, loan programs, grants and rebate programs. In addition, it provides links to energy-related rules, policies and regulations in Minnesota and to related energy programs and initiatives. An exceptional part of this website is the list of links to energy-related programs offered by utility companies throughout Minnesota.
http://www.dsireusa.org/

ENERGY STAR®
ENERGY STAR® is a program of the U.S. Environmental Protection Agency and the U.S. Department of Energy which certifies and promotes energy-efficient products. In addition, this organization provides information, tools, resources and programs designed specifically for improving energy efficiency in local government. In addition, the website provides a searchable database, which allows users to find ENERGY STAR® labeled buildings by state and building type.
www.energystar.gov

ENERGY STAR® for Local Governments
This website includes tools and resources specifically for improving energy efficiency in local government. The website includes information on the following resources:

- Information on the ENERGY STAR® Challenge, a program aimed at improving energy efficiency in commercial and industrial buildings.
- Guidelines for energy management and improved efficiency.
- Access to a free energy portfolio manager.
- Lists of ENERGY STAR® qualified products.
- Information on financing options for energy efficiency-related investments and projects.
- Case studies of energy-related programs and initiatives in local governments across the country.

http://www.energystar.gov/index.cfm?c=government.bus_government_local

ENERGY STAR® for K-12 Schools provides information and resources for energy management and cost reduction in K-12 schools. ENERGY STAR® provides information and resources in the following areas:

- Training and educational resources
- Benchmarking and tracking energy use
- Ideas and resources for building upgrades
- Resources on financing lighting and energy-related improvements
- Information on outreach campaigns and programs
  http://www.energystar.gov/index.cfm?c=k12_schools.bus_schoolsk12

International City/County Management Association's Local Government Environmental Assistance Network
This website provides various tools for local governments pursuing a variety of environmental projects, including air quality and energy-efficiency initiatives. Specific resources include a guidebook of project financing tools, energy, water and waste consumption calculator, roof energy cost savings calculator for various products and roofing types, a grant writing tutorial for small communities, a sustainable building manual and other building energy design tools and resources.
http://www.lgean.org/html/toolbox.cfm

Midwest Energy Efficiency Alliance (MEEA)
This website provides an Energy Efficiency Resource Center with energy codes and appliance standards, energy-related programs, financing resources and policy initiatives in Midwest states.
http://www.mwalliance.org/

Minnesota Center for Energy and the Environment (MNCEE)
This non-profit organization connects local governments with energy audits, commissioning and recommissioning services, and with financing resources for energy-related projects.
http://www.mncee.org/

Minnesota Department of Commerce, State Energy Office
The Energy Information Center is a comprehensive resource center for energy-related tax incentives, grants and project loans. The website covers various types of energy initiatives, including lighting, solar, wind, heating and cooling, and building standards.
www.commerce.state.mn.us

> **Energy Incentives and Grants**
> The website reviews various incentives, grants and loans for energy initiatives. More specifically, it provides information on current energy funding opportunities, renewable energy incentives, federal tax incentives for energy conservation and depreciation information.
> http://www.state.mn.us/portal/mn/jsp/content.do?subchannel=-536881511&programid=536885394&id=-536881350&agency=Commerce&sp2=y

Minnesota Department of Health, Indoor Air Quality Resources for Schools
The MDH has created a resource list for school officials relating to indoor air quality monitoring and improvements. The document includes a list of financing resources for indoor air quality improvement projects.
http://www.health.state.mn.us/divs/eh/indoorair/schools/schooliaqresources2.pdf

Rebuild America's Schools Program
The website provides a link to resources related to school design and modernization, including a link to a toolkit for schools to find financing resources for energy-related projects. The toolkit includes resources specifically for rural schools.
http://www.modernschools.org/ras/

U.S. Department of Energy's EnergySmart Schools
This website contains information and resources on financing energy projects for schools. It also contains planning tools and resources for school officials
http://www.eere.energy.gov/buildings/energysmartschools/
http://www.modernschools.org/ras/

U.S. Environmental Protection Agency
This website contains funding opportunities for green buildings:
http://www.epa.gov/greenbuilding/tools/funding.htm

Cost Calculators

Alliant Energy, Energy Efficiency Calculators
Alliant's resources include energy-efficiency calculators for HVAC equipment, T8 fluorescent lighting, compact fluorescent lighting, LED exit lights and boilers.
http://www.alliantenergy.com/docs/groups/public/documents/pub/p013446.hcsp

Cash Flow Calculator
The U.S. Environmental Protection Agency has developed a spreadsheet to help decision-makers calculate the costs and savings associated with energy-efficient investments.
http://www.energystar.gov/index.cfm?c=business.bus_financing

Dialight LED Traffic Signal Module Savings Calculator:
http://www.dialight.com/excel/calctraf.xls

International City/County Management Association's Local Government Environmental Assistance Network
This website provides various tools for local governments pursuing a variety of environmental projects, including air quality and energy-efficiency initiatives. Specific resources include a guidebook of project financing tools, energy, water and waste consumption calculator, roof energy cost savings calculator for various products and roofing types, a grant writing tutorial for small communities, a sustainable building manual and other building energy design tools and resources.
http://www.lgean.org/html/toolbox.cfm

Life Cycle Cost Estimate for ENERGY STAR® Qualified Lighting Fixtures
http://www.energystar.gov/index.cfm?c=join.tools_calculators

Information Resources: Minnesota

Clean Energy Resources Teams (CERTS)
CERTS includes 7 regional teams located throughout Minnesota. The teams study and assist in the implementation of renewable energy technologies and resources in each region. The CERTS website provides case studies of renewable energy initiatives in each region. In addition, a list of resources on renewable energy technologies and resources is provided, including information on financing sources for energy projects.
http://www.cleanenergyresourceteams.org/

> **Energy Efficiency Workshops for School and Local Government Building Operators**
> Workshops for building operators, superintendents, and school business managers focus on topics related to building energy-efficiency issues, including suggestions for equipment, rebate programs, and tactics for working with teachers, students, and administration. Check the CERTS website for future workshop dates.
> http://www.cleanenergyresourceteams.org/technology/energy-efficiency

ECONAR
ECONAR is the one geothermal manufacturer located in Minnesota. The website provides case studies of geothermal systems in Minnesota**,** including examples in local government.
http://www.econar.com/

Green Institute
A non-profit organization that provides energy/environmental resources, including:

> **Green Buildings Program:** This program provides technical assistance to organizations and individuals, including local governments, related to sustainable building design and operations.
>
> **Re-Use Center:** This entity markets high quality salvaged building materials and green building products.
>
> **Community Energy Program:** This program provides services to government agencies to help them incorporate clean energy decisions and programs into communities.
> http://www.greeninstitute.org/

The Green Institute is leading a collaborative effort to launch the **"GreenStar Cities Initiative."** This program will focus on helping local governments access financial resources, technical assistance and other tools to pursue cost-effective, sustainable practices related to energy, water, buildings, transportation and development. For more information on this program, please check the Clean Energy Resource Teams (CERTS) website or contact the Green Institute for more information.

Midwest Energy Efficiency Alliance (MEEA)
This website provides an Energy Efficiency Resource Center with resources on energy codes and appliance standards, energy-related programs, financing resources and policy initiatives in Midwest states.
http://www.mwalliance.org/

> **Building Operator Certification (BOC)**
> BOC is a training and certification program offered by the MEEA for operations and maintenance staff focused on improving energy efficiency in buildings.
> http://www.mwalliance.org/program_page.php?page=Building%20Operator%20Certification

Minnesota B3 Benchmarking System
Minnesota law requires that all public buildings in the state be benchmarked through the Minnesota B3 Benchmarking program. This benchmarking program uses an energy model to compare actual facility energy performance with a model of the same facility, as it would perform under current State energy code. The results of this analysis and important information on energy performance for the benchmarked facility will be provided to local governments for use in making energy-related improvements.
http://www.mnbenchmarking.com/

> The Minnesota B3 Benchmarking website provides a useful tutorial on the benchmarking system.
> http://www.mnbenchmarking.com/B3SiteTutorial/B3SiteTutorial.html

Minnesota Building Code Assistance Project
This website contains detailed information on current energy codes in the State of Minnesota.
http://www.bcap-energy.org/

Minnesota Center for Energy and the Environment (MNCEE)
This entity is a non-profit organization that connects local governments with energy audits, commissioning and recommissioning services, and with financing resources for energy-related projects.
http://www.mncee.org/

Minnesota Department of Commerce, State Energy Office
The Energy Information Center is a comprehensive resource center for information on energy-related tax incentives, grants and project loans. The website covers various types of energy initiatives, including lighting, solar, wind, heating and cooling, and building standards.
www.commerce.state.mn.us

Energy Incentives and Grants
The website reviews various incentives, grants and loans for energy initiatives. More specifically, this section provides information on current energy funding opportunities, renewable energy incentives, federal tax incentives for energy conservation and depreciation information.
http://www.state.mn.us/portal/mn/jsp/content.do?subchannel=-536881511&programid=536885394&id=-536881350&agency=Commerce&sp2=y

Utility Conservation Resources Information
Another section of the website provides links to conservation programs offered by Minnesota electric and gas utilities.
http://www.state.mn.us/portal/mn/jsp/content.do?subchannel=-536881511&programid=536907777&sc3=null&sc2=null&id=-536881350&agency=Commerce

Minnesota Department of Health, Indoor Air Quality Resources for Schools
The MDH has created a resource list for school officials relating to indoor air quality monitoring and improvements. The document includes a list of financing resources for indoor air quality improvement projects.
http://www.health.state.mn.us/divs/eh/indoorair/schools/schooliaqresources2.pdf

Minnesota Energy Challenge
Minnesota Center for Energy and the Environment administers the Minnesota Energy Challenge, a program that assists local governments in calculating their carbon footprint and pledging to reduce overall emissions through energy related initiatives.
http://www.mnenergychallenge.org/challenge/

Utility Programs
In addition to information about the Challenge, the website provides links to programs and resources offered by Minnesota utilities for reducing energy use.
http://www.mnenergychallenge.org/resources/govtnonprofit/index.php

Minnesota Healthy Sustainable Schools
This organization is the State's first interagency, cross-sector collaboration helping schools with a variety of energy-efficiency issues, including sustainability and performance.
http://www.healthyschools.state.mn.us/

Minnesota Pollution Control Agency, Green Building
This agency provides information on green buildings specific to Minnesota. The website provides design guidelines, product directories, information on deconstruction and reuse services, local manufacturing and a toolkit for K-12 schools.
http://www.pca.state.mn.us/oea/greenbuilding/index.cfm

