# City of Traverse City

# Climate Action Plan

## City Government Operations

## For People, Place, and Planet

**February 2011**

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## ACKNOWLEDGEMENTS

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### SPECIAL THANKS

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### ACADEMIC CITATION

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## EXECUTIVE SUMMARY

The world is dependent on a consistent supply of energy to power nearly every aspect of life. The vast majority of this energy comes from fossil fuels that are limited in supply. At the same time, a large portion of the world's population is moving towards greater industrialization and higher energy use. Rising demand and a limited supply of fossil fuel make a significant rise in energy costs seem inevitable. Meanwhile, the scientific community is raising its voice ever louder about the environmental impacts of extracting, refining, transporting, and burning fossil fuels. For these reasons, it makes both economic and environmental sense to develop a plan to maximize efficiency and manage resource consumption.

City of Traverse City is setting an example for the community and other local governments by proactively developing this Climate Action Plan. Actively pursuing this plan will protect the environment and help meet current budget challenges, as well as prepare for escalating energy costs in the near future

This action plan lays a foundation for a transition toward energy independence through the establishment of clear goals and objectives. The plan promotes environmental stewardship and economic sustainability through resource conservation, responsible consumption, and energy efficiency efforts. The plan provides both specific strategies for reducing energy usage and meeting climate goals as well as a step-by-step planning guide. It establishes a prioritization of projects and a sustaining source of financing through the use of an Energy Savings Account. Quick progress is made by first tackling energy efficiency projects that provide the strongest economic return. In the long term, through incremental steps, a transition to economic and environmental resilience becomes feasible.

### Key Facts:

#### Fossil Fuel Use & Waste

- **Currently the United States consumes 25% of the world's energy and holds less than 3% of the world's oil and natural gas reserves.**
- **Fossils fuels currently provide over 86% of the world energy needs.**
- **Michigan currently pays $18 billion each year to import coal, oil and natural gas.**
- **Nationwide 1/3 of energy used in government buildings is wasted.**

**Sources**:
*http://en.wikipedia.org/wiki/World_energy_resources_and_consumption

***http://earthtrends.wri.org/pdf_library/data_tables/ene4_2005.pdf *http://en.wikipedia.org/wiki/Fossil_fuel**

***http://www.michigan.gov/documents/gov/Alternative**_Energy_223194_7.pdf

*http://energystar.gov/istar/pmpam/index.cfm?fuseaction=portfolio.portfolioView

## A CLIMATE FOR CHANGE

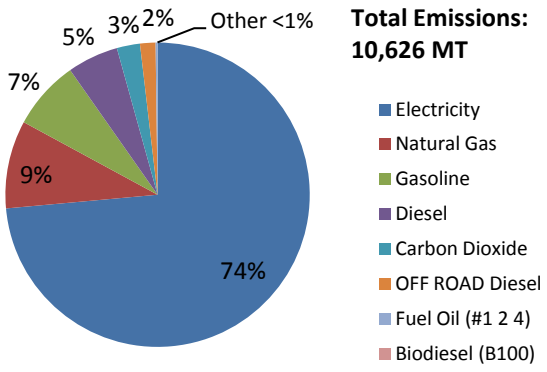
The cost of using energy is rising with global demand and regulatory responses to the environmental impacts of fossil fuels. Resources to assist local governments, businesses, and residents in achieving greater levels of efficiency are constantly evolving. Federal, state, and other financing options are giving preference to – and sometimes requiring – institutions that are demonstrating steps of strategic action toward the reduction of energy and emissions. Energy awareness on the part of City staff matched with expectations from the community is creating leadership and responsibility. Survey results show that the vast majority City employees are already taking action to reduce resource consumption and that there is broad support for new initiatives to reduce energy consumption by the City. The combination of economic and environmental

reasons for change, along with the strong support of City staff and the community at large, provides an excellent foundation for building continued commitment to energy conservation and environmental stewardship.

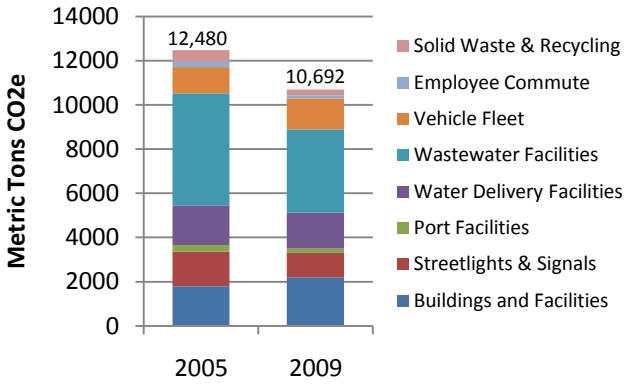
## A STARTING POINT: BASELINE INVENTORY & UPDATE

Strategic action begins with an analysis of operational assets and liabilities and progress is gauged against benchmarks of performance. In 2008 the City completed a baseline inventory of energy use and greenhouse gas emissions generated by City government operations. As part of this action plan operational costs, energy use, and emissions were again inventoried for the year 2009. This interim inventory indicated that, as in 2005, the Wastewater Facilities sector of operations represents the largest portion of City government emissions and that the primary energy source contributing to these emissions is electricity. The 2009 annual emissions inventoried were 10,692 MT $CO_2e$, 14% below the 2005 baseline. This reduction was achieved in part through LED traffic signal retrofits, turning off unnecessary lighting at the marina, recycling waste generated during the Spring Clean-up, and lighting retrofits in buildings, but was primarily due to process optimization and biogas utilization at the City's regional wastewater treatment plant.

**2009 $CO_2e$ Emissions by Source**




**2005 & 2009 $CO_2e$ Emissions by Sector**




## A PLAN OF ACTION

From this baseline inventory and update the City Green Team worked with SEEDS, Inc. to develop a quantified and strategic plan of action as the next step in achieving the goal SEEDS recommended to the City of reducing Government emissions by 25% below the 2005 baseline by 2012. The plan is structured on a platform of sustaining energy efficiency financing through the establishment of a City Energy Savings Account (ESA) which reinvests energy savings into increasing energy, cost, and carbon reductions. Leveraging other climate action plans, energy audits, Green Team experience and other resources, a list of energy and emission reduction measures was created to meet the reduction target. These measures were carefully evaluated based on financial cost, ease of implementation, economic benefit, GHG reduction potential, and Green Team preference. Utilizing 22 of these selected measures and the ESA as the sole financing mechanism, a recommended 5 year reinvestment scenario was developed that could save annually a total of $75,098 in energy and in 720 MT $CO_2e$, achieving the plan's primary objective of establishing "*a clear plan for attaining significant reductions in greenhouse gases based on analysis of environmental effectiveness, economic efficiency, and operational feasibility.*"

| Year Executed | Description of Measure | Initial Cost | Annual Emissions Savings ($MTCO_2e$) | Estimated Annual Savings | Energy Savings Account Balance | Contribution to Energy Savings Account (50% of Savings) | | | | | | Total 5 Year Savings |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2011 | 2012 | 2013 | 2014 | 2015 | Total | |
| 2011 | **T-12 to T-8 Lighting Replacement** | Already Paid | 21.0 | $2,498 | $0 | $1,998 | $1,998 | $1,998 | $1,998 | $1,998 | **$9,991** | **$19,983** |
| 2011 | **VFDs for RAS Pumping At WWTP** | Already Paid | 150.1 | $17,852 | $0 | $14,282 | $14,282 | $14,282 | $14,282 | $14,282 | **$71,409** | **$142,819** |
| 2011 | **TCLP Upgrades Street Lighting to LED** | Already Paid | 97.6 | $11,604 | $0 | $9,283 | $9,283 | $9,283 | $9,283 | $9,283 | **$46,416** | **$92,832** |
| 2011 | **Senior Center Boiler Upgraded** | Already Paid | 2.1 | $345 | $0 | $276 | $276 | $276 | $276 | $276 | **$1,380** | **$2,761** |
| ***2011 Year End Totals*** | | ***$0*** | ***270.7*** | ***$32,299*** | ***$25,839*** | ***$25,839*** | | | | | | |
| 2012 | **Optimize Interior Lighting with Delamping** | $0 | 21.0 | $2,498 | $25,839 | | $1,998 | $1,998 | $1,998 | $1,998 | **$7,993** | **$15,986** |
| 2012 | **Computer Energy Efficient Settings** | $0 | 19.7 | $2,340 | $25,839 | | $1,872 | $1,872 | $1,872 | $1,872 | **$7,489** | **$14,977** |
| 2012 | **Promote Lights Out Policy** | $0 | 11.8 | $1,407 | $25,839 | | $1,126 | $1,126 | $1,126 | $1,126 | **$4,502** | **$9,005** |
| 2012 | **Office Resource Conservation Initiative (Reduce Solid Waste 10%)** | $0 | 26.3 | $0 | $25,839 | | $0 | $0 | $0 | $0 | **$0** | **$0** |
| 2012 | **Install Programmable Thermostats/EMS** | $3,197 | 21.4 | $3,015 | $22,642 | | $2,412 | $2,412 | $2,412 | $2,412 | **$9,647** | **$19,295** |
| 2012 | **Reduce Unnecessary Electrical Loads** | $1,685 | 13.5 | $1,601 | $20,957 | | $1,281 | $1,281 | $1,281 | $1,281 | **$5,124** | **$10,248** |
| 2012 | **Install Occupancy Sensors** | $580 | 1.8 | $214 | $20,377 | | | | | | | |
| 2012 | **Replace Exit Signs with LEDs** | $1,425 | 5.1 | $607 | $18,952 | | | | | | | |
| 2012 | **Remaining T-12 to T-8 with DeLamping** | $18,000 | 21.4 | $2,550 | $952 | | $2,040 | $2,040 | $2,040 | $2,040 | **$8,160** | **$16,319** |
| 2012 | **Install Vending Misers** | $700 | 4.7 | $563 | $252 | | $450 | $450 | $450 | $450 | **$1,802** | **$3,603** |
| ***2012 Year End Totals*** | | ***$25,587*** | ***146.7*** | ***$14,795*** | ***$37,270*** | | ***$37,018*** | | | | | |
| 2013 | **Efficient Driving Campaign with Training** | $0 | 38.7 | $8,601 | $37,270 | | | $6,881 | $6,881 | $6,881 | **$20,642** | **$41,285** |
| 2013 | **Community Water Conservation Initiative (Reduce Use by 5%)** | $0 | 60.9 | $0 | $37,270 | | | $0 | $0 | $0 | **$0** | **$0** |
| 2013 | **HVAC System Retro-Commissioning** | $10,000 | 26.8 | $10 | $27,270 | | | $8 | $8 | $8 | **$24** | **$48** |
| 2013 | **Upgrade Exterior Lighting** | $27,000 | 23.0 | $2,742 | $270 | | | $2,193 | $2,193 | $2,193 | **$6,580** | **$13,160** |
| ***2013 Year End Totals*** | | ***$37,000*** | ***149.4*** | ***$11,353*** | ***$46,371*** | | | ***$46,101*** | | | | |
| 2014 | **Use Smaller Fleet Vehicles** | $0 | 17.2 | $5,157 | $46,371 | | | | $4,126 | $4,126 | **$8,251** | **$16,503** |
| 2014 | **20% Increase in Recycling** | $0 | 37.2 | $0 | $46,371 | | | | $0 | $0 | **$0** | **$0** |
| 2015 | **Upgrade Exterior Lighting** | $46,000 | 39.3 | $4,671 | $371 | | | | $3,737 | $3,737 | **$7,473** | **$14,947** |
| ***2014 Year End Totals*** | | ***$46,000*** | ***93.7*** | ***$9,828*** | ***$54,334*** | | | | ***$53,963*** | | | |
| 2015 | **Promote Low Carbon Commuter Options** | $0 | 8.9 | $0 | $54,334 | | | | | $0 | **$0** | **$0** |
| 2015 | **Use Bikes at on the Job** | $0 | 4.5 | $1,340 | $54,334 | | | | | $1,072 | **$1,072** | **$2,144** |
| 2015 | **Upgrade Exterior Lighting** | $54,000 | 46.1 | $5,483 | $334 | | | | | $4,387 | **$4,387** | **$8,773** |
| ***2015 Year End Totals*** | | ***$54,000*** | ***59.5*** | ***$6,823*** | ***$334*** | | | | | **$59,422** | | |
| ***Cumulative Totals*** | | ***$162,587*** | ***720.0*** | ***$75,098*** | | | | | | | ***$222,343*** | **$444,686** |