> **Design Guidelines, Specifications and Rating Systems, Minnesota Pollution Control Agency (MNPCA)**
> The MNPCA website provides links to tools related to sustainable design, construction, operation and maintenance.
> http://www.pca.state.mn.us/oea/greenbuilding/design.cfm

Minnesota Pollution Control Agency has a green building toolkit for K-12 Schools which contains general resources, teaching materials, and links to case studies.
http://www.pca.state.mn.us/oea/greenbuilding/schools.cfm

Minnesota Pollution Control Agency and Minnesota Office of Environmental Assistance
These two agencies have recently merged. The agency provides information, directories, resources and case studies of high-performance buildings and sustainable building practices in Minnesota. In addition, the website provides information on technical resources and energy-related audits in local government. A unique resource here is a link to tools to use in finding a local green building professional.
http://www.pca.state.mn.us/oea/

> **Disposal of Hazardous Waste**
> Important information on proper disposal of hazardous waste, including light-bulbs and other items, is provided by the Minnesota Pollution Control Agency. The website includes an interactive map to local disposal sites in your area.
> http://www.pca.state.mn.us/waste/hhw/hhw-disposalguide.html

Minnesota Retired Engineers Program (RETAP)
Minnesota RETAP provides technical assistance using retired engineers, scientists, and managers, each with 30-40 years experience in business, technology and waste reduction. Upon request, a team of RETAP professionals can perform an energy audit and provide local government with a written report, including recommendations for process or procedural changes, the application of new technologies, or methods by which an organization can reduce energy costs. Website for RETAP:
http://www.pca.state.mn.us/oea/p2/retap.cfm#climate

Minnesota Climate Change Corps
The Minnesota Climate Change Corps began in November 2007, and its membership consists of skilled, retired professionals who work to help reduce a community's "carbon footprint" (the amount of carbon dioxide released into the environment). City and county governments are the Corps' priorities for assistance.
http://www.pca.state.mn.us/oea/p2/retap.cfm#climate
For more information or to request a FREE assessment, contact Minnesota RETAP at 612-624-1300 or 800-247-0015. (Ask for the retired engineers program.)

Minnesota Sustainable Communities Network
This website contains resources and links related to a variety of energy-related projects in local government, including green buildings, energy efficiency, renewable energy, transportation and distributed energy.
http://www.nextstep.state.mn.us/index.cfm

Minnesota Sustainable Design Guide
This resource provides guidelines for sustainable building design in five categories: Performance Management, Site and Water, Energy and Atmosphere, Indoor Environmental Quality, and Materials and Waste. The guidelines were developed to be compatible with LEED standards, while maintaining a focus on regional priorities and standards.
http://www.sustainabledesignguide.umn.edu/

Minnesota Building Materials Database: A Tool for Selecting Sustainable Materials
http://www.buildingmaterials.umn.edu/

Saving Energy, Energy Conservation Information for Minnesota State Employees
This website provides tips for employees on reducing energy use, tools for building managers and a list of helpful energy conservation links.
http://www.savingenergy.state.mn.us/

Small Wind Minnesota
Small Wind Minnesota provides information specific to buying and installing small wind energy systems in Minnesota.
http://www.awea.org/smallwind/minnesota_sw.html

State of Minnesota Report on Geothermal Heat Pumps
The report examines the differences in energy use, costs and pollution for Ground Source Heat Pumps with conventional heating and cooling systems in residential, commercial and institutional buildings in Minnesota. An appendix of this report provides a complete listing of the 29 geothermal installation companies in Minnesota.
http://archive.leg.state.mn.us/docs/2008/mandated/080477.pdf

Utility Programs
The Minnesota Energy Challenge website provides links to programs and resources offered by Minnesota utilities for reducing energy use.
http://www.mnenergychallenge.org/resources/govtnonprofit/index.php

Windustry
This Minnesota non-profit organization focuses on providing technical support and tools for rural landowners and communities to assess and develop wind energy systems.
http://www.windustry.org/

Information Resources: National

Alliance to Save Energy
Alliance to Save Energy is a non-profit organization providing research and resources for a range of energy efficiency projects.
http://www.ase.org/

Alliance to Save Energy's Green School Program
A program to help schools become more energy efficient through energy audits, building retrofits, and changes in operations and maintenance. The program website provides case studies of "green schools."
http://www.ase.org/section/program/greenschl

Advanced Design Guide for K-12 School Buildings, American Association of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
The design guide for K-12 school buildings ncludes design recommendations by climate, as well as case studies of school design. In addition, the guide provides information on commissioning and ENERGY STAR® appliances for K-12 schools. The design guide is available for free download.
http://www.ashrae.org/publications/page/1604

American City and County
The website and publication provide examples of energy efficiency-related initiatives in cities and counties across the nation.
http://americancityandcounty.com/

American Council for an Energy-Efficient Economy, Guide to Energy Efficient Commercial Equipment
For purchasing or specifying lighting fixtures, heating, ventilating, or air conditioning (HVAC) equipment, motors; transformers; packaged refrigeration units; or office equipment for a commercial building, this Online Guide provides information on the kind of equipment to look for, applications that may favor one type of equipment over another, and other considerations that may affect the efficiency and performance of the system. Topics covered include:

- Energy-efficient lighting and lighting design
- High-performing HVAC systems
- Energy-efficient motor selection
- Best options for other energy-using equipment

http://aceee.org/buildings/coml_equp/index.htm

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
This website has guides available for free download, including:

- Advanced Energy Design Guide for K-12 School Buildings
- Advanced Energy Design Guide for Small Office Buildings
- Advanced Energy Design Guide for Small Warehouses and Self-Storage Buildings

http://www.ashrae.org/publications/page/1604

American Wind Energy Association
This national trade association provides resources related to wind energy project development, including financing information, wind energy publications, case studies, educational materials, and answers to technical and policy questions.
http://www.awea.org/

California Local Energy Efficiency Program Workbook
This workbook, provided by the California Public Utilities Commission, provides steps to designing and implementing local energy efficiency programs.
http://www.caleep.com/workbook/workbook.htm

Collaborative for High Performance Schools
This program has technical resources for school districts relating to the design, maintenance and operation of high performance buildings. In addition, the website has a best practices manual for planning and designing a high performance building.
http://www.chps.net/

Cool Cities Program
This program for cities has signed the U.S. Mayor's Climate Change Protection Agreement, focused on "energy solutions to save money and build a cleaner, safer future."
http://coolcities.us/

Cool Counties Climate Stabilization Initiative
The Cool Counties initiative seeks to organize the resources of all counties in the U.S. to address the challenges climate change poses to counties.
http://www.kingcounty.gov/exec/coolcounties

ENERGY STAR®
ENERGY STAR® is a program of the U.S. Environmental Protection Agency and the U.S. Department of Energy which certifies, and promotes, energy-efficient products. In addition, this organization provides information, tools, resources and programs designed specifically for improving energy efficiency in local government. In addition, the website contains a searchable database, which allows users to find ENERGY STAR® labeled buildings by state and building type.
www.energystar.gov

ENERGY STAR® for Local Governments
This website includes tools and resources specifically for improving energy efficiency in local government. The website includes information on the following resources:

- Information on the ENERGY STAR® Challenge, a program aimed at improving energy efficiency in commercial and industrial buildings.
- Guidelines for energy management and improved efficiency.
- Access to a free energy portfolio manager.
- Lists of ENERGY STAR® qualified products.
- Information on financing options for energy efficiency related investments and projects.
- Case studies of energy related programs and initiatives in local governments across the country.

http://www.energystar.gov/index.cfm?c=government.bus_government_local

ENERGY STAR® for K-12 Schools
This program provides information and resources for energy management and cost reduction in K-12 schools. ENERGY STAR® provides information and resources in the following areas:

- Training and educational resources
- Benchmarking and tracking energy use
- Ideas and resources for building upgrades
- Resources on financing lighting and energy related improvements
- Information on outreach campaigns and programs

In addition, the K-12 section on the ENERGY STAR® website provides case studies of how schools across the nation have become more energy efficient.
http://www.energystar.gov/index.cfm?c=k12_schools.bus_schoolsk12

ENERGY STAR® Portfolio Manager
This interactive energy management tool tracks and assesses building energy and water consumption. This tool can be used to identify needed improvements, set priorities, verify performance of energy-efficiency-related improvements and achieve EPA recognition for superior energy performance.
http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

Greening Schools
This project by the Illinois Environmental Protection Agency and Waste Management Resource Center provides information on how to increase energy efficiency and reduce pollution in schools. The "Green Your Buildin," section contains links to energy efficiency and indoor air quality resources for schools.
http://www.greeningschools.org

Local Government Commission
Local Government Commission is a non-profit, non-partisan membership organization providing resources and technical assistance to locally elected officials looking to develop "resource-efficient communities."
http://www.lgc.org/

National Association of Counties (NACo), Green Government Initiative
This website includes a searchable database of "county green practices, programs, policies and plans," in addition to general information on best practices, products and policies that can result in financial savings in local government. Resources also include an "Energy Efficiency Newsletter," and free "green government" webinars.
www.greencounties.org

National Park Service and the Department of Energy, Lighting Retrofit Workbook
This workbook includes information on lighting retrofits, including in offices, auditoriums, exterior space, parking lots, bathrooms, hallways and stores. It was made for National Park Visitors Centers, but it provides good information for lighting retrofits in local government. A particularly useful part of this workbook is the lighting audit worksheet.
http://www1.eere.energy.gov/femp/pdfs/NPS_guidebook.pdf

New Energy for Cities: Energy-Savings and Job Creation for Local Government, Apollo Alliance
This report outlines a four-part energy plan for cities: 1) Invest in renewable power, 2) Create high-performance buildings, 3) Drive toward energy independence, 4) Build high-performance cities.
http://www.apolloalliance.org/downloads/resources_new_energy_cities.pdf

New York City Department of Design and Construction
This City Department has various manuals and resources for sustainable building including "High Performance Building Guidelines."
http://www.nyc.gov/html/ddc/html/ddcgreen/

Massachusetts High Performance Green Schools Guidelines
This is a 2005, comprehensive guide to planning and financing a high-performance school from the Collaboration of High Performance Schools.
http://www.mtpc.org/renewableenergy/green_schools/CHPSMA_vI-PLANNING-FINAL.pdf

Oikos
This is a searchable database of sustainable buildings products, materials and guidelines.
http://oikos.com/

Portland Energy Conservation Inc., Building Commissioning Operation and Maintenance
This website has information on building commissioning operation and maintenance. Resources include a best practices guide for operations and maintenance. The guide focuses on how building operators can improve comfort and reduce operating expenses through low-cost operating improvements.
http://www.peci.org/

City of Portland Green Building Initiative
This website has various case studies, policy documents, guidelines and resources for sustainable building practices.
http://www.portlandonline.com/OSD/index.cfm?c=ebeib

Rebuild America's Schools Program
The website provides a link to resources relating to school design and modernization, including a link to a toolkit to help schools find financing resources for energy-related projects. The toolkit includes resources specifically for rural schools.
http://www.modernschools.org/ras/

Smart Communities Network
This website includes case studies and links to resources related to green building initiatives, land use planning, sustainable materials, transportation and energy efficiency.
http://www.sustainable.org

School Operations and Maintenance: Best Practices for Controlling Energy Costs, A Guidebook for K-12 System
http://www.ase.org/uploaded_files/greenschools/School%20Energy%20Guidebook_9-04.pdf

U.S. Conference of Mayors
This non-partisan organization for cities with populations exceeding 30,000 houses the Mayors Climate Protection Center and organizes the U.S. Mayor's Climate Protection Agreement. The purpose of the Center and the agreement is to provide U.S. mayors with guidance and assistance to reduce greenhouse gases and energy use.
http://www.usmayors.org/climateprotection/

> **U.S. Mayors' Climate Change Protection Center's Best Practices Guide**
> This guide contains examples of what cities across the country are doing to reduce energy costs.
> http://www.usmayors.org/climateprotection/bestpractices.htm

U.S. Mayors' Climate Action Handbook
This handbook is for implementing actions under the U.S. Climate Change Agreement. The handbook includes sample actions, best practices and resources on topics, including energy efficiency.
http://www.iclei.org/documents/USA/documents/CCP/Climate_Action_Handbook-0906.pdf

U.S. Communities Purchasing Alliance, Green Initiative Information and Resources
This resource helps local governments access a broad line of environmentally certified products and services. The website includes articles, policies, presentations, training links and general resources related to purchasing energy-efficient products and services for local government.

U.S. Department of Energy, Energy Efficiency and Renewable Energy
This website contains resources on a wide-variety of energy-efficient technologies. It provides local government resources, including technology descriptions, case studies, financial opportunities and energy-efficiency guides.
http://www.eere.energy.gov/

U.S. Department of Energy's EnergySmart Schools
This program provides:

- Information and resources on financing
- Planning tools and resources for school officials
- Best practices guide for energy efficient school construction and retrofitting
- Best practices for facilities managers on operating and maintaining high-performance systems and equipment
- Educational tools for teachers

http://www.eere.energy.gov/buildings/energysmartschools/

U.S. Environmental Protection Agency
This website identifies funding opportunities for green buildings:
http://www.epa.gov/greenbuilding/tools/funding.htm

Information on light-bulb disposal:
http://www.epa.gov/epaoswer/hazwaste/id/univwast/lamps/live.htm

U.S. Environmental Protection Agency's Healthy School Environments
This program is designed to be a one-stop source for schools to access programs and resources to help schools become more energy efficient.
http://www.epa.gov/greenbuilding/index.htm

U.S. Environmental Protection Agency (E.P.A.), Clean Energy-Environment Municipal Network

The EPA is creating a comprehensive database of planning, policy, technical, analytical, and information resources for municipal governments, and developing Municipal Clean Energy Best Practices guidance. The Network will also include highlights of local government clean energy actions to recognize and help others replicate the successes. EPA currently offers many clean energy programs, resources, and tools that can assist local governments, including:

- Programs and resources to support local best practices
- Tools for local and state governments
- Local clean energy webcast series

http://www.epa.gov/cleanenergy/energy-programs/state-and-local/local.html

U.S. Green Building Council

This website has various resources for local governments considering LEED standards for new and existing buildings, including a "State and Local Government Toolkit" which outlines best practice steps to developing a green building program in local government. In addition, the website has a searchable database of government bodies that have implemented LEED initiatives including related ordinances, resolutions, policies, incentives and building programs. The database allows users to find LEED policies by such characteristics as state, size, building type, incentive and performance.

U.S. Green Building Council
http://www.usgbc.org/

LEED Toolkit for State and Local Governments
www.usgbc.org/Docs/Member_Resource_Docs/toolkit_statelocal.pdf

Database for LEED Public Policies
http://www.usgbc.org/PublicPolicy/SearchPublicPolicies.aspx?PageID=1776

Information Resources: International

ICLEI – Local Governments for Sustainability
ICLEI is an international association of local government, and national and regional local government associations, which provides consulting, training and information services to support sustainable development. The website provides information on services, training, and research and includes case studies of sustainable development in local government. ICLEI provides comprehensive and strategic tools for measuring carbon emissions.
www.iclei.org

International City/County Management Association's Local Government Environmental Assistance Network
This website provides various tools for local governments pursuing a variety of environmental projects, including air quality and energy-efficiency initiatives. Specific resources include a guidebook of project financing tools, energy, water and waste consumption calculator, roof energy cost savings calculator for various products and roofing types, a grant writing tutorial for small communities, a sustainable building manual and other building energy design tools and resources.
http://www.lgean.org/html/toolbox.cfm

International Ground Source Heat Pump Association (IGSHPA)
IGSHPA is the primary center for geothermal heat pump system installation training and research. This website contains information on geothermal systems and technical resources. The Frequently Asked Questions section provides a good overview of geothermal heating and cooling systems.
http://www.igshpa.okstate.edu/

Appendix 1: Best Practices in Reducing Energy Costs Survey

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BEST PRACTICES IN REDUCING ENERGY COSTS

This survey covers the years 2000 through 2007.

1. Please provide the following information:

a) Type of local government entity:
___Township ___City ___County ___School ___Special District

b) Name of local government: _____

2. Please provide contact information for future follow-up.

c) Contact name: _____

d) Contact phone number: _____

3. Has your local government made investments in any of the following energy efficiency products and/or services? Please check all that apply.

__Energy audit
__Retrofit of an existing building
__Insulation retrofit
__High efficiency lighting
__Occupancy sensor
__Motion sensor
__Daylight optimizer
__LED traffic signal or sign
__LED decoration or holiday lights
__Energy efficient windows
__Sustainable landscaping
__Energy efficient doors (weatherized or vestibule)
__Hybrid vehicle
__Alternative fuel vehicle
__Fuel converter
__Fuel cell vehicle
__Electric vehicle
__Natural gas vehicle
__Retrofit of vehicles or bus
__Solar/photovoltaic technology
__Wind energy project
__HAVC retrofit
__Energy control devices for heating and cooling system
__Boiler efficiency testing, analysis or tune-up
__Boiler replacement/retrofit
__ Ventilation system retrofit (Example: air destratifiers)
__Geothermal system
__Vending machine miser
__Computer energy control software
__Utility management software
__Energy savings guarantee contract

__Other energy efficiency related products or services:

BEST PRACTICES IN REDUCING ENERGY COSTS

4. Has your local government obtained a cost-benefit analysis of any energy efficiency products or services?

___Yes
___No

5. If yes, please describe the energy efficiency products/services and the cost-benefit analysis performed: (Maximum of five)
(Example: A simple payback analysis of an investment in LED traffic signals.)

6. Has your local government conducted an energy usage study?

___Yes
___No

7. Has your local government had an energy audit performed on one or more facilities?

___Yes
___No

8. Did your local government implement all of the suggested improvements from the energy audit?

___Yes
___No

9. Which suggested improvements from the energy audit were not implemented/will not be implemented?

10. Has your local government contracted with an outside firm to perform large-scale energy efficiency projects on any existing buildings?
(Example: Hiring an engineering firm to retrofit several facilities.)

___Yes
___No

11. If yes, and if the project has been completed, did you achieve the desired results? Is there anything your local government would have done differently?

12. Has your staff implemented any of the following energy efficiency related *policies*?
Please check all that apply.

__Energy management training for staff
__Employee awareness campaigns around energy usage in the workplace
__Vehicle usage (idling, planning more efficient routes)
__Personal appliance restrictions
__Energy efficient purchasing guidelines
__Power-down equipment during non-business hours
__Delamp vending machines
__Delamp signs
__Temperature settings for heating/cooling
__Other energy efficiency related policies. Please list:

BEST PRACTICES IN REDUCING ENERGY COSTS

13. Has your local government participated in any of the following *programs*?

__LEED sustainable building certification
__Green Globe sustainable building certification
__ENERGY STAR program
__Minnesota Energy Challenge program
__Cool Counties Initiative
__Schools for Energy Efficiency
__Other energy efficiency related programs. Please list:

14. Does your local government have any of the following energy management resources? Please check all that apply.

__Energy management team/board/task force
__Sustainable building program and/or ordinances
__Staff position(s) focused on energy efficiency
__Energy management guidelines or handbook
__Other management resources related to energy efficiency:

15. Has your local government used any of the following resources in financing energy efficiency related products/services? Please check all that apply.

__State loan program
Program Name:

Project:

__State grant program
Program Name:

Project:

__Utility loan program
Program Name:

Project:

__Utility grant program
Program Name:

Project:

__Federal program (Example: grant or loan program)
Program Name:

Project:

__Other financing resource
Name of resource:
(Example: name of a private grant)

Project:

16. Has your local government used any of the following energy related incentives? Please answer all that apply.

__State solar-electric rebate program
Program Name:

Project:

__Production incentive (government and/or utility)
Program Name:

Project:

__Utility rebate programs
Program Name:

Project:

__Other energy efficiency incentive
Name of incentive:

Project:

17. If your local government has been involved in planning the construction of a new building, have energy efficiency building standards considered?
(Examples: LEED standards or Green Building Initiatives)

__Yes, considered and implemented
__Yes, currently considering
__Yes, considered but not implemented
__No, energy efficiency standards were not considered

18. Does your local government have examples of policies or energy efficiency services/products that have been implemented resulting in documented energy cost savings that could be highlighted as a best practice? If yes, please explain.