**Five Year Potential Reinvestment Scenario**

## INTRODUCTION

Local governments are uniquely positioned for leadership in achieving wins for people, place, and planet. Regardless of whether the potential impacts of climate change are felt by the people of City of Traverse City in the next five years, fifty years, or ever, taking action to save costs on energy used by government operations is a clear win-win-win for local tax-payers, regional air quality, and the global environment *today*. The use of fossil fuels and electricity produced from fossil fuels as well as solid waste generated from local government operations are directly linked to reduced air quality, greenhouse gas emissions, and rising operating costs. Therefore strategic actions to reduce solid waste generation and smarter use of energy can result in significant reductions in both emissions and costs.

This Climate Action Plan plots a course of responsible action to manage resource consumption and thereby reduce climate degrading emissions. The plan is intended to be implemented incrementally. This report acts as both a guide and reference material for implementation. It is designed to be both interactive and adaptable to changing needs. In order to meet changing needs the Action Plan is set up in sections that follow the steps of climate action planning outlined in Figure 1 with information about the various steps so that it can provide direction when changes are required. Integral to this plan, an Energy Savings Account for the City has been proposed that would provide a financial platform to incrementally implement the many measures that are provided within. By following this plan City of Traverse City can stand as leader in climate stewardship and can move towards economic and environmental sustainability.

## BACKGROUND

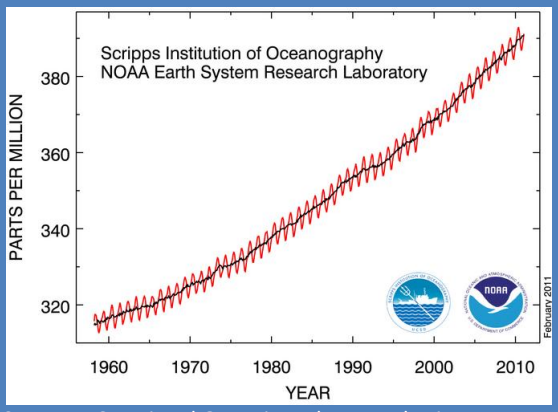
Expenditures on energy and solid waste management at facilities and fuel for vehicles owned by local governments typically hold substantial potential for reduction. Energy purchases and solid waste management are expensive and efficiencies can lead to reduced expenses. These activities also contribute to the release of criteria air pollutants, emissions directly affecting local and regional air quality, and the release of greenhouse gases, which are of global concern. Criteria air pollutants include precursors to smog formation, particulates and other substances that pose serious local health risks to asthmatics, children, the elderly and individuals with heart and lung diseases. These same pollutants pose health risks to everyone who is chronically exposed.

Greenhouse gases (GHGs) pose longer-term more global risks. The current and growing rate of emission of these gases to atmosphere threatens to disturb the balance of the Earth's natural greenhouse effect that may result in drastic and long-term global climate change. The three greenhouse gases most commonly tracked by local governments are carbon

**Key Facts**:

Atmospheric $CO_2$ Levels

Atmospheric levels of CO2 have risen 24% since 1960.




**Source**: US National Oceanic and Atmospheric Administration Earth System Research Laboratory

dioxide (CO2), methane (CH4), and nitrous oxide (N2O). All three gases can be emitted during the combustion of fossil fuels for heating, transportation, and electricity production. Methane (CH4) is particularly potent and is emitted during decomposition of solid waste in landfills.

These adverse effects of our energy and waste choices may be mitigated through a variety of actions including measures that save local governments money and provide greater energy security for communities.

**Why should local governments take action?**

Short Term – As government budgets grow tighter due to reduced revenues, communities are demanding better value for tax dollars. Taking action to reduce energy and waste makes sense, because these actions reduce operating costs, improve local air quality, and pay for themselves.

Mid Term – Demand for energy nationally and globally continues to drive rising costs. Current federal greenhouse gas regulations that go into effect in 2011 will likely raise the price of fossil energy. This means that the value of energy efficiency measures will also continue to climb.

Long Term – Energy security, the feeling that we will have enough energy resources to provide for our community, is of growing interest. As fossil fuels get scarcer and more expensive it becomes increasingly obvious that communities cannot start too early to prepare for energy self-reliance. This means reducing consumption through efficiencies as well as producing power through clean, renewable resources. This kind of action will improve air quality locally and also mitigate the most severe potential effects of climate change around the globe. Changes in temperature and precipitation intensity will likely negatively affect tourism, fishing, local agriculture, and the demands on community infrastructure. Taking action to reduce these risks can direct City dollars into the local economy and better prepare the community for global uncertainties.

*A more detailed discussion of greenhouse gases, climate change, and environmental, human health, and economic risks can be found in Appendix A.*

## APPROACH

Grand Traverse County and the City of Traverse City have proactively engaged in the Climate Action Planning Process because they recognize the value of protecting their local environment and setting an example for the community. Wanting to create a win for people, place, and planet; a focus was placed on making climate action economically viable, as well socially and environmentally responsible. Understanding that financing would be a major obstacle an Energy Savings Account has been proposed to provide sustaining funding for the incremental implementation of energy and climate measures. In creating and following this action plan, a precedent will be set for the community and the surrounding region to responsibly manage resources and encourage environmental resilience along with economic sustainability.

The planning process pursued by the City Green Team merges the ICLEI[1] climate change mitigation process and the Energy Star[2] energy management action planning process. It begins with a "Commitment to Action" and then proceeds to an "Assessment of the Current Situation" which usually involves a baseline inventory. The process then continues sequentially through the following steps; "Strategize and Set Priorities / Goals", "Generate an Action Plan", "Implement Measures", "Evaluate Progress / Review", and "Reinvest and Recognize Achievement". The process is demonstrated visually in Figure 1. Plan Action Process Flow Chart. Note that the remainder of this report follows this process in the structure of its sections.

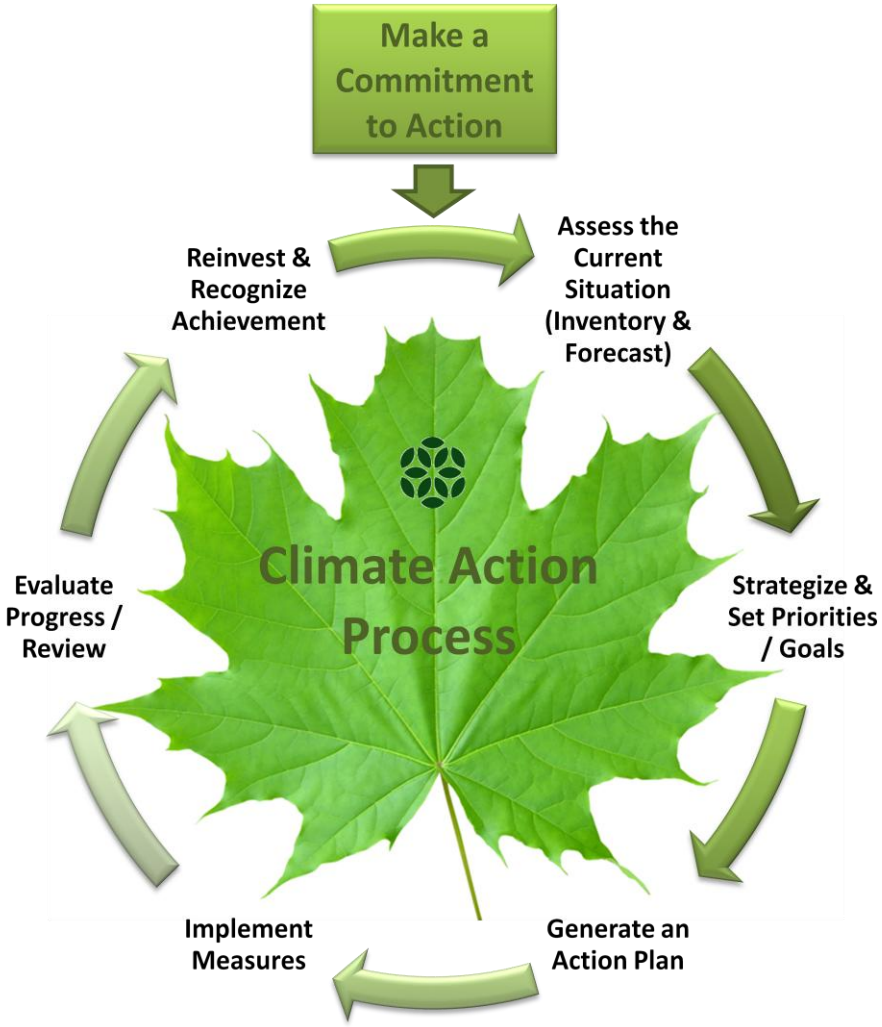



**Figure 1. Plan Action Process Flow Chart**

[1] ICLEI - Local Governments for Sustainability is an association of over 1200 local government Members who are committed to sustainable development.