Date of Project:

Project:

Contact:

19. Are there obstacles that your local government faces in reducing overall energy costs? Please check all that apply.
__Cost/lack of funds
__Conflict with other budget priorities
__Lack of time/expertise to design and plan the project
__Lack of informational resources to implement a project
__Not able to find contractors in your area with experience in these types of projects
__Lack of “political will” within the decision-making process
__Length of time needed for approval by governing body
__Length of implementation time
__Other:

BEST PRACTICES IN REDUCING ENERGY COSTS

20. Please list any energy efficiency related products/services and policies/programs that you would like to see addressed in the Best Practices Review:

Please return the survey to: Government Information Division, Office of the State Auditor, Suite 500, 525 Park Street, St. Paul, MN 55103

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Appendix 2: City of Minnetonka Energy Audit

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City of Minnetonka - Lighting Retrofit Projects - Estimated Investments and Savings							
Location	**Retrofit Cost***	**Xcel Energy Rebate**	**Net Cost**	**Demand Savings (KW)**	**Annual kWh Savings**	**Total Energy Savings**	**Payback in Years**
Public Works	**$38,338**	**$12,287**	**$26,051**	**30.0**	**188,712**	**$13,311**	**2.0**
City Hall	$80,184	$11,425	$68,759	22.2	$75,767	$6,106	11.3
Community Center	$44,918	$11,650	$33,268	26.8	$52,676	$5,521	6.0
Fire Station	$19,853	$6,214	$13,639	14.4	$65,276	$4,992	2.7
Ice Arena A&B	$79,029	$25,902	$53,127	62.0	$409,410	$26,686	2.0
Police Station	$59,580	$14,649	$44,931	30.1	$185,188	$13,294	3.4
Williston Center	$77,070	$28,603	$48,467	70.0	$325,741	$25,298	1.9
Totals	**$398,972**	**$110,730**	**$288,242**	**255.5**	**1,302,770**	**$95,208**	**4.2**

*Installation costs are included.

City of Minnetonka
14600 Minnetonka Boulevard Minnetonka, MN 55345 952-939-8200 Fax 952-939-8244

EMS Energy Management Solutions LLC

Location: Minnetonka, MN
Updated: 06/26/07
Summary

	Range of Opportunities	
Opportunities	$ 135,769	$ 271,537
Cumulative Savings (Actual)	$63,187	
% of Total Energy	38%	

HIGH PRIORITY

Item #	Description of Initiative	Location	Status	Est. Yearly Savings	One Time Savings	Investment	Payback Years	Cumulative Savings	Responsibility	Due Date
1	Gas Supply - Provide Center Point Energy Services Contracts.	All Locations	In Progress	$ 9,000						
2	Benchmark Reports for MN State.	All Locations	Complete					$ 5,000	Roger and Tanuj	
3	Benchmark Reports	All Locations	In Progress						Tanuj G.	
1	Lighting Redesign Study incl. Controls	ICE ARENA A	Complete					$ 2,250	Tanuj G.	
2	EMS Energy Audit (Gas and Electric)	ICE ARENA A	Complete					$ 800	Tanuj G.	
3	Rate Review - Presently on Interruptible Rate - There were pnalties from Xcel Energy. It has been brought to customer's attention.	ICE ARENA A	Complete							
4	Timers on Game Machines	ICE ARENA A	Not Started	$ 240		$ 300	1.25			
5	Timers on Water Fountains	ICE ARENA A	Not Started	$ 609		$ 450	0.74			
6	Timer on Coffee Vending Machine	ICE ARENA A	Not Started	$ 218		$ 75	0.34			
7	Sensors on Vending Machines	ICE ARENA A	Not Started	$ 804		$ 875	1.09			
8	Air Curtain in the Vestibule	ICE ARENA A	Not Started	$ 1,100		$ 2,000	1.82			
9	Turn Off Old Freezer in Concession Room	ICE ARENA A	Not Started	$ 498		$ -	-			
10	Low Flow Faucets with Auto Shut Off Controls	ICE ARENA A	Not Started	$ 2,076		$ 2,250	1.08			
11	Low Flow Showers	ICE ARENA A	Not Started	$ 1,661		$ 800	0.48			
12	Programmable Set Back Thermostat	ICE ARENA A	Not Started	$ 1,214		$ 872	0.72			
13	Timer on Electric Heater in Instructors Room	ICE ARENA A	Not Started	$ 290		$ 75	0.26			
14	Timer on Electric Heater in Figure Skating Club	ICE ARENA A	Not Started	$ 290		$ 75	0.26			
15	Condensing Water Heater in Loft Room	ICE ARENA A	In Progress	$ 484		$ 1,500	3.10	$ 484	Tanuj G.	
16	Insulate Hot Water Pipe in Loft Room	ICE ARENA A	Not Started	$ 30		$ 10	0.33			
17	Condensing Water Heater in Mezzanine	ICE ARENA A	Not Started	$ 300		$ 1,500	5.00			
18	Replace incandescent in storage under stairs	ICE ARENA A	Not Started	$ 22		$ 30	1.34			
19	Condensing Water Heater in Closet	ICE ARENA A	Not Started	$ 1,100		$ 2,000	1.82			
20	CO Sensor on Exhaust Fans	ICE ARENA A	Not Started	$ 169		$ 375	2.22			
21	Condensing Water Heater in Mezzanine	ICE ARENA A	Not Started	$ 300		$ 1,500	5.00			

Item #	Description of Initiative	Location	Status	Est. Yearly Savings	One Time Savings	Investment	Payback Years	Cumulative Savings	Responsibility	Due Date
22	Premium Efficiency Motors - Replace three 100 HP motors with premium efficiency motors.	ICE ARENA A	Not Started	$ 1,889	$ 4,950	$ 14,000	4.79			
23	Cooling Tower - Replace the water cooled cooling tower with air cooled cooling tower.	ICE ARENA A	In Progress	$ 6,943	$ 960	$ 20,000	2.74	$ 7,903	Tanuj G.	
24	Premium Efficiency Motors - Replace one 20 HP motor with premium efficiency motor.	ICE ARENA A	Complete		$ 80.00			$ 80	Tanuj G.	
25	Programmable Set Back Thermostat on Space Heater in Zamboni Room	ICE ARENA A	Not Started	$ 96		$ 200	2.09			
26	Insulate Garage Door	ICE ARENA A	Not Started	$ 143		$ 100	0.70			
27	Recover Waste Heat from Refrigeration Compressors	ICE ARENA A	Not Started							
28	Energy Efficient HVAC System - Replace existing forced air furnaces for the front offices, loft rooms and the locker rooms with energy efficient equipment.	ICE ARENA A	Not Started	$ 32,700						
29	Heat Furnace - Motors - Replace a 7.5 HP and a 1.5 HP motor in the heat furnace with premium efficiency motor.	ICE ARENA A	Not Started	$ 125	$ 149	$ 721	4.58			
30	VFD on MUA#1	ICE ARENA A	Not Started							
31	Condensing Water Heater for Zamboni Hot Water	ICE ARENA A	Not Started	$ 1,548		$ 2,000	1.29			
32	Buy Energy Star Equipment	ICE ARENA A	Not Started							
33	Timer on Coffee Maker	ICE ARENA A	Not Started	$ 471		$ 150	0.32			
34	Occupancy sensor in Office 1	ICE ARENA A	Not Started	$ 79	$ 36	$ 200	2.07			
35	Occupancy sensor in Office 2	ICE ARENA A	Not Started	$ 53	$ 36	$ 200	3.10			
36	Occupancy sensor in Shoe Room	ICE ARENA A	Not Started	$ 79	$ 36	$ 200	2.07			
37	Occupancy sensor in Game Room	ICE ARENA A	Not Started	$ 79	$ 36	$ 200	2.07			
38	Occupancy sensor in Display Case	ICE ARENA A	Not Started	$ 24	$ 36	$ 75	1.62			
39	Occupancy sensor in Break room	ICE ARENA A	Not Started	$ 159	$ 36	$ 200	1.03			
40	Occupancy sensor in Concession Room	ICE ARENA A	Not Started	$ 79	$ 36	$ 200	2.07			
41	Occupancy sensor in restrooms	ICE ARENA A	Not Started	$ 138	$ 72	$ 300	1.65			
42	Occupancy sensor in instructor room	ICE ARENA A	Not Started	$ 69	$ 36	$ 200	2.37			
43	Occupancy sensor in locker rooms 1,2,3 and 4	ICE ARENA A	Not Started	$ 323	$ 144	$ 600	1.41			
44	Occupancy sensor in figure skating club	ICE ARENA A	Not Started	$ 185	$ 36	$ 200	0.89			
45	Occupancy sensor in figure skating club	ICE ARENA A	Not Started	$ 145	$ 36	$ 200	1.13			
46	Occupancy sensor in loft rooms	ICE ARENA A	Not Started	$ 204	$ 36	$ 200	0.80			
47	Occupancy sensor behind stairs	ICE ARENA A	Not Started	$ 105	$ 36	$ 200	1.56			
48	Occupancy sensor in maintenance shop	ICE ARENA A	Not Started	$ 92	$ 36	$ 200	1.78			
49	Occupancy sensor in compressor room	ICE ARENA A	Not Started	$ 215	$ 36	$ 200	0.76			
50	Occupancy sensor in zamboni room	ICE ARENA A	Not Started	$ 138	$ 36	$ 200	1.18			
51	Gas Supply - Working with gas vendors for the low cost gas supply.	ICE ARENA A	In Progress							
52	Lighting Redesign Study	ICE ARENA B	Complete					$ 2,250		
53	EMS Energy Audit (Gas)	ICE ARENA B	Complete					$ 200		