[2] ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping people save money and protect the environment through energy efficient products and practices.

Recognizing the benefits of this process, the City took the first formal step in Climate Action Process in spring of 2008 by completing a baseline inventory of 2005 operations and setting a reduction target. In the winter of 2010 a Green Team was assembled to create a Climate Action Plan to formalize City of Traverse City's commitment to environmental stewardship and responsible resource consumption. The team worked collaboratively to outline project objectives, develop GHG reduction strategies, and create a prioritized plan for their execution.

**The objectives that laid the foundation for the planning process were as follows:**

- The action plan shall establish a clear plan based on analysis of environmental effectiveness, economic efficiency, and operational feasibility.
- The action plan shall outline the process, timeline, and rationale for implementing short, mid, and long-term reduction strategies towards short, mid, and long-term greenhouse gas reduction goals.
- The action plan shall create mechanisms to enable the sustainability of the project including reinvestment of cost savings.
- The action plan shall serve as a dynamic and adaptive document that is updated as progress is achieved, goals are advanced, and opportunities emerge.
- The action plan shall strive to create a culture of energy conservation and environmental stewardship among government officials, employees, and contractors.
- The action plan shall set an example of energy conservation and environmental stewardship for the Grand Traverse region.

Throughout the planning process these objectives provided direction. Leveraging other climate action plans, energy audits, ICLEI's CAPPA tool[3], and Green Team experience a list of many potential energy and emission reduction measures was created to meet the reduction target. These measures were evaluated based on financial cost, ease of implementation, economic benefit, GHG reduction potential, and Green Team preference. Other City staff members were engaged through a survey to provide ideas and feedback thus allowing for a balanced perspective. This long list was refined and the remaining measures were grouped and organized into ten targeted strategies for simplification. These strategies are the heart of the action plan and are summarized in the "

[3] ICLEI CAPPA (Climate and Air Pollution Planning Assistant) - Is a decision support tool designed to help U.S. local governments explore, identify, and analyze potential climate and air pollution emissions reduction opportunities.

Ten Strategies for Action" section of this report. However it is the individual measures within these strategies that will be implemented, so they are what will be seen in the implementation and prioritization tables.

This plan will act as road map to meeting the climate and energy goals and objectives, while also being a living process that is adapted to changing needs. It provides specific strategies for reducing GHGs, through fiscally sound methods, while also acting as a framework for decision making, thus acting as a guide to meeting established climate goals and objectives.

## STEP 1 - COMMITMENT TO LOCAL ACTION

Creating and executing a Climate Action Plan requires a serious commitment. The Grand Traverse region has a long history of commitment to protecting natural resources and recognizing them as drivers of the local economy. This region is also known for an active, participatory citizenry. In 2006, these factors came together with a citizen driven movement to encourage the City to sign onto the Mayor's Climate Protection Agreement in order to participate in the international study and discussion of the use of carbon-based fuel sources, the implications for the atmosphere of the planet and leverage energy savings and future funding opportunities.

This movement was successful and on January 15, 2007 the Traverse City Commissioners unanimously voted to sign onto the U.S. Mayor's Climate Protection Agreement. Following this move by the City, the County government decided to partner with the City to issue a joint request for proposals for a phased approach to the process outlined by the International Council for Local Environmental Initiatives (ICLEI).

Through this competitive bid process, a local nonprofit organization, SEEDS, was awarded the contract. The City and County each formally joined ICLEI to gain access to that organization's support systems and software and SEEDS got to work!

In the fall of 2008, SEEDS delivered a comprehensive assessment of greenhouse gas emissions for each municipality's operations and also for the county-wide community. The baseline was for the year 2005, the earliest year with complete and digitized data sets. Included in SEEDS' report was a set of target reduction recommendations: by 2012, a 25% reduction from 2005 emissions for the City and the County governments, and a goal of no increase in emissions for the community.

When adopting the U.S. Mayor's Climate Agreement, then-City Manager, Richard Lewis, commented that this action should be more about saving energy, cutting costs and improving quality of life, rather than attracting attention. He said, ***"If we're going to sign this agreement, I want to do it right, otherwise, I'd just as soon not sign it."***

Recognizing the cost saving implications of energy efficiency, Grand Traverse County Commissioners formally adopted the 25% reduction goal. The City decided to involve their staff more directly in setting their reduction target. To date, no target has been formally adopted by the City, though following a review of the inventory findings, City staff reported that a 25% reduction is a reasonable goal.

With a comprehensive baseline assessment completed, the City and County continued their partnership. They submitted and were awarded an Energy Efficiency and Community Block Grant (EECBG) to fund the creation of a Local Action Plan, a step-by-step plan for reaching the 25% reduction of emissions. The EECBG funding was received in 2010 and this report is a component of the results of that funding.

## STEP 2 - ASSESSMENT OF CURRENT SITUATION (INVENTORY UPDATE SUMMARY)

An assessment of the current situation or inventory is the cornerstone of action planning. It serves as the basis for developing goals, strategies for action, and plans for implementation, as well as the means by which performance is measured and progress against goals is monitored. The initial inventory was performed with 2005 data and established a benchmark upon which to establish climate and energy goals and subsequently evaluate progress. As part of this action plan an updated inventory was performed for 2009 operations. This section will cover the methodology for evaluating carbon emissions and the details of 2005 and 2009 inventories, and summarize the results of the employee survey.

**Assessing your climate and energy performance helps you to:**

- Categorize current energy and emissions use by source and type.
- Identify areas of high performance for recognition and replicable practices.
- Prioritize areas of low performance for improvement.
- Understand the contribution of energy and waste expenditures to operating costs.
- Develop a historical perspective and context for future actions and decisions.
- Establish reference points for measuring and rewarding good performance.

### METHODOLOGY

The first step toward reducing energy expenses and greenhouse gas emissions is to identify baseline levels and sources of emissions as well as the sectors of government operations that are responsible for the bulk of these emissions. Emissions are estimated by applying standardized emission factors to local government records of energy use or waste generation.

For example, from monthly utility bills we may know that a particular building spends $20,000 a year for the 200,000 kilowatt-hours (kWh) of electricity that it consumes. Because the US EPA monitors and reports greenhouse gas emissions from power plants we know that for every kWh of electricity purchased from the regional electricity grid in Northern Michigan on average 1.6 pounds of greenhouse gases (lbs $CO_2$-e) are emitted to the atmosphere.

Similarly from City fleet records we may learn that $20,000 in diesel fuel was purchased annually for 8000 gallons of fuel for fleet trucks. Based on national emission standards, we know that on average 22 lbs $CO_2$-e are also emitted per gallon of diesel fuel burned for the heavy truck vehicle class and a particular model year.

**Table 1: Emissions Estimation Example**

| Examples | Annual Expense | Energy | Units | Cost per Unit Energy | Emission Factor: (lbs of GHGs per Unit Energy) | Total Annual tons of GHGs | Cost per ton of GHGs emitted |
|---|---|---|---|---|---|---|---|
| Building | $20,000 | 200,000 | kWh | $0.10 | 1.6 | 160 | $125 |
| Truck Fleet | $20,000 | 8,000 | gallons diesel | $2.50 | 22 | 88 | $227 |

By inventorying and comparing the two we see that different quantities of emissions result from similar expenditures depending on the type of energy. Likewise investments and actions taken to reduce these energy expenses will yield differing financial and environmental returns depending on the fuel source. Comprehensively analyzing these expenditures provides the foundation for strategic planning and investment to maximize cost and carbon savings.

ICLEI – Local Governments for Sustainability assists local governments in systematically tracking these energy and waste related activities and cost by providing software and a standardized methodology for estimation and reporting emissions.

ICLEI's Clean Air Climate Protection (CACP) software tracks emissions of greenhouse gases (primarily carbon dioxide, methane, and nitrous oxide) that result from the use of electricity, fuel, and waste disposal. It then reports the greenhouse gases cumulatively in equivalent carbon dioxide emissions[4] ($CO_2$-e).

**Key Facts:**

*Emissions Equivalency*

Reducing one metric ton of CO2e is equivalent to the emissions of driving an average car 2500 miles (about 1/5 of an average car) or the carbon sequestered annually by 1/5 of an acre pine forests.

**1 MTCO2e** = 1/5 of a car's annual emissions

**1 MTCO2e** = annual carbon sequestration

In 2008, the City contracted SEEDS to complete a baseline inventory that analyzed government operations for the calendar year 2005 using the 2005 release of ICLEI's CACP software. The methodology and results of that inventory are described in detail in the 2005 Baseline Inventory Report (included in the Resource CD). In 2010 ICLEI released a substantially updated version of the software, CACP 2009. As part of completing this action plan 2005 data was reassessed using the CACP 2009 software and calendar year 2009 operations were analyzed to compare to the baseline. Below is a summary of the method used and changes in methodology from the original 2005 baseline.

### METHOD SUMMARY:

Software: The City government inventories performed for this action plan have been prepared using the CACP 2009 software and its default calculations, values, and assumptions unless otherwise noted. Additional calculations related to solid waste and recycling were completed using the US EPA's Waste Reduction and Assessment Model (WARM).

[4] Because different greenhouse gases have different impact intensities, total emissions are converted to carbon dioxide equivalents (CO2-e) to provide a standard unit of measurement.

Base Year: To re-set energy and emission reduction targets, government operations were inventoried for a specific base year, calendar year 2005, against which reduction measures and subsequent inventory years are compared.

Interim Year: The most recent interim year for which data was ready available was the calendar year 2009, which has been used to measure progress and provide assessment of current energy use and emissions.

Scope: The scope of analysis generally includes electricity, natural gas, propane and refrigerants used by facilities, vehicles, and equipment that are directly financially controlled by the City government. However this inventory also includes four activities – employee commuting, reimbursed business travel, solid waste generation, and solid waste recycling that result in emissions indirectly controlled by City operations.

Data Sources: Data for the inventory were collected from City utility expense records, facility records, and staff surveys.

### METHODOLOGY CHANGES:

Key changes between the methods used for the original inventory and this action plan include:

- The use of the ICLEI's CACP 2009 software with revised emission factors for fleet vehicles and revised fleet vehicle classes;
- The use of the US EPA's eGRID emission factors for electricity based on the 2005 RFC Michigan regional grid;
- Elimination of the evaluation of sub-contracted services as part of the government operations;
- Changing from the CACP 2005 listing of 7 categories to CACP 2009 listing of 13 categories, resulting in a different breakdown of categories but similar scope of activities;
- Elimination of the evaluation of criteria air pollutants (CAP) because CAP emission factors were not available for all sectors, most notably electricity; and lastly,
- The use of actual building natural gas consumption data as opposed to consumption estimated from gas expenditures and assumed fuel costs.

Other notable changes between 2005 and 2009 include the addition of several facilities & accounts – new parking facilities, Heritage Center, and Downtown Development Authority.

*For more details on the inventory and data sources used please see Appendix B.*

Compared to the revised 2005 baseline, emissions from City government operations declined by 14% with a corresponding 4% decrease in operating costs in the year 2009 (Table 2). Similar to the findings of the original 2005 baseline, wastewater treatment represented the sector of City government with the greatest contributions of greenhouse gas emissions (Figure 2).

**Table 2: Comparison of Greenhouse Gas Emissions and Operating Costs Years 2005 & 2009**

| | | | 2005 | | 2009 | | | |
|---|---|---|---|---|---|---|---|---|
| **Sector** | **Source** | **Scope** | **MT $CO_2e$** | **Cost** | **MT $CO_2e$** | **% Change** | **Cost** | **% Change** |
| **Buildings and Facilities Sector** | | | | | | | | |
| | Electricity | 2 | 1038 | $109,841 | 1372 | 32% | $167,760 | 53% |
| | Waste Oil | 1 | 22 | 0 | 22 | 0% | 0 | 0% |
| | Natural Gas | 1 | 730 | $136,988 | 807 | 11% | $141,237 | 3% |
| *Subtotal* | | | 1790 | $246,828 | 2201 | 23% | $308,997 | 25% |
| **Streetlights & Traffic Signals Sector** | | | | | | | | |
| | Electricity | 2 | 1567 | $394,200 | 1092 | -30% | $254,484 | -35% |
| *Subtotal* | | | 1567 | $394,200 | 1092 | -30% | $254,484 | -35% |
| **Port Facilities** | | | | | | | | |
| | Electricity | 2 | 298 | $30,726 | 195 | -35% | $25,524 | -17% |
| | Natural Gas | 1 | 8 | $1,712 | 7 | -13% | $1,599 | -7% |
| *Subtotal* | | | 306 | $32,438 | 202 | -34% | $27,123 | -16% |
| **Water Delivery Facilities Sector** | | | | | | | | |
| | Electricity | 2 | 1711 | $160,311 | 1542 | -10% | $180,720 | 13% |
| | Natural Gas | 1 | 85 | $15,901 | 81 | -5% | $15,393 | -3% |
| *Subtotal* | | | 1797 | $176,212 | 1623 | -10% | $196,113 | 11% |
| **Wastewater Facilities Sector** | | | | | | | | |
| | Electricity | 2 | 4654 | $348,691 | 3666 | -21% | $349,827 | 0% |
| | Natural Gas | 1 | 404 | $63,673 | 104 | -74% | $20,192 | -68% |
| *Subtotal* | | | 5057 | $412,364 | 3770 | -25% | $370,019 | -10% |
| **Vehicle Fleet Sector** | | | | | | | | |
| | Biodiesel (B100) | 1 | | | 0 | | 2781 | |
| | Diesel | 1 | 50 | $6,561 | 579 | 1058% | $103,120 | 1472% |
| | Gasoline | 1 | 643 | $129,373 | 646 | 0% | $134,418 | 4% |
| | OFF ROAD Diesel | 1 | 452 | $79,979 | 176 | -61% | $30,722 | -62% |
| | OFF ROAD Gasoline | 1 | 40 | $8,239 | | -100% | | -100% |
| *Subtotal* | | | 1185 | $224,152 | 1400 | 18% | $271,041 | 21% |
| **Employee Commute Sector** | | | | | | | | |
| | Diesel | 3 | 9 | | 1 | -89% | | |
| | Gasoline | 3 | 256 | | 141 | -45% | | |
| *Subtotal* | | | 266 | | 142 | -47% | | |
| **Other - Solid Waste & Recycling** | | | | | | | | |
| | Carbon Dioxide | 3 | 512 | | 263 | -49% | | |
| *Subtotal* | | | 512 | | 263 | -49% | | |
| **Total** | | | **12480** | **$1,486,195** | **10692** | **-14%** | **$1,427,779** | **-4%** |

Figure 2. 2009 $CO_2e$ Emissions by Sector

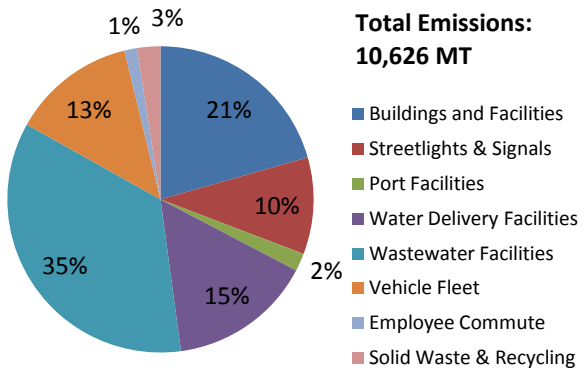



Figure 3. 2009 $CO_2e$ Emissions by Source

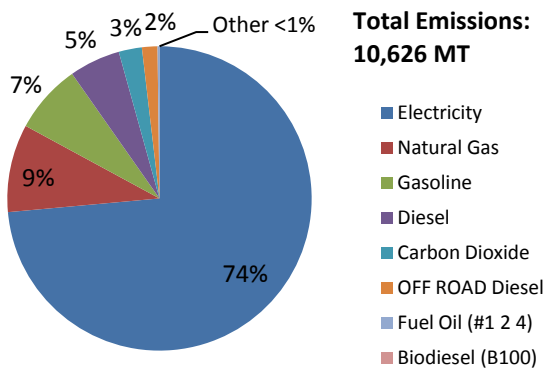



Figure 4. 2005 & 2009 $CO_2e$ Emissions by Sector

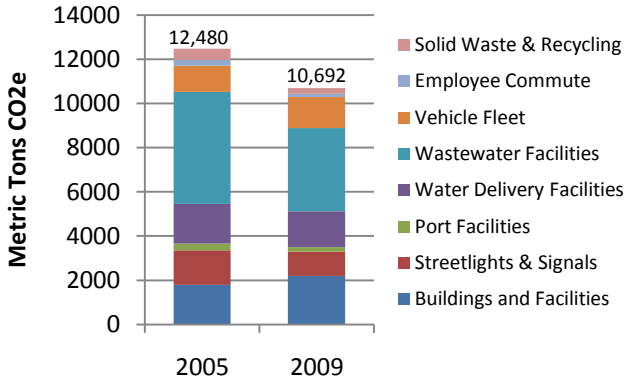



Figure 5. 2005 & 2009 $CO_2e$ Emissions by Source

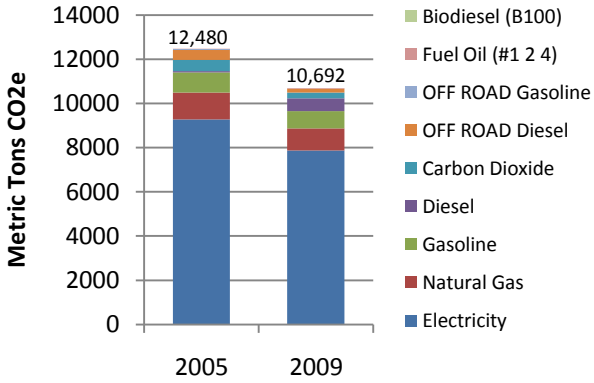
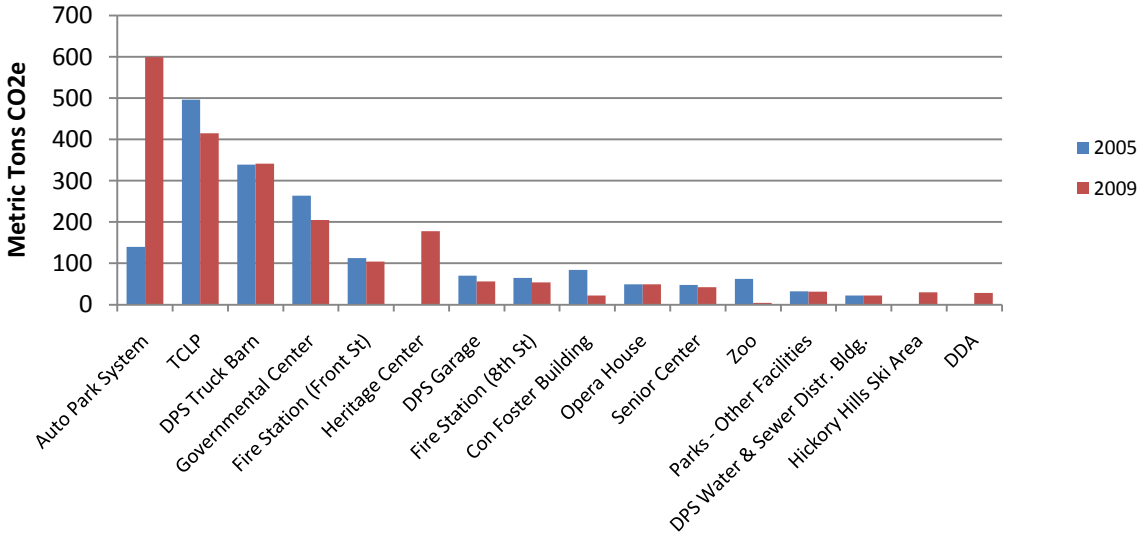



Figure 6. 2005 & 2009 $CO_2e$ Emissions Among Buildings & Facilities




Of the sources of greenhouse gases from County operations, electricity used in buildings and for water wastewater services represented nearly three quarters (Figure 3). Emissions related to streetlights and traffic signals, the marina, water & wastewater facilities, employee commuting, and solid waste & recycling

decreased between 2005 and 2009. The only noticeable area of emissions growth occurred in the Buildings & Facilities and Vehicle Fleet sectors (Figure 3). New parking facilities completed after 2005 were the primary contributor to the 23% increase in Buildings & Facilities (Figure 5).