Item #	Description of Initiative	Location	Status	Est. Yearly Savings	One Time Savings	Investment	Payback Years	Cumulative Savings	Responsibility	Due Date
54	Energy Efficient HVAC Equipment for Concession Room and Offices - During the audit it was noticed that the temperature of the rooms was 115 F. The unit is very old and inefficient.	ICE ARENA B	Not Started	$ 853		$ 2,000	2.34			
55	Programmable Set Back Thermostat	ICE ARENA B	Not Started	$ 1,214		$ 872	0.72			
56	Timers on Water Fountains	ICE ARENA B	Not Started	$ 406		$ 300	0.74			
57	Timer on Coffee Vending Machine	ICE ARENA B	Not Started	$ 218		$ 75	0.34			
58	Motion Sensor on Vending Machines	ICE ARENA B	Not Started	$ 482		$ 525	1.09			
59	Low Flow Faucets with Auto Shut Off Controls	ICE ARENA B	Not Started	$ 2,715		$ 900	0.33			
60	Energy Efficient HVAC Equipment for Room C - During the audit it was noticed that the temperature of the room was 115 F. The unit is very old and inefficient.	ICE ARENA B	Not Started	$ 853		$ 1,500	1.76			
61	Replace Heaters in the Rest Rooms and Install Timers on the Heaters.	ICE ARENA B	Not Started	$ 391		$ 150	0.38			
62	Energy Efficient HVAC Equipment for Room B - During the audit it was noticed that the temperature of the room was 90 F. The unit is very old and inefficient.	ICE ARENA B	Not Started	$ 853		$ 1,500	1.76			
63	Air Curtains in the Vestibules	ICE ARENA B	Not Started	$ 3,189		$ 4,000	1.25			
64	Timers on Vestibule Heaters	ICE ARENA B	Not Started	$ 446		$ 450	1.01			
65	Install Programmable Set Back Thermostats on Co-Ray-Vac Radiant Heaters	ICE ARENA B	Not Started	$ 3,801		$ 840	0.22			
66	Insulate Garage Door	ICE ARENA B	Not Started	$ 638		$ 100	0.16			
67	Insulate Pipes in Mechanical Room	ICE ARENA B	Not Started							
68	Programmable Set Back Thermostat on Space Heater in Mechanical Room	ICE ARENA B	Not Started	$ 27		$ 50	1.82			
69	Condensing Water Heater in Mechanical Room	ICE ARENA B	Not Started	$ 2,458		$ 5,000	2.03			
70	Recover Waste Heat from Refrigeration Compressors	ICE ARENA B	Not Started							
71	Premium Efficiency Motors (2) - 100 HP	ICE ARENA B	Not Started	$ 488	$ 3,300	$ 10,000	13.73			
72	Premium Efficiency Motors (2) - 5 HP	ICE ARENA B	Not Started	$ 43	$ 165	$ 788	14.49			
73	Premium Efficiency Motors (2) - 15 HP	ICE ARENA B	Not Started	$ 84	$ 495	$ 1,460	11.49			
74	VFD on MUA#2	ICE ARENA B	Not Started	$ 3,138	$ 300	$ 2,430	0.68			
75	Insulate Garage Door	ICE ARENA B	Not Started							
76	Occupancy sensor in corridor	ICE ARENA B	Not Started	$ 174	$ 36	$ 200	0.94			
77	Occupancy sensor in rest area	ICE ARENA B	Not Started	$ 178	$ 36	$ 200	0.92			
78	Occupancy sensor in girls locker room	ICE ARENA B	Not Started	$ 178	$ 36	$ 200	0.92			
79	Occupancy sensor in office	ICE ARENA B	Not Started	$ 40	$ 36	$ 200	4.14			
80	Occupancy sensor in restrooms	ICE ARENA B	Not Started	$ 58	$ 36	$ 200	2.83			
81	Occupancy sensor in restrooms	ICE ARENA B	Not Started	$ 58	$ 36	$ 200	2.83			
82	Occupancy sensor in office	ICE ARENA B	Not Started	$ 40	$ 36	$ 200	4.14			
83	Occupancy sensor in Room D	ICE ARENA B	Not Started	$ 40	$ 36	$ 200	4.14			
84	Occupancy sensor in Room C	ICE ARENA B	Not Started	$ 59	$ 36	$ 200	2.76			
85	Occupancy sensor in Room B	ICE ARENA B	Not Started	$ 59	$ 36	$ 200	2.76			
86	Occupancy sensor in Room A	ICE ARENA B	Not Started	$ 59	$ 36	$ 200	2.76			
87	New Cooling Tower	ICE ARENA B	Complete							
88	Occupancy sensor in compressor room	ICE ARENA B	Not Started	$ 79	$ 36	$ 200	2.07			
	TOTAL ENERGY USAGE COST	$ 237,694								
	TOTAL POTENTIAL COST SAVINGS	$ 80,809								
	% SAVINGS	34%								

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Item #	Description of Initiative	Location	Status	Est. Yearly Savings	One Time Savings	Investment	Payback Years	Cumulative Savings	Responsibility	Due Date
89	Gas Supply - Working with gas vendors for the low cost gas supply.	WILLISTON CENTER	In Progress							
90	Lighting Redesign Study	WILLISTON CENTER	Complete					$ 2,250		
91	EMS Energy Audit (Gas and Electric)	WILLISTON CENTER	Complete					$ 800		
92	Canopy Lights - Clean photocell or install timers on the outside lights.	WILLISTON CENTER	Not Started	$ 193		$ -	-			
93	Reprogram Occupancy Sensor	WILLISTON CENTER	Not Started	$ 274		$ -	-			
94	Install occupancy sensor in Office	WILLISTON CENTER	Not Started	$ 456	$ 36	$ 200	0.36			
95	CO Sensor on Exhaust Fans Court Room	WILLISTON CENTER	Not Started	$ 1,007		$ 400	0.40			
96	Install Programmable Set Back Thermostats on Co-Ray-Vac Radiant Heaters	WILLISTON CENTER	Not Started	$ 457		$ 840	1.84			
97	Timers on fans	WILLISTON CENTER	Not Started	$ 607		$ 300	0.49			
98	CO Sensor on Exhaust Fans Baseball Room (2)	WILLISTON CENTER	Not Started	$ 504		$ 400	0.79			
99	Occupancy Sensor in Baseball Cage Room	WILLISTON CENTER	Not Started	$ 1,244	$ 72	$ 300	0.18			
100	Energy Efficient HVAC Equipment for Baseball Room	WILLISTON CENTER	Not Started							
101	Programmable Set Back Thermostat for the Baseball Room	WILLISTON CENTER	Not Started							
102	Install Timers on Ceiling Fans	WILLISTON CENTER	Not Started	$ 405		$ 200	0.49			
103	Motion Sensor on Vending Machines	WILLISTON CENTER	Not Started	$ 826		$ 875	1.06			
104	Occupancy Sensor in Exercise Room	WILLISTON CENTER	Not Started	$ 330	$ 36	$ 200	0.50			
105	Occupancy Sensor in Weight Room	WILLISTON CENTER	Not Started	$ 413	$ 36	$ 200	0.40			
106	Occupancy Sensor in Jog Room	WILLISTON CENTER	Not Started	$ 330	$ 36	$ 200	0.50			
107	Occupancy Sensor in Cycling Room	WILLISTON CENTER	Not Started	$ 130	$ 36	$ 200	1.26			
108	Occupancy Sensor in Lounge	WILLISTON CENTER	Not Started	$ 287	$ 36	$ 200	0.57			
109	Occupancy Sensor in Office 1	WILLISTON CENTER	Not Started	$ 84	$ 36	$ 200	1.96			
110	Occupancy Sensor in Office 2	WILLISTON CENTER	Not Started	$ 84	$ 36	$ 200	1.96			
111	Occupancy Sensor in Men Locker Room	WILLISTON CENTER	Not Started	$ 366	$ 36	$ 300	0.72			
112	Occupancy Sensor in Men Locker Room	WILLISTON CENTER	Not Started	$ 81	$ 36	$ 300	3.25			
113	Occupancy Sensor in Women Locker Room	WILLISTON CENTER	Not Started	$ 366	$ 36	$ 300	0.72			
114	Occupancy Sensor in Women Locker Room	WILLISTON CENTER	Not Started	$ 81	$ 36	$ 300	3.25			
115	Install Timer on Coffee Maker	WILLISTON CENTER	Not Started	$ 141		$ 100	0.71			
116	Install Timer on TV	WILLISTON CENTER	Not Started	$ 978		$ 500	0.51			
117	Install Low Flow Faucets with Auto Controls	WILLISTON CENTER	Not Started	$ 2,972		$ 1,200	0.40			
118	Timers on Water Fountains	WILLISTON CENTER	Not Started	$ 626		$ 450	0.72			

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Item #	Description of Initiative	Location	Status	Est. Yearly Savings	One Time Savings	Investment	Payback Years	Cumulative Savings	Responsibility	Due Date
119	Install Low Flow Showers	WILLISTON CENTER	Not Started	$ 5,945		$ 1,800	0.30			
120	Photo Sensor on lights in Nova Care Entrance	WILLISTON CENTER	Not Started	$ 39	$ 12	$ 100	2.23			
121	Retrofit incandescent with compact fluorescents	WILLISTON CENTER	Not Started	$ 72		$ 20	0.28			
122	Premium Efficiency Motor in the Air Handler	WILLISTON CENTER	Not Started	$ 100	$ 124	$ 432	3.08			
123	VFD on MUA	WILLISTON CENTER	Not Started	$ 2,323	$ 225	$ 1,990	0.76			
124	Savers Switch on RTU	WILLISTON CENTER	Not Started		$ 720					
125	Premium Efficient Water Circ Pump	WILLISTON CENTER	Not Started	$ 66	$ 165	$ 512	5.26			
126	VFD on Water Circ Pump	WILLISTON CENTER	Not Started	$ 2,993	$ 300	$ 2,430	0.71			
127	Condensing Water Heater in Mechanical Room (2)	WILLISTON CENTER	Not Started	$ 5,000		$ 8,000	1.60			
128	Full Modulating Condensing Boilers for Pool Water	WILLISTON CENTER	Not Started	$ 2,000		$ 5,000	2.50			
129	Gas Supply - Working with gas vendors for the low cost gas supply.	WILLISTON CENTER	In Progress							
130	Occupancy Sensor in Yoga Room	WILLISTON CENTER	Not Started	$ 342	$ 36	$ 300	0.77			
	TOTAL ENERGY USAGE COST	$ 124,799								
	TOTAL POTENTIAL COST SAVINGS	$ 32,120								
	% SAVINGS	26%								

Item #	Description of Initiative	Location	Status	Est. Yearly Savings	One Time Savings	Investment	Payback Years	Cumulative Savings	Responsibility	Due Date
131	EMS Energy Audit (Gas and Electric)	FIRE STATION #2	Complete					$ 800		
132	Insulate Garage Doors	FIRE STATION #2	Not Started	$ 204		$ 200	0.98			
133	Insulate Doors	FIRE STATION #2	Not Started	$ 81		$ 100	1.23			
134	Install occupancy sensor	FIRE STATION #2	Not Started	$ 329	$ 36	$ 300	0.80			
135	Prog Set Back Thermostats on Unit Heaters	FIRE STATION #2	Not Started	$ 352		$ 280	0.80			
136	Exit Signs	FIRE STATION #2	Not Started	$ 133		$ 120	0.90			
137	Upgrade lights in the closet	FIRE STATION #2	Not Started	$ 31	$ 10	$ 100	2.90			
138	Install energy efficient water heater	FIRE STATION #2	Not Started	$ 59		$ 1,500	25.42			
139	Upgrade lights in office	FIRE STATION #2	Not Started	$ 12	$ 10	$ 100	7.23			
140	Upgrade lights in locker room	FIRE STATION #2	Not Started	$ 62	$ 50	$ 400	5.62			
141	Upgrade lights in Rest Room	FIRE STATION #2	Not Started	$ 25	$ 20	$ 200	7.23			
142	Upgrade lights in closet	FIRE STATION #2	Not Started	$ 25	$ 20	$ 200	7.23			
143	Water Heater	FIRE STATION #2	Not Started	$ 70		$ 1,500	21.43			
144	Replace two water heaters with one condensing water heater	FIRE STATION #2	Not Started							
145	Set Back Heat	FIRE STATION #2	Not Started							
146	Upgrade lights in training room	FIRE STATION #2	Not Started	$ 75	$ 60	$ 600	7.23			
147	Blower running all the time	FIRE STATION #2	Not Started							
148	Coffee Maker	FIRE STATION #2	Not Started	$ 175		$ 75	0.43			
149	Controls in rest rooms	FIRE STATION #2	Not Started							
150	Saver's Switch	FIRE STATION #2	Complete		$ -			$ 230		
151	Change outside lights	FIRE STATION #2	Not Started							
152	Install controls on outside lights	FIRE STATION #2	Not Started							
	TOTAL ENERGY USAGE COST	$ 7,603								
	TOTAL POTENTIAL COST SAVINGS	$ 1,633								
	% SAVINGS	21%								