*Without the addition of the new parking facilities and four accounts not inventoried in 2005, the City's footprint would have dropped an additional 5% below 2005 levels.*

Of the sectors, the 21% reduction in electricity and 74% reduction in natural gas consumption at wastewater treatment facilities contributed more than 2/3rds of the reduction the City realized between 2005 and 2009. These efficiencies were achieved largely through treatment process optimization and utilization of methane biogas produced from wastewater in place of natural gas.

Other notable decreases were also observed in energy consumption and emissions at the water treatment plant with the use of variable frequency drive pumps, at the Marina by turning off unnecessary lighting, among traffic signals by retrofitting with LED lights, at Traverse City Light & Power facilities and the Governmental Center via efficient lighting upgrades, and reductions in solid waste generation by recycling Spring Clean-Up materials (Table 1 and Figure 5). Analysis of each of these sectors, sources, scopes, and costs helps identify priorities for future targeted emissions and cost reduction, but feasibility and acceptance among staff may be just as critical to effective implementation and realization of true emissions reductions.

## CITY EMPLOYEE SURVEY

An energy and commute survey was conducted among employees to better understand employees' motivations, current energy conservation practices, and a willingness to make changes. The survey was used to generate new ideas for energy savings, as well as identify existing issues that might be wasting energy. The results were very positive, indicating that the majority of City employees are already actively trying to save energy and would support new initiatives at the City. See Figure 2, below to see a summary of employee energy conservation behaviors at home.

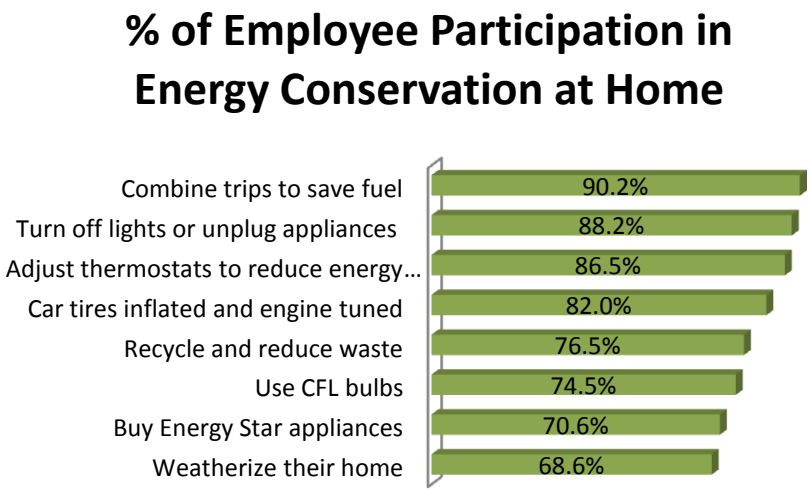



**Figure 7: Employee Energy Conservation Behavior**

***Employee Support of Energy Conservation***

Support for new policies or initiatives to save energy scored a 6.8 out of 10.

59.8% of staff are motivated to save energy by beliefs or values.

***Positive Comments***

"I am glad to see that city/ county is taking steps to be more "green" and I hope they have a true commitment to it."

"I am very glad to see the county and city getting involved in energy reduction!"

"good luck getting everyone on board, I think it's great that you're trying! sooner or later everyone will "get it"."

Overall employees did not have many issues with heating, cooling, and lighting system, but there may be some opportunities for localized improvement (See Figure 3). Some opportunities for improvement identified by employees include: the HVAC distribution systems at the Government Center may need to be adjusted because of large fluctuation in temperature throughout the building, in addition there may be is potential for removing bulbs from the newly installed T8 lighting because 18% of employees felt their work area was over lit.

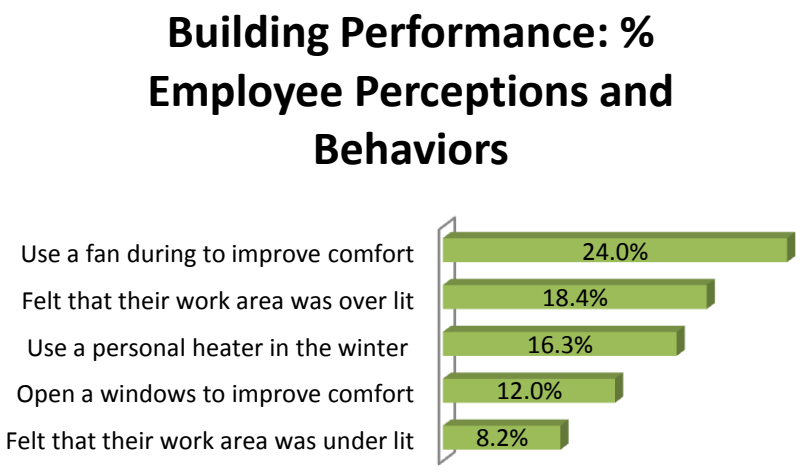



**Figure 8: Employee Perception and Behaviors at Work**

***Employee Comments about Building Performance and Energy Conservation Opportunities***

"Government Center- 1st floor too hot in winter. Too cold in summer. Can't comfortably wear seasonal clothes"

"First Floor / Gov Center - Very warm in the front office. Others towards the back / window are very cold"

"We should have a way to recycle more than just paper (i.e. plastics, glass, etc)"

"Outside lighting- cut every other light" "Turn up the temp on the AC setting in the summer. Get rid of some of the FL bulbs in the offices."

## STEP 3 - SETTING AN EMISSIONS REDUCTION GOAL

The process of goal setting is essential to success. Clearly identifying intended outcomes allows for prioritization of tasks and making plans for their execution. Without goals efforts tend to lack focus and direction. In order to provide motivation and insure success, goals should be SMART: Specific, Measurable, Attainable, Relevant, and Time Bound. Goals should be developed and written down so that they will be real and tangible.

*Although the City Board of Commissioners has not yetratified a formal goal, this action plan is based on a Specific, Measurable, Attainable, Relevant, and Time Bound goal for reducing greenhouse gas emissions. Based on the 2005 baseline inventory of a goal was recommended by SEEDS to reduce emissions from City operations by 25% from 2005 levels by the year 2012 – a goal assumed to be roughly equivalent to the reduction levels requested of the U.S. under the Kyoto Protocol. This goal was later reveiwed by Public Services staff and acknowledged as reasonable.*

Goal setting will continue to be an important part of the action planning process. There is great opportunity to take a leadership role in their community and lead by example. The City should continue to raise the bar and set new goals. By striving for continuing success a precedent will be set for other local governments and the community. See Resource CD in the "Goal Setting" folder for additional information.

### GOALS IN A GLOBAL, NATIONAL, REGIONAL, AND STATE CONTEXT

On a global scale climate related goals and objectives have been developing through the efforts of the United Nations and their organization of Climate Change Conferences. The first binding GHG reduction targets were set in 1997 with the formation of the Kyoto Protocol that has since been signed by 191 countries. In 2010 at the Copenhagen conference, United Nations members agreed to set a target of limiting global warming to a maximum 2 degrees Celsius[5] Most recently, in 2011 at the Cancun conference mechanisms were set in place to reach the goal of a maximum global warming of two degrees Celsius. As part of the conference voluntary targets were set for individual nations and the United States set a goal of reducing emissions by 17 percent by 2020 from 2005 levels. In addition, recently in his 2011 state of the union address the President proposed a goal of having 80% of the United State's electricity be produced by clean sources by 2035.

[5] http://www.independent.co.uk/environment/climate-change/china-says-it-achieved-its-goal-in-copenhagen-climate-deal-1862709.html

Regionally there is has been a lot of action being taken to protect the environment and reduce emissions. The members of the Midwestern Governors Association united to form an Energy Security and Climate Stewardship Platform. Together, with provinces in Canada, they set a goal to "Maximize the energy resources and economic advantages and opportunities of Midwestern states while reducing emissions of atmospheric CO2 and other greenhouse gases"[6]. Furthermore they created a roadmap for meeting this goal which included a priority recommendation to "Demonstrate public sector leadership in applying energy efficiency technologies by reducing energy consumption in existing and new government buildings by 15 percent by 2015, 20 percent by 2020 and 25 percent by 2025, relative to forecasted levels[7]."

In Michigan, renewable energy and climate protection are gaining considerable attention. The State of Michigan is requiring energy producers to meet a 10% renewable portfolio by 2015 as part of Clean, Renewable, and Efficient Energy Act, S.B. 213. In addition, Governor Granholm supported a goal of 25% renewable energy by 2025. Grand Valley State University in Grand Rapids set a goal to reduce CO2e emissions to 20% of the 2006 total before the year 2020 and to 50% of the 2006 levels by 2030. The City of Ann Arbor set a city wide reduction target of being 7% below 1990 GHG emissions by 2020 . Ann Arbor also set a goal to have the municipal government use 30% green energy by 2010 and 20% green energy for the whole city by 2015.

***Global, Regional, and State Climate Goals***

- In 2010 in Copenhagen the United Nations members agreed to set a target of limiting global warming to a maximum of 2 degrees Celsius.
- In his 2011 State of the Union address the President proposed a goal of having 80% of the United State's electricity be produced by clean sources by 2035.
- Midwestern Governors Association set a goal to "Maximize the energy resources and economic advantages and opportunities of Midwestern states while reducing emissions of atmospheric CO2 and other greenhouse gases."
- The State of Michigan is requiring energy producers to meet a 10% renewable portfolio by 2015 as part of Clean, Renewable, and Efficient Energy Act, S.B. 213.

Other Notable Goals:

- Chicago set a community wide reduction goal of reducing emissions to 25% below 1990 levels by 2025 and 80% below 1990 levels by 2050
- Portland, OR established a goal of using 100% renewable energy in city facilities by 2010.

[6] http://www.midwesterngovernors.org/publications/energyplatform.pdf

[7] http://www.midwesterngovernors.org/Publications/Roadmap.pdf

## STEP 4 - A PLAN OF ACTION

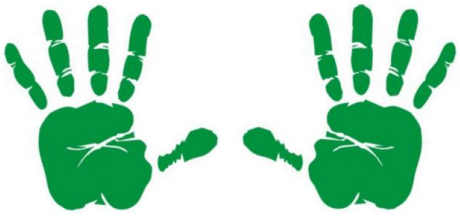
A detailed action plan provides systematic processes and acts as a guide to implementation, and efficient allocation of resources. The plan maximizes results and provides direction toward meeting goals. Because of the nature of climate and energy action, this type of action requires regular updating usually annually to reflect recent achievement, changes in performance, and shifting priorities.

This action plan is built on two key principles of **sequence** and **reinvestment**. With respect to sequence, a great deal of effort has been taken to use the most effective measures and to prioritize them based on economic and environmental impact. This generally means investing in measures that provide the greatest return first. The end result was a prioritized list of measures to maximize impact. The second principle is reinvestment. By setting aside a percentage of or the total cost savings produced from one purchase or measure, a sustained funding source for future purchases can be created. An initial lump sum can yield returns not just once in one year, but through multiple purchases for years to come. Economic sustainability is provided by 80% reinvestment of savings through the Energy Savings Account. This incremental sequencing and reinvestment approach has been used by cities nationwide with great success and beneficial returns, (Ann Arbor, MI has demonstrated this over a 20 year period).

This action plan acts as a road map to energy management and achievement of the City's climate goal through incremental steps. It plots a course, but also provides the resources to change or correct along the way. In order to meet the goals and objectives, this plan provides strategies for reducing energy and resource consumption, as well as providing information for future planning, education and building staff support. The document contains short-term, mid-term, and long-term actions nested within the overall process. The short-term actions include actions that have or will be funded under recent grant awards. The mid-term and long-term actions will be funded by contributing 80% of the cost savings to an energy savings account. The mechanism of reinvesting energy savings has been very successful in cutting energy cost and emissions over the long-term. Although the process is structured, it also intended that the process be flexible to changing needs. Each year the Green Team will assemble to decide which measures to implement. By utilizing this reinvestment mechanism this Climate Action Plan stands as powerful resource and a model for successful energy management and environmental stewardship.

The primary objectives addressed by the measures in this section include: the establishment of "*a clear plan for attaining significant reductions in greenhouse gases based on analysis of environmental effectiveness, economic efficiency, and operational feasibility*" and the creation of "*a culture of energy conservation and environmental stewardship among local government employees*".

## TEN STRATEGIES FOR ACTION



During the planning process the Green Team considered many ways to reduce the City's environmental impact. A great deal of time was spent creating a comprehensive list of possible measures for reducing GHG emissions. This included studying the successes of many other climate action plans, energy audits, conservation literature, and the use of ICLEI's CAPPA action planning tool. These measures were analyzed, quantified, and narrowed based on economic and environmental benefits, as well as feasibility of implementation and City interest. These remaining measures were grouped and organized into ten targeted strategies for reducing City GHG emissions. These strategies are the core of this action plan; they are focused on the major areas of energy use and all major sectors of emissions. The many measures that comprise the ten strategies are covered in detail in Appendix C. These individual measures have been analyzed in detail and been prioritized for implementation in the "Prioritizing Action" section below in this report.

### REDUCE UNNECESSARY ELECTRICAL LOADS


It is not uncommon to find devices that are using electricity unnecessarily. This strategy involves actively reducing unnecessary electrical loads through intelligent application of technology and procedure.

### PURCHASING ENERGY EFFICIENT EQUIPMENT


This strategy sets a policy to only purchase energy efficient products at time of replacement. The use of energy efficient products will save a significant amount of both energy and money.

### RESOURCE CONSERVATION POLICIES OR INITIATIVES

Although the City already has a recycling program and lighting policies in place there is potential to promote greater participation. This strategy involves adopting and actively promoting policies and initiatives that encourage responsible resource usage.

### OPTIMIZE INTERIOR LIGHTING

Artificial light is essential to working indoors and is a significant expense, on average making up 30-40% of energy usage in commercial buildings in the United States. Good lighting creates a positive and productive work environment, while poor lighting can lead to low morale, reduced productivity, and increased errors. This strategy involves optimizing lighting to provide good quality lighting, while also reducing energy usage.

## OPTIMIZE HVAC PERFORMANCE

Energy used to heat, cool, and ventilate contributes to the majority of energy use in buildings. An intelligently designed, well tuned, and properly maintained HVAC system can provide a healthy and safe work environment while also saving money. This strategy involves optimizing the functions of the existing HVAC equipment to ensure that everything is running at peak performance as well as upgrading HVAC equipment to high efficiency equipment at the time of replacement.

## OPTIMIZE EXTERIOR LIGHTING

Substantial amounts of electricity are consumed through outdoor lighting, much of which is unnecessary. This strategy involves optimizing your exterior lighting performance to save energy, cut down on light pollution, and reduces associated GHG emissions.

## WATER SYSTEM UPGRADES AND CONSERVATION MEASURES

The process of supplying water, as well as heating it, requires considerable amounts of energy and money. This strategy targets water conservation at City facility and community levels through education and devices as well as efficient water and wastewater pumping equipment to reduce water and energy use.

## UTILIZE RENEWABLE ENERGY

Renewable energy represents an environmentally friendly alternative to the use of fossil fuels. This strategy involves employing clean energy technologies like solar water heating, solar PV, and wind energy.

## PROMOTE SMART TRANSPORTATION OPTIONS

Fleet vehicle usage and employee commuting contribute significantly to City emissions. Many low and no cost strategies exist for reducing transportation related fossil fuel usage and the associated emissions. This would include promoting activities like carpooling, efficient driving, and reduced fleet usage.

## PRIORITIZING ACTION

As mentioned above the ten strategies include many individual measures. In order to quantify economic and environmental impacts of these measures, five key criteria were chosen and a detailed analysis was performed to determine each measure's impact in each of these chosen metrics. These criteria or metrics served as a basis for decision making and prioritizing implementation. The Green Team wanted this action plan to be both economically and environmentally beneficial, so priority was placed on measures that that paid for themselves most quickly or had no cost it all. For this reason, when prioritizing this list, it was first sorted by "payback period" criteria. It was then divided into "No Cost or Low Cost Measures" and "Investment Measures". Finally the Green team ranked the measures in order of preference. The tables below represent the final list of measures selected by the Green Team to reduce GHG emissions and benefit the bottom line. These measures will be implemented sequentially based on this table as money is made available. The energy savings account

will act as the primary mechanism for insuring financial support and sustainability of this action plan. The criteria or metrics by which each measure was evaluated in the tables are briefly defined below:

*Potential Reduction $CO_2e$ (metric tons)*

This expresses the amount of carbon dioxide equivalent emissions that a particular measure will save, shown in metric tons. This shows the overall impact of a particular measure.

*Potential % of Goal*

This expresses the % of the total reduction from 2005 levels needed to reach the goal of 25% reduction.

*Annual $ Saved*

This expresses the dollar amount that is saved annually by implementing a measure.

*10 Year Average $ per MT $CO_2e$*

This expresses the 10 year average annual cost per metric ton of carbon dioxide equivalent.

*Simple Payback Period*

This expresses the amount of time it takes the savings of a particular measure to pay for the initial cost.

## NO OR LOW COST MEASURES

Table 3 below contains a prioritized list of "no or low cost" measures for reducing GHG emissions. These simple measures can make a big difference. They generally involve operational or behavioral changes. Estimating impacts of these types of measures is not easy, but an effort was made to be conservative in estimating impacts.

| Description of Measure | Potential Reduction CO2e (metric tons) | Potential % of Goal | Annual $ Saved | 10 Year Avg $ per MT CO2e | Payback Period (years) |
|---|---|---|---|---|---|
| Optimize Interior Lighting with Delamping | 21.0 | 0.7% | $2,498 | -$119 | 0.0 |
| Future Potential for Computer Energy Efficient Settings | 19.7 | 0.6% | $2,340 | -$119 | 0.0 |
| Promote Lights Out Policy | 11.8 | 0.4% | $1,407 | -$119 | 0.0 |
| Office Resource Conservation Initiative (Reduce Solid Waste 10%) | 26.3 | 0.8% | NA | NA | 0.0 |
| Optimize Exterior Lighting reduce Hours | 19.9 | 0.6% | $2,616 | -$132 | 0.0 |
| Efficient Driving Campaign with Training | 38.7 | 1.2% | $8,601 | -$196 | 0.0 |
| Community Water Conservation Initiative (Reduce Use by 5%) | 60.9 | 2.0% | NA | NA | 0.0 |
| Use Smaller Fleet Vehicles | 17.2 | 0.6% | $5,157 | -$300 | 0.0 |
| 20% Increase in Recycling | 37.2 | 1.2% | NA | NA | 0.0 |
| Promote Low Carbon Commuter Options | 8.9 | 0.3% | NA | NA | 0.0 |
| Use Bikes at on the Job | 4.5 | 0.1% | $1,340 | -$300 | 0.0 |
| **Total of No and Low Cost Measures** | **266.0** | **8.5%** | **$23,960** | | |

**Table 3: No and Low Cost Measures**

## INVESTMENT ACTIONS

Table 4 below contains a prioritized list of measures that require an investment of capital. Many of them provide significant savings in energy and money that pay for cost of implementation in addition to their emission reductions.

| Description of Measure | Potential Reduction CO2e (metric tons) | Potential % of Goal | Annual $ Saved | 10 Year Avg $ per MT CO2e | Payback Period (years) |
|---|---|---|---|---|---|
| Install Programmable Thermostats or Energy Management Systems | 21.4 | 0.7% | $3,015 | -$126 | 1.1 |
| Reduce Unnecessary Electrical Loads | 13.5 | 0.4% | $1,601 | -$94 | 1.1 |
| Buy Energy Efficient Equipment Policy | 10.9 | 0.3% | $1,293 | -$116 | 0.3 |
| Install Occupancy Sensors | 1.8 | 0.1% | $214 | -$87 | 2.7 |
| Replace Exit Signs with LEDs | 5.1 | 0.2% | $607 | -$91 | 2.3 |
| Remaining T-12 to T-8 Conversion with DeLamping | 21.4 | 0.7% | $2,550 | -$35 | 7.1 |
| Install Vending Miser on Vending Machines. | 4.7 | 0.2% | $563 | -$104 | 1.2 |
| Buy High Efficiency HVAC at Replacement | 10.6 | 0.3% | $1,311 | -$54 | 5.6 |
| Upgrade Exterior Lighting | 119.5 | 3.8% | $14,216 | -$2 | 9.8 |
| Hybrid Vehicles | 3.1 | 0.1% | $765 | -$167 | 3.3 |
| Upgrade to High Efficiency Water Heaters | 1.3 | 0.0% | $213 | -$77 | 5.4 |
| HVAC System Retrocommissioning | 26.8 | 0.9% | $3,536 | -$95 | 2.8 |
| Upgrade all State/City Traffic Signals | 108.1 | 3.5% | $15,693 | $40 | 12.7 |
| Upgrade all Streetlights | 30.0 | 1.0% | $63,725 | $144 | 15.7 |
| Solar Hot Water | 4.8 | 0.2% | $907 | $197 | 20.4 |
| 10kW Solar PV Demonstration Project | 11.0 | 0.4% | $1,597 | $219 | 17.5 |
| Electric Vehicles | 5.4 | 0.2% | $1,137 | -$26 | 8.8 |
| **Total of Investment Measures** | **399.2** | **12.8%** | **$112,945** | | |