Item #	Description of Initiative	Location	Status	Est Yearly Savings	One Time Savings	Investment	Payback Years	Cumulative Savings	Responsibility	Due Date
153	EMS Energy Audit (Gas and Electric)	FIRE STATION #3	Complete					$ 800		
154	Occupancy Sensor on Office Light	FIRE STATION #3	Not Started	$ 51	$ 36	$ 200	3.24			
155	Occupancy Sensor on Vestibule Light	FIRE STATION #3	Not Started	$ 51	$ 36	$ 200	3.24			
156	Upgrade lights in Rest Room	FIRE STATION #3	Not Started	$ 24	$ 20	$ 200	7.38			
157	Controls in rest rooms	FIRE STATION #3	Not Started							
158	Install occupancy sensor in corridor	FIRE STATION #3	Not Started	$ 322	$ 36	$ 300	0.82			
159	Upgrade lights in closet	FIRE STATION #3	Not Started	$ 71	$ 36	$ 200	2.30			
160	Upgrade lights in training room	FIRE STATION #3	Not Started	$ 73	$ 20	$ 600	7.93			
161	Timer on Coffee Maker	FIRE STATION #3	Not Started	$ 172		$ 75	0.44			
162	Replace lights in Office	FIRE STATION #3	Not Started	$ 132		$ 30	0.23			
163	Insulate Garage Door	FIRE STATION #3	Not Started	$ 344		$ 200	0.58			
164	Upgrade Lights	FIRE STATION #3	Not Started	$ 461	$ 324	$ 2,700	5.15			
165	Install set back thermostat on CO Rayvac. (77.5F noticed)	FIRE STATION #3	Not Started	$ 1,376		$ 800	0.58			
166	Hot Dawg Heater, malfunction noticed.	FIRE STATION #3	Not Started							
167	Exit Signs	FIRE STATION #3	Not Started	$ 65		$ 60	0.92			
168	Hose Tower	FIRE STATION #3	Not Started	$ 49	$ 20	$ 400	7.79			
169	Stairs 169F of the exhaust fan	FIRE STATION #3	Not Started							
170	Controls on Exhaust fan	FIRE STATION #3	Not Started							
171	Controls on Exhaust fan	FIRE STATION #3	Not Started							
172	Occupancy Sensor on Gym Lights	FIRE STATION #3	Not Started	$ 152	$ 36	$ 200	1.08			
173	Upgrade lights in Locker Rooms	FIRE STATION #3	Not Started	$ 37		$ 12	0.33			
174	Occupancy Sensor in Locker Rooms	FIRE STATION #3	Not Started	$ 228	$ 36	$ 200	0.72			
175	Closet	FIRE STATION #3	Not Started							
176	Install condensing water heater	FIRE STATION #3	Not Started	$ 56		$ 1,500	26.79			
177	Install condensing water heater	FIRE STATION #3	Not Started	$ 146		$ 2,000	13.70			
178	Replace two water heaters with one condensing water heater.	FIRE STATION #3	Not Started							
179	Upgrade lights in Stairs	FIRE STATION #3	Not Started	$ 37		$ 12	0.33			
180	Savers Switch on RTU	FIRE STATION #3	Complete		$ -			$ 250		
181	Thermostat - Malfunctioning	FIRE STATION #3	Not Started							
	TOTAL ENERGY USAGE COST	$ 12,643								
	TOTAL POTENTIAL COST SAVINGS	$ 3,845								
	% SAVINGS	30%								

Item #	Description of Initiative	Location	Status	Est. Yearly Savings	One Time Savings	Investment	Payback Years	Cumulative Savings	Responsibility	Due Date
182	EMS Energy Audit (Gas and Electric)	FIRE STATION #4	Complete					$ 800		
183	Training Room - Reduce light fixtures.	FIRE STATION #4	Not Started	$ 179		$ 200	1.12			
184	Timer on Coffee Maker	FIRE STATION #4	Not Started	$ 282		$ 100	0.35			
185	Entrance - Reduce light fixtures	FIRE STATION #4	Not Started	$ 179		$ 200	1.12			
186	Set Back Thermostats	FIRE STATION #4	Not Started	$ 757		$ 300	0.40			
187	Insulate Garage Door	FIRE STATION #4	Not Started	$ 1,135		$ 200	0.18			
188	Insulate Door	FIRE STATION #4	Not Started	$ 378		$ 100	0.26			
189	Install Occupancy Sensor on Garage Lights - 15 lights were on with nobody around.	FIRE STATION #4	Not Started	$ 435	$ 36	$ 300	0.61			
190	Upgrade lights in Garage	FIRE STATION #4	Not Started	$ 476	$ 23	$ 1,800	3.73			
191	Exit Sign	FIRE STATION #4	Not Started							
192	VFD on MAU fan motor.	FIRE STATION #4	Not Started							
193	Prog Set Back Thermostat on CO Raywac	FIRE STATION #4	Not Started	$ 757		$ 200	0.26			
194	Occupancy Sensor on Office Lights	FIRE STATION #4	Not Started	$ 36	$ 36	$ 150	3.21			
195	Occupancy Sensor on Closet Lights	FIRE STATION #4	Not Started	$ 57	$ 36	$ 150	1.99			
196	Hallway Heat - 163F out of the heater	FIRE STATION #4	Not Started							
197	Reduce to 1 lamp fixture in Stairs	FIRE STATION #4	Not Started	$ 130		$ 200	1.54			
198	Upgrade Lights in Hose Tower	FIRE STATION #4	Not Started	$ 40	$ 40	$ 150	2.77			
199	Controls on Exhaust fans	FIRE STATION #4	Not Started							
200	Install occupancy sensor in the gym	FIRE STATION #4	Not Started	$ 104	$ 36	$ 150	1.10			
201	Reduce light in the corridor - remove one lamp from each fixture.	FIRE STATION #4	Not Started	$ 102		$ 50	0.49			
202	Install condensing water heater	FIRE STATION #4	Not Started	$ 115		$ 1,500	13.04			
203	Install condensing water heater	FIRE STATION #4	Not Started	$ 75		$ 1,500	20.00			
204	Replace two water heaters with one condensing water heater.	FIRE STATION #4	Not Started							
205	Install Programmable Set Back Thermostat in office area	FIRE STATION #4	Not Started							
206	Reduce lights in Office with Windows	FIRE STATION #4	Not Started	$ 66		$ 50	0.76			
207	Upgrade lights in Stairs	FIRE STATION #4	Not Started	$ 83		$ 10	0.12			
208	Install Savers Switch	FIRE STATION #4	Complete		$ -			$ 200		
	TOTAL ENERGY USAGE COST	$ 12,983								
	TOTAL POTENTIAL COST SAVINGS	$ 5,386								
	% SAVINGS	41%								

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Item #	Description of Initiative	Location	Status	Est. Yearly Savings	One Time Savings	Investment	Payback Years	Cumulative Savings	Responsibility	Due Date
								$ 800		
209	EMS Energy Audit (Gas and Electric)	FIRE STATION #5	Complete							
210	Install Controls in Garage - New sky lights but lights were on	FIRE STATION #5	Not Started	$ 552	$ 36	$ 150	0.21			
211	Upgrade lights in Garage	FIRE STATION #5	Not Started	$ 339	$ 23	$ 1,800	5.24			
212	Insulate door	FIRE STATION #5	Not Started	$ 174		$ 100	0.58			
213	Insulate garage door	FIRE STATION #5	Not Started	$ 521		$ 200	0.38			
214	Prog Set Back Thermostat on CO Raywac	FIRE STATION #5	Not Started	$ 348		$ 200	0.58			
215	Upgrade lights in Closet	FIRE STATION #5	Not Started	$ 84	$ 20	$ 200	2.15			
216	Update Lights in Corridor	FIRE STATION #5	Not Started	$ 563	$ 220	$ 1,100	1.56			
217	Bunn Coffee Maker	FIRE STATION #5	Not Started	$ 331		$ 100	0.30			
218	Turn off Unit Heater in the vestibule	FIRE STATION #5	Not Started	$ 94	$ -	$ 50	0.53			
219	Upgrade lights in Offices	FIRE STATION #5	Not Started	$ 170	$ 130	$ 780	3.83			
220	Upgrade lights in Offices	FIRE STATION #5	Not Started	$ 138	$ 120	$ 600	3.48			
221	Replace incandescent with compact fluorescent lamps.	FIRE STATION #5	Not Started	$ 177		$ 30	0.17			
222	Update Lights in Stairs	FIRE STATION #5	Not Started	$ 90	$ 20	$ 100	0.89			
223	Update Lights in Stairs	FIRE STATION #5	Not Started	$ 86		$ 10	0.12			
224	Kitchen	FIRE STATION #5	Not Started	$ 52	$ 10	$ 60	0.96			
225	Install Programmable Set Back Thermostat in office area	FIRE STATION #5	Not Started							
226	Upgrade lights in Closet	FIRE STATION #5	Not Started	$ 209	$ 40	$ 240	0.96			
227	Upgrade lights in Stairs	FIRE STATION #5	Not Started	$ 224	$ 50	$ 250	0.89			
228	Install condensing water heater	FIRE STATION #5	Not Started	$ 147		$ 1,500	10.20			
229	Install condensing water heater	FIRE STATION #5	Not Started	$ 54		$ 1,500	27.78			
230	Replace two water heaters with one condensing water heater.	FIRE STATION #5	Not Started							
231	Upgrade lights in corridor	FIRE STATION #5	Not Started	$ 90	$ 20	$ 100	0.89			
232	Upgrade lights in locker room	FIRE STATION #5	Not Started	$ 157	$ 100	$ 500	2.55			
233	Install controls in locker room	FIRE STATION #5	Not Started	$ 232	$ 36	$ 175	0.60			
234	Upgrade lights in Gym	FIRE STATION #5	Not Started	$ 282	$ 108	$ 450	1.21			
235	Install controls in Gym	FIRE STATION #5	Not Started	$ 280	$ 36	$ 175	0.50			
236	Savers Switch on RTU	FIRE STATION #5	Complete		$ -			$ 160		
	TOTAL ENERGY USAGE COST	$ 9,080								
	TOTAL POTENTIAL COST SAVINGS	$ 5,393								
	% SAVINGS	59%								