**Table 4: Investment Measures**

## INVESTMENT ACTIONS WITHOUT ECONOMIC RETURN

The measures in Table 5 below have an environmental benefit, but do not save any money. They should be considered for implementation when the no cost and low cost, as well as, investment measures have been implemented.

| Description of Measure | Potential Reduction CO2e (metric tons) | Potential % of Goal | Annual $ Cost | 10 Year Avg $ per MT CO2e | Payback Period (years) |
|---|---|---|---|---|---|
| Green Electricity Purchase for Government Center | 539.0 | 17.3% | NA | $29 | NA |
| DPS Truck Fleet Change to B20 Biodiesel | 21.5 | 0.7% | NA | $27 | NA |
| Ethanol Vehicles | 21.0 | 0.7% | NA | $82 | NA |

**Table 5: Investment Measures without Economic Return**

## SHORT-TERM ACTIONS

### IMPLEMENT GRANT FUNDED PROJECTS

Below in Table 6 is a list of measures that are either recently completed or in-process measures. The savings from these measures will be used to fund future measures.

| Description of Measure | Potential Reduction CO2e (metric tons) | Potential% of Goal | Annual $ Saved |
|---|---|---|---|
| Planned T-12 to T-8 Lighting Replacement | 21.0 | 0.7% | $2,498 |
| Installation of VFDs for RAS Pumping At WWTP | 150.1 | 4.8% | $17,852 |
| TCLP Upgrades Street Lighting to LED | 97.6 | 3.1% | $11,604 |
| Senior Center Boiler Upgraded | 2.1 | 0.1% | $345 |
| **Total of Planned Measures** | **270.7** | **8.7%** | **$32,299** |

**Table 6: Investment Measures without Economic Return**

### TAKE ACTION ON NO AND LOW COST MEASURES

It is recommended that action be taken to complete as many of the no and low cost measures as possible. In addition to the list of measures in Table 3, many additional measures are listed throughout Appendix C. Some are simple changes that can be implemented by maintenance staff or department heads. Others are measures that involve participation by all staff and represent an opportunity to meet the objectives of *creating a culture of energy conservation and environmental stewardship* by direct participation. Although it may be a challenge to change behaviors, this is an area where there is great potential for the City to set an example in the community, provide valuable education, give recognition, and get external recognition.

### EDUCATE AND GET STAFF INVOLVED

Getting all City employees involved in energy conservation and environmental stewardship will greatly increase the impact of this climate initiative. With staff involvement this plan can have greater impact on the community as a whole and the local environment because behavior changes at work can translate into changes at home as well.

Education activities may include:

- A good first step is to inform employees of the ratification of the Climate Action Plan and the importance of energy conservation.
- Keep staff informed throughout the implementation process of the Energy Action Plan
- Post energy conservation flyers around the office (flyers are included on the Resource CD)
- Consider distributing a bi-annual energy conservation newsletter to employees with tips on saving energy at home and at work (newsletter is included on the Resource CD)
- Consider recognizing and/or rewarding staff by department or individual for energy conservation efforts (draft certificates are included on the Resource CD).

## REINVESTING ENERGY SAVINGS

Reinvestment of energy savings will provide long term sustainability to this Climate Action Plan and have the greatest long term impact. **Error! Reference source not found.** below shows a potential five year reinvestment scenario (based on reinvesting 80% of the energy savings). This is provided to demonstrate the power of reinvestment and results are likely to vary significantly. With that being said, it is estimated that if the schedule is followed there is potential that in 5 years the plan could provide a total of $444,686 in energy savings.

These recommendations were based on economic and environmental benefits as well as the preference of the Green Team. If other measures come along that are either functionally essential or have a better economic return it would make sense to invest in these new measures. The Green Team will meet annually to manage investment in new measures from this action plan by evaluating progress, updating priorities, and creating new plans.

| Year Executed | Description of Measure | Initial Cost | Annual Emissions Savings ($MTCO_2e$) | Estimated Annual Savings | Energy Savings Account Balance | Contribution to Energy Savings Account (50% of Savings) | | | | | | Total 5 Year Savings |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2011 | 2012 | 2013 | 2014 | 2015 | Total | |
| 2011 | **T-12 to T-8 Lighting Replacement** | Already Paid | 21.0 | $2,498 | $0 | $1,998 | $1,998 | $1,998 | $1,998 | $1,998 | **$9,991** | **$19,983** |
| 2011 | **VFDs for RAS Pumping At WWTP** | Already Paid | 150.1 | $17,852 | $0 | $14,282 | $14,282 | $14,282 | $14,282 | $14,282 | **$71,409** | **$142,819** |
| 2011 | **TCLP Upgrades Street Lighting to LED** | Already Paid | 97.6 | $11,604 | $0 | $9,283 | $9,283 | $9,283 | $9,283 | $9,283 | **$46,416** | **$92,832** |
| 2011 | **Senior Center Boiler Upgraded** | Already Paid | 2.1 | $345 | $0 | $276 | $276 | $276 | $276 | $276 | **$1,380** | **$2,761** |
| ***2011 Year End Totals*** | | ***$0*** | ***270.7*** | ***$32,299*** | ***$25,839*** | ***$25,839*** | | | | | | |
| 2012 | **Optimize Interior Lighting with Delamping** | $0 | 21.0 | $2,498 | $25,839 | | $1,998 | $1,998 | $1,998 | $1,998 | **$7,993** | **$15,986** |
| 2012 | **Computer Energy Efficient Settings** | $0 | 19.7 | $2,340 | $25,839 | | $1,872 | $1,872 | $1,872 | $1,872 | **$7,489** | **$14,977** |
| 2012 | **Promote Lights Out Policy** | $0 | 11.8 | $1,407 | $25,839 | | $1,126 | $1,126 | $1,126 | $1,126 | **$4,502** | **$9,005** |
| 2012 | **Office Resource Conservation Initiative (Reduce Solid Waste 10%)** | $0 | 26.3 | $0 | $25,839 | | $0 | $0 | $0 | $0 | **$0** | **$0** |
| 2012 | **Install Programmable Thermostats/EMS** | $3,197 | 21.4 | $3,015 | $22,642 | | $2,412 | $2,412 | $2,412 | $2,412 | **$9,647** | **$19,295** |
| 2012 | **Reduce Unnecessary Electrical Loads** | $1,685 | 13.5 | $1,601 | $20,957 | | $1,281 | $1,281 | $1,281 | $1,281 | **$5,124** | **$10,248** |
| 2012 | **Install Occupancy Sensors** | $580 | 1.8 | $214 | $20,377 | | | | | | | |
| 2012 | **Replace Exit Signs with LEDs** | $1,425 | 5.1 | $607 | $18,952 | | | | | | | |
| 2012 | **Remaining T-12 to T-8 with DeLamping** | $18,000 | 21.4 | $2,550 | $952 | | $2,040 | $2,040 | $2,040 | $2,040 | **$8,160** | **$16,319** |
| 2012 | **Install Vending Misers** | $700 | 4.7 | $563 | $252 | | $450 | $450 | $450 | $450 | **$1,802** | **$3,603** |
| ***2012 Year End Totals*** | | ***$25,587*** | ***146.7*** | ***$14,795*** | ***$37,270*** | | ***$37,018*** | | | | | |
| 2013 | **Efficient Driving Campaign with Training** | $0 | 38.7 | $8,601 | $37,270 | | | $6,881 | $6,881 | $6,881 | **$20,642** | **$41,285** |
| 2013 | **Community Water Conservation Initiative (Reduce Use by 5%)** | $0 | 60.9 | $0 | $37,270 | | | $0 | $0 | $0 | **$0** | **$0** |
| 2013 | **HVAC System Retro-Commissioning** | $10,000 | 26.8 | $10 | $27,270 | | | $8 | $8 | $8 | **$24** | **$48** |
| 2013 | **Upgrade Exterior Lighting** | $27,000 | 23.0 | $2,742 | $270 | | | $2,193 | $2,193 | $2,193 | **$6,580** | **$13,160** |
| ***2013 Year End Totals*** | | ***$37,000*** | ***149.4*** | ***$11,353*** | ***$46,371*** | | | ***$46,101*** | | | | |
| 2014 | **Use Smaller Fleet Vehicles** | $0 | 17.2 | $5,157 | $46,371 | | | | $4,126 | $4,126 | **$8,251** | **$16,503** |
| 2014 | **20% Increase in Recycling** | $0 | 37.2 | $0 | $46,371 | | | | $0 | $0 | **$0** | **$0** |
| 2015 | **Upgrade Exterior Lighting** | $46,000 | 39.3 | $4,671 | $371 | | | | $3,737 | $3,737 | **$7,473** | **$14,947** |
| ***2014 Year End Totals*** | | ***$46,000*** | ***93.7*** | ***$9,828*** | ***$54,334*** | | | | ***$53,963*** | | | |
| 2015 | **Promote Low Carbon Commuter Options** | $0 | 8.9 | $0 | $54,334 | | | | | $0 | **$0** | **$0** |
| 2015 | **Use Bikes at on the Job** | $0 | 4.5 | $1,340 | $54,334 | | | | | $1,072 | **$1,072** | **$2,144** |
| 2015 | **Upgrade Exterior Lighting** | $54,000 | 46.1 | $5,483 | $334 | | | | | $4,387 | **$4,387** | **$8,773** |
| ***2015 Year End Totals*** | | ***$54,000*** | ***59.5*** | ***$6,823*** | ***$334*** | | | | | **$59,422** | | |
| ***Cumulative Totals*** | | ***$162,587*** | ***720.0*** | ***$75,098*** | | | | | | | ***$222,343*** | **$444,686** |

**Table 7: Five Year Potential Reinvestment Scenario**

### WORKING TO CREATE A CULTURE OF ENERGY CONSERVATION AND ENVIRONMENTAL STEWARDSHIP

With concerns over energy costs and climate change rising, saving energy, and being "Green" have gained considerable attention. Given this existing momentum, there is no better time to unite City staff in a collaborative effort to be conscious of energy use and take measures toward climate protection. The actions of the building occupants greatly impact total building energy use. It makes dollars sense and ecological sense to educate staff and get them involved in the energy saving process. By getting everyone involved there is more likely to be a sense of ownership and responsibility for energy conservation. Some forward thinking businesses and local governments are actually writing energy conservation into the job description of all employees. Below is a list of several strategies that can help create a culture of conservation.