Item #	Description of Initiative	Location	Status	Est. Yearly Savings	One Time Savings	Investment	Payback Years	Cumulative Savings	Responsibility	Due Date
237	Lighting Redesign Study	Public Works	Complete					$ 2,250		
238	EMS Energy Audit (Gas and Electric)	Public Works	Complete					$ 800		
239	Lighting Fixtures and Controls - Worked with the vendors to get the cheapest price for the fixtures and the controls.	Public Works	Complete					$ 3,500		
240	Gas Supply - Working with gas vendors for the low cost gas supply.	Public Works	In Progress							
241	Truck Bay Lighting Upgrade	Public Works	Complete	$ 5,039	$ 6,516	$ 15,899	1.86	$ 11,555		
242	Truck Bay Lighting Controls	Public Works	Complete	$ 1,050	$ 1,368	$ 1,365	(0.00)	$ 2,418		
243	Stand by Generator - 300 kW	Public Works	In Progress	$ 7,192						
244	Lighting Upgrade in Mechanic Shop	Public Works	In Progress							
245	Lighting Reduction in the Office Area	Public Works	Complete	$ 101				$ 101		
246	Occupancy Sensor in Sign Shop	Public Works	Not Started	$ 231	$ 36	$ 200	0.71			
247	Occupancy Sensor in Mezzanine	Public Works	Not Started	$ 50	$ 36	$ 100	1.29			
248	Occupancy Sensor in Office	Public Works	Not Started	$ 124	$ 36	$ 150	0.92			
249	Energy efficient furnace	Public Works	Not Started							
250	Energy efficient furnace in Utility Room	Public Works	Not Started							
251	Energy efficient furnace in Utility Room	Public Works	Not Started							
252	Replace 3 furnaces with full modulating condensing boilers.	Public Works	Not Started							
253	Occupancy sensor in tool room	Public Works	Not Started	$ 99	$ 36	$ 200	1.66			
254	Occupancy Sensor in shop lower level	Public Works	Not Started	$ 173	$ 36	$ 200	0.95			
255	Occupancy sensor in shop mezzanine	Public Works	Not Started	$ 149	$ 36	$ 200	1.10			
256	Occupancy sensor in shop	Public Works	Not Started	$ 136	$ 36	$ 200	1.20			
257	Enough outside light in shop	Public Works	Not Started							
258	Enough outside light in park shop	Public Works	Not Started							
259	Occupancy Sensor in park shop	Public Works	Not Started	$ 342	$ 36	$ 200	0.48			
260	Programmable thermostat on Vantage heaters	Public Works	Not Started	$ 2,826		$ 2,400	0.85			
261	Insulate garage door	Public Works	Not Started	$ 565		$ 200	0.35			
262	Insulate door	Public Works	Not Started	$ 283		$ 100	0.35			
263	Photo Sensor on lights near bay doors	Public Works	Not Started	$ 1,074	$ 48	$ 800	0.70			
264	Relocate lights under or near skylights.	Public Works	Not Started							
265	Install prog set back thermostats	Public Works	Complete	$ 2,400		$ 598	0.25	$ 2,400		
266	Install CO Sensors on Exhaust Fan	Public Works	Not Started							
267	Relocate lights from near the bay door - Lights hidden when bay door open.	Public Works	Not Started							
268	Insulate Garage Doors	Public Works	Not Started	$ 1,413		$ 200	0.14			
269	Lighting controls in wash bay	Public Works	Not Started	$ 694	$ 36	$ 400	0.52			
270	Remove lights from the water softener area in wash bay	Public Works	Not Started	$ 390		$ 100	0.26			
271	Install premium efficiency motors - 75HP	Public Works	Not Started	$ 915	$ 1,238	$ 3,490	2.46			
272	Install premium efficiency motors - 3HP	Public Works	Not Started	$ 24	$ 50	$ 321	11.29			
273	Full Modulating Condensing Water Heater	Public Works	Not Started	$ 800		$ 2,000	2.50			
274	Replace single pane glass doors in the workshop.	Public Works	Not Started	$ 5,651		$ 10,000	1.77			
275	Install controls on lights on the lights near the glass door.	Public Works	Not Started	$ 268	$ 48	$ 800	2.80			

Item #	Description of Initiative	Location	Status	Est Yearly Savings	One Time Savings	Investment	Payback Years	Cumulative Savings	Responsibility	Due Date
276	Install timers on wall lights in the workshop	Public Works	Not Started	$ 327		$ 300	0.92			
277	Occupancy Sensor in mechanic office	Public Works	Not Started	$ 37	$ 36	$ 100	1.72			
278	Occupancy Sensor in parts storage	Public Works	Not Started	$ 136	$ 36	$ 200	1.20			
279	Occupancy Sensor in mezzanine	Public Works	Not Started	$ 124	$ 36	$ 200	1.33			
280	Occupancy Sensor in office	Public Works	Not Started	$ 37	$ 36	$ 200	4.42			
281	Replace single pane glass doors in welding shop.	Public Works	Not Started							
282	Install timers on wall lights in the welding shop	Public Works	Not Started	$ 129		$ 300	2.33			
283	Decrease fixture height in the welding shop.	Public Works	Not Started							
284	Lock the thermostat for MAU - 6	Public Works	Not Started							
285	Timers on Water Fountains	Public Works	Not Started	$ 344		$ 225	0.65			
286	Occupancy Sensor in lunch room	Public Works	Not Started	$ 37	$ 36	$ 200	4.42			
287	Timer on Coffee Maker	Public Works	Not Started	$ 236		$ 100	0.42			
288	Auto shut off on computers in lunch room	Public Works	Not Started							
289	Savers Switch on RTU	Public Works	Not Started		$ 530					
290	Full Modulating Condensing Boilers for Hot Water	Public Works	Not Started	$ 1,210		$ 2,000	1.65			
291	Install VFD on MAU#1 fan	Public Works	Not Started	$ 3,000	$ 450	$ 2,903	0.82			
292	Install premium efficiency motor	Public Works	Not Started	$ 136	$ 248	$ 730	3.54			
293	Install VFD on MAU#4 and 5 fan	Public Works	Not Started	$ 15,000	$ 1,800	$ 9,235	0.50			
294	Waste Oil Heaters - At present, the City is getting about $1,800 per year by selling the oil.	Public Works	In Progress	$ 2,240		$ 4,995	2.23			
295	Install premium efficiency motor	Public Works	Not Started	$ 400	$ 990	$ 2,600	3.78			
296	Install CO Sensors on Exhaust Fan	Public Works	Not Started	$ 1,826	$ 36	$ 1,500	0.80			
	TOTAL ENERGY USAGE COST	$ 69,541								
	TOTAL POTENTIAL COST SAVINGS	$ 57,205								
	% SAVINGS	82%								

Item #	Description of Initiative	Location	Status	Est Yearly Savings	One Time Savings	Investment	Payback Years	Cumulative Savings	Responsibility	Due Date
297	EMS Energy Audit (Gas and Electric)	Glen Lake Activity Center	Complete					$ 800		
298	Full Modulating Condensing Water Heater	Glen Lake Activity Center	Not Started	$ 139		$ 1,500	10.79			
299	Replace incandescent with compact fluorescent lamps.	Glen Lake Activity Center	Not Started	$ 148		$ 20	0.14			
300	Reduce light in the corridor - remove one lamp from each fixture.	Glen Lake Activity Center	Not Started							
301	Window open in Police Office - Heat Loss	Glen Lake Activity Center	Not Started	$ 120		$ -	-			
302	Install Programmable Set Back Thermostat	Glen Lake Activity Center	Not Started	$ 303		$ 200	0.66			
303	Occupancy Sensor in the Offices	Glen Lake Activity Center	Not Started	$ 121	$ 72	$ 300	1.89			
304	Occupancy sensor in Glen Lake meeting room	Glen Lake Activity Center	Not Started	$ 187	$ 36	$ 200	0.88			
305	Occupancy sensor in storage room	Glen Lake Activity Center	Not Started	$ 31	$ 36	$ 100	2.05			
306	Storage Room - Low temperature, air conditioned	Glen Lake Activity Center	Not Started							
307	Occupancy sensor in Excelsior room	Glen Lake Activity Center	Not Started	$ 187	$ 36	$ 200	0.88			
308	Savers Switch on RTU	Glen Lake Activity Center	Complete		$ -			$ 150		
	TOTAL ENERGY USAGE COST	$ 7,681								
	TOTAL POTENTIAL COST SAVINGS	$ 1,236								
	% SAVINGS	16%								
309	EMS Energy Audit (Gas and Electric)	West Ridge Pavilion	Complete					$ 800		
310	Replace MH with compact fluorescent in hanging fixtures	West Ridge Pavilion	Not Started	$ 426		$ 200	0.47			
311	Replace incandescent with compact fluorescent lamps.	West Ridge Pavilion	Not Started	$ 72		$ 20	0.28			
312	Install Programmable Set Back Thermostat - Temp set at 71F	West Ridge Pavilion	Not Started	$ 95		$ -	-			
313	Install energy efficient furnace	West Ridge Pavilion	Not Started							
314	Timer on hot water heater - Heater was operating during the audit.	West Ridge Pavilion	Not Started	$ 166		$ 50	0.30			
315	Savers Switch on RTU	West Ridge Pavilion	Complete		$ -			$ 80		
316	Turn off Lights in and around the tower.	West Ridge Pavilion	Complete	$ 1,785		$ -		$ 1,785		
	TOTAL ENERGY USAGE COST	$ 3,326								
	TOTAL POTENTIAL COST SAVINGS	$ 2,544								
	% SAVINGS	76%								

Item #	Description of Initiative	Location	Status	Est. Yearly Savings	One Time Savings	Investment	Payback Years	Cumulative Savings	Responsibility	Due Date
317	EMS Energy Audit (Gas)	Community Center	Complete					$ 200		
318	Reduce hot water temperature	Community Center	Complete	$ 21		$ -				
319	Turn off refrigerator in kitchen	Community Center	Not Started	$ 202		$ -				
320	Timers on coffee makers	Community Center	Not Started	$ 485		$ 400	0.82			
321	Occupancy sensors in storage areas, offices, boiler room, reception conference room, kitchen and waiting area.	Community Center	Not Started	$ 488	$ 1,080	$ 2,400	2.70			
322	VFD on condenser fans	Community Center	Not Started	$ 567	$ 210	$ 3,000	4.92			
323	VFD on hot water circ pumps	Community Center	Not Started	$ 286	$ 120	$ 2,400	7.97			
324	Low flow auto controlled faucets	Community Center	Not Started	$ 431		$ 3,000	6.96			
325	Lighting Redesign Study	Community Center	Complete					$ 2,250		
	TOTAL ENERGY USAGE COST	$ 29,062								
	TOTAL POTENTIAL COST SAVINGS	$ 2,480								
	% SAVINGS	9%								
326	EMS Energy Audit (Gas)	City Hall	Complete					$ 200		
327	Occupancy sensors in restrooms, offices, conference rooms, common areas, electrical rooms, storage, hallways, garage, recreation area, kitchen and meeting room.	City Hall	Not Started	$ 1,267	$ 1,764	$ 5,000	2.55			
328	VFD on AHU3	City Hall	Not Started	$ 559	$ 150	$ 1,738	2.84			
329	VFD on AHU2	City Hall	Not Started	$ 1,080	$ 300	$ 2,430	1.97			
330	VFD on AHU1	City Hall	Not Started	$ 1,620	$ 450	$ 2,904	1.51			
331	Insulate pipes	City Hall	Not Started	$ 370		$ 500	1.35			
332	VFD on hot water circ pumps	City Hall	Not Started	$ 473	$ 180	$ 1,738	3.29			
333	Install new RTU - Roger got a quote of 9.7 SEER RTUs, on EMS recommendation the City bought two units with 13 SEER and economizer.	City Hall	Complete	$ 692	$ -	$ 2,860	4.13	$ 692		
334	Low flow auto controlled faucets	City Hall	Not Started	$ 432	$ -	$ 2,000	4.63			
335	VFD on side walk hot water circ pump	City Hall	Not Started	$ 118		$ 1,000	8.47			
336	Insulate roof	City Hall	Not Started	$ 5,267		$ 80,000	15.19			
337	Lighting Redesign Study	City Hall	Complete					$ 2,250		
338	Stand by generator 140 kW	City Hall	Not Started		$ 5,040					
	TOTAL ENERGY USAGE COST	$ 71,647								
	TOTAL POTENTIAL COST SAVINGS	$ 11,878								
	% SAVINGS	17%								

Item #	Description of Initiative	Location	Status	Est Yearly Savings	One Time Savings	Investment	Payback Years	Cumulative Savings	Responsibility	Due Date
339	EMS Energy Audit (Gas)	Police Station	Complete					$ 200		
340	Photo sensor on garage, stairs and corridor lights	Police Station	Not Started	$ 445	$ 36	$ 500	1.04			
341	Install occupancy sensors in corridors, report writing room, garage, conference room, offices, kitchen, locker room, investigator room, storage and records room	Police Station	Not Started	$ 1,689	$ 1,800	$ 3,250	0.86			
342	VFD on hot water circ pumps	Police Station	Not Started	$ 774	$ 300	$ 2,430	2.75			
343	VFD on return air fan	Police Station	Not Started	$ 559	$ 150	$ 1,738	2.84			
344	VFD on supply air fan	Police Station	Not Started	$ 1,620	$ 450	$ 2,903	1.51			
345	Insulate pipes	Police Station	Not Started	$ 370		$ 500	1.35			
346	Low flow auto controlled faucets	Police Station	Not Started	$ 324		$ 2,000	6.17			
347	Lighting Redesign Study	Police Station	Complete					$ 2,250		
348	Stand by generator 215 kW	Police Station	Not Started		$ 5,040					
	TOTAL ENERGY USAGE COST	$ 92,780								
	TOTAL POTENTIAL COST SAVINGS	$ 5,781								
	% SAVINGS	6%								
349	EMS Energy Audit (Gas)	Fire Station #1	Complete					$ 200		
350	Install occupancy sensors in offices, rest rooms, kitchen, common room, conference room, locker room, boiler room, electrical and storage room.	Fire Station #2	Not Started	$ 1,787	$ 828	$ 3,000	1.22			
351	Install photocell on fire truck garage lights.	Fire Station #3	Not Started	$ 531	$ 12	$ 600	1.11			
352	VFD on hot water circ pump	Fire Station #4	Not Started	$ 774	$ 300	$ 2,430	2.75			
353	VFD on return air fan	Fire Station #5	Not Started	$ 341		$ 1,000	2.93			
354	VFD on supply air fan	Fire Station #6	Not Started	$ 559	$ 150	$ 1,738	2.84			
355	Low flow auto controlled faucets	Fire Station #7	Not Started	$ 216		$ 1,500	6.94			
356	Lighting Redesign Study	Fire Station #8	Complete					$ 2,250		
357	Stand by generator	Fire Station #9	Not Started							
	TOTAL ENERGY USAGE COST	$ 27,846								
	TOTAL POTENTIAL COST SAVINGS	$ 4,208								
	% SAVINGS	15%								
Summary of Opportunities				**$ 223,517**	**$ 48,020**	**$ 356,725**		**$ 63,187**		
Completed Items										
Summary of Completed Items				$ -	$ -	$ -		$ 63,187		
On Going Projects										
1	**Training** - We are available to help train employees to better use the load control information provided as well as the costs associated with air and steam leaks. We have talked about meeting to look at other opportunities to control loads and will do so		On Going							
2	**Load Profile Reports** - We are completing load profile reports for the main meter each month along with analyzing the data.		On Going							
3	**Bill Review** - Part of our on going services is to analyze bills on a monthly basis to identify utility errors and operation changes that need to be identified.		On Going							

Note: Not all of these items are mutually exclusive. Some opportunities will impact the energy savings from other projects. The total numbers have accounted for some of these items.

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Appendix 3: Bibliography

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Bibliography

Alliant Energy, http://www.alliantenergy.com/ (accessed November 7, 2007).

American Society of Heating, Refrigerating and Air-Conditioning (ASHRAE), http://www.ashrae.org/ (accessed January 7, 2008).

American Wind Energy Association, http://www.awea.org/ (accessed December 20, 2008).

City of Minneapolis, "Sustainability Initiatives," http://www.ci.minneapolis.mn.us/sustainability/ (accessed November 1, 2007).

Consortium for Energy Efficiency, http://www.cee1.org/ (accessed March 19, 2008).

Department of Energy, Energy Efficiency and Renewable Energy, http://www.eere.energy.gov/ (accessed November 2, 2007).

ENERGY STAR, http://www.energystar.gov/ (accessed November 2, 2007).

Arent, John J., Blatt, Morton H. and Meister, Bradley, PH.D., P.E., "The Right Place for Displacement," *Engineering Systems Magazine*, March 25, 2006, http://www.esmagazine.com/CDA/Articles/Feature_Article/96fd16fba223a010VgnVCM100000f932a8c0 (accessed March 18, 2008).

Environmental Law and Policy Center, http://www.elpc.org/ (accessed December 20, 2007).

Government Accountability Office, "Capital Financing Partnerships and Energy Savings Performance Contracts Raise Budgeting and Monitoring Concerns," Report No. GAO-05 55, December 16, 2004, http://www.gao.gov/highlights/d0555high.pdf (accessed December 18, 2007).

Havens, Chris, "LED Street Lights: Bright Idea for St. Paul?" *Star Tribune*, April 6, 2008. http://www.startribune.com/local/stpaul/17340884.html (accessed April 6, 2008).

Kats, Gregory, "The Costs and Financial Benefits of Building Green," *A Report to California's Sustainable Building Task Force*, Massachusetts Technology Collaborative, October 2003, http://www.usgbc.org/Docs/News/News477.pdf (accessed February 23, 2008).

Lau, Josephine, Chen, Qingyan, "Energy Analysis for Workshops with Floor-Supply Displacement Ventilation Under U.S. Climates," *Energy and Buildings*, 2006. https://engineering.purdue.edu/~yanchen/paper/2006-1.pdf (accessed June 6, 2008).

Matthiessen, Lisa Fay and Morris, Peter, "The Cost of Green Revisited: Reexamining The Feasibility and Cost Impact of Sustainable Design in Light of Increased Market Adoption," David Langdon, July 2007, http://www.davislangdon.com/USA/Research/ResearchFinder/2007-The-Cost-of-Green-Revisited/ (accessed February 22, 2007).

Minnesota Department of Commerce, http://www.state.mn.us/ (accessed November 1, 2007).

Minnesota Department of Commerce, "Performance, Emissions, Economics Analysis of Minnesota Geothermal Heat Pumps," April 2008, http://archive.leg.state.mn.us/docs/2008/mandated/080477.pdf (accessed May 12, 2008).

Minnesota Pollution Control Agency, http://www.pca.state.mn.us/oea/ (accessed November 5, 2007).

Minnesota Office of Environmental Assistance, http://www.pca.state.mn.us/oea/ (accessed November 12, 2007).

National Association of Energy Service Companies, http://www.naesco.org/ (accessed March 5, 2008).

Nelson, Carl, Stiever, Emily and Kearney, John, "Clean Energy Resource Teams (CERTS), Solar Pioneers, A Case Study of the Southeast Como Neighborhood Solar Thermal Project," Green Institute, December 2007.

SolarWall®, http://solarwall.com/ (accessed April 7, 2008).

U.S. General Services Administration, "LEED Cost Study Final Report," Steve Winter and Associates, Inc., October 2004, http://www.wbdg.org/ccb/GSAMAN/gsaleed.pdf (accessed February 22, 2008).

U.S. Environmental Protection Agency, http://www.epa.gov/ (accessed November 6, 2007).

U.S. Green Building Council, http://www.usgbc.org/ (accessed December 19, 2008).

Wachenfeldt, Bjorn Jenssen, Mysenand, Mads, Schild, Peter G. "Air flow rates and energy saving potential in schools with demand-controlled displacement ventilation," *Energy and Buildings,* October 2007.