*Further detail is provided in Appendix D and on the Resource CD.*

- Solicit Regular Feedback and Ideas from Staff
- Distribute an Energy Conservation Newsletter
- Promote a Resource Conservation Initiative
- Adopt Conservation Policies
- Utilize USEPA's Energy Star "Bring your Green to Work" Resources
- Train Facility or Department Managers on Energy Efficiency
- Give Recognition Where It's Due
- Provide Incentives for Participation

### FINANCING

The Energy Saving Account is a primary financing mechanism. However, in order to meet the established GHG emissions target, it is important to continue seeking additional financing for climate and energy projects. Traverse City should continue to seek grant funding when it is available and investigate loans and other financing mechanism to enable further energy conservation measures. Any conservation measure that has a higher percentage return on investment than the interest rate for a loan is worth considering. *Additional details on several financing options are discussed in Appendix E.*

## LONG-TERM ACTIONS

### CREATING A BETTER FUTURE

The growing interest in clean technologies and sustainable business practices represent a paradigm shift happening at the local level around the globe. Local governments are leading by example. Despite a struggling economy, opportunities continue to manifest in the alternative energy and conservation fields. Local governments and the communities they represent have win-win-win opportunities to save money, support their local economy and support the health of the planet. There is no doubt that capitalizing on the opportunities outlined in this report will lead to further opportunities for the Grand Traverse region to ensure economic stability, ecological protection and ultimately pave a road to energy independence.

## CONTINUE REINVESTING AND MANAGING ENERGY SAVINGS

The degree of long term improvement will be dependent on the commitment to following a process of incremental improvement and reinvestment of energy savings. The use of the Energy Savings Account is the single most powerful long-term tool for in creating energy efficiency and a transition to renewable energy. Ann Arbor is good example; they have had great long term success in saving energy by reinvesting 80% of the savings realized by conservation measures (see sidebar for details).

It is highly recommended that the Energy Savings Account be kept active as a permanent mechanism for implementing energy efficiency and renewable energy measures. The Energy Savings Account will continue to provide increasing benefits in the years to come, while reducing operational costs due to increased energy efficiency and reduced maintenance and replacement costs.

When deciding how to reinvest, it is generally advised that the Energy Savings Account be used to fund energy measures that will provide the most savings per dollar invested. Usually energy efficiency projects are recommended before renewable energy technologies because they often have a quicker payback period. However that is not always true and the cost of renewable energy will continue to come down with new technologies and increased demand. It makes sense to stay abreast of the advances in technologies because they will inevitably provide new opportunities for both energy efficiency and renewable energy. In tough economic times getting money allocated for equipment upgrades may be difficult even if they have a good payback. The Energy Savings Account will allow for investment in these new technologies.

**Ann Arbor, Michigan**
*Municipal Energy Fund*
Population: 113,000 (in 2006)

The Ann Arbor, Michigan, Municipal Energy Fund, founded in 1998, is an excellent example of how energy efficiency can pay for itself in the long term.

The fund started with an initial payment of $100,000 per year over five years to be invested in energy efficiency projects and technologies. In conjunction, the fund captures 80% of resulting savings for reinvestment back into new energy-saving projects.

Future investment is based solely on the payback of past projects that will finance new ones without any additional appropriations. Annual cost savings enabled by the fund total $142,000 across 60 facilities.

Source:

- -Ann Arbor Energy Fund website

Methods for calculating future contributions into the Energy Savings Account are found in the *Contributing to and Managing an Energy Savings Account* section below.

## MOVING TOWARD ENERGY INDEPENDENCE AND CLEAN, RENEWABLE TECHNONOLOGY

This Climate Action Plan lays a foundation for a transition toward energy independence and financial stability. Tackling the “low-hang fruit” first provides good economic return, reduces overall energy demands, and the savings help fund larger capital items. In the long term, the collective efficiency and conservation efforts will provide significant funding to the Energy Savings Account as well as reduce energy demands. This sets the stage for renewable energy technology. A transition to renewable energy becomes feasible through incremental steps because of the consistent funding supplied by the energy savings account and the reduced

energy demand from energy efficiency and conservation measures.

Locally generated renewable energy keeps money the in local economy, creates jobs, as well as reduces energy costs and reduces negative environmental impacts. Michigan is geographically well suited for the use of many renewable energy technologies. Some renewable energy options to consider include solar water heating, solar photovoltaic (PV) electricity, passive solar heating, and wind turbine electricity.

- **Solar Water Heating** for domestic use or heating pools is an excellent technology that can significantly reduce energy use especially at facilities that use a lot of hot water such as jails, pools, and recreational facilities. Solar water heating often provides the fastest payback of renewable energy options. Solar heating for pools provides even better paybacks than domestic systems because the equipment is less costly.
- **Solar PV** is a simple low maintenance way to produce clean energy directly from the sun that can be done on virtually any scale from small to very large. The price of solar PV has significantly reduced and will likely continue to become more affordable. Germany has the highest concentration of solar PV in the world and they receive a similar amount of sun to Michigan.
- **Passive Solar** heating involves collecting heat energy in the winter to reduce heating costs. Usually this means having windows on the south face of a building that only allow direct sunlight during the winter. Passive solar is usually most cost effective if designed in to new construction but if a building has south facing windows it is worth trying to harvest heat energy in the winter and reduce solar gain during the summer.
- **Wind Energy** generation has great potential in Michigan both on land and offshore. Wind turbines are available in a wide variety of sizes from large scale commercial units to small units designed for residential application. As interest in wind energy increases and technology improves the cost of installing turbines will likely come down.

## STEP 5 - IMPLEMENTATION STRATEGY

Implementation of this action plan is designed to be flexible to existing needs, motivations, staff, and financing. Steady long term incremental gains should be the goal.

This Climate Action Plan is designed to be a living document. The Plan of Action section above contains a prioritized list of measures to be implemented as well as short-term, mid-term, and long term actions that can be progressively implemented. It is intended that the process itself be revisited annually by the Green Team along with decisions regarding expenditures from the Energy Savings Account and planning for the implementation of energy efficiency and conservation measures. In other words, you can cover each step of the process annually: evaluating goals, making and revising plans, implementing measures, tracking progress, giving recognition and reinvesting accrued savings. The Energy Savings Account is central to this incremental approach by creating a mechanism for reinvestment.

While equipment upgrades are important, equally important is the culture of conservation among staff and building users. This Action Plan provides many ideas for low and no cost energy conservation measures and initiatives. These measures are primarily behavior-based choices that can be implemented at any point in time. Although staff involvement and building a culture of conservation are outlined in the mid-term section of the plan, this work is essential and should be a focus early and often. These activities get staff involved and allow them to take direct credit for reducing energy consumption.

## STEP 6 - EVALUATION OF PROGRESS

Evaluating progress is critical to managing energy. It includes formal review of both energy use data and the activities carried out as part of the Action Plan as compared to the performance goals. Evaluation of results and information gathered during the formal review process can be used to create new action plans, give recognition, identify best practices, and set new performance goals. This evaluation of progress generally involves two key steps; measuring results and reviewing the Action Plan.

### MEASURING RESULTS

Energy Star Portfolio Manager (ESPM) was used to establish the initial baseline performance of the City's facilities and will also be employed to track energy usage over time and gauge performance with respect to energy goals. After making facility improvements, utility data will need to continue to be gathered and entered into Portfolio Manager, preferably monthly or quarterly. Portfolio Manager can then be used to quantify changes in facility energy usage by comparing the new annual energy usage to the baseline year (2005) or any other previous year. For this project, each year's total usage will be benchmarked against the baseline to determine the reduction in energy use and contributions to the energy savings account.

This benchmarking process allows us to track progress against goals, while also increasing awareness about how energy is being used. This increased awareness helps us make more informed decisions which lead to better energy conservation and efficiency. In fact, simply monitoring energy use generally results in a 5-15% reduction in energy use.

**Benchmarking energy performance has many benefits that help us make informed decisions including:**

- Verifying and tracking progress of projects
- Identifying underperforming buildings
- Prioritizing projects
- Assessing performance of current operations policies and practices
- Assisting in planning; setting goals, targets, and timelines
- Identifying anomalies and /or billing errors

## EVALUATING/ REVIEWING THE ACTION PLAN

After gathering, analyzing, and reviewing performance data, it is time to also look at the overall effectiveness of the Action Plan. This process should include understanding the factors affecting the results as well, as the additional benefits of the improved energy performance. Where activities and projects were successful, document best practices and provide recognition internally and externally. Where goals were not met, you may determine the cause and decide what corrective or preventive actions should be taken.

### KEY STEPS TO REVIEWING THE ACTION PLAN

- **Get feedback** — Solicit feedback and ideas on the plan from the energy team, implementation staff, and other departments.
- **Gauge awareness** — Assess changes in employee and organizational awareness of energy issues.
- **Identify critical factors** — Identify factors that contributed to surpassing or missing targets.
- **Quantify side benefits** — Identify and quantify, if possible, side benefits arising from energy management activities such as employee comfort, productivity improvement, impact on community services, reduced operation and maintenance expenses, or better public/community relations.

Action plan review involves a commitment of resources; however it is worth the investment. This process has the potential to; create insights for new actions (technologies/practices/programs), help avoid repeating failures by identifying activities that were not as effective as expected, assess the usefulness of the tracking system and other administrative tools to ensure better management and evaluation.

### IMPORTANCE OF REGULARLY EVALUATING PROGRESS

Regular evaluation of performance and the results of the climate and energy conservation measures are necessary for good resource management. The process reveals the effectiveness of projects and programs being implemented while simultaneously increasing awareness about energy use. Additionally other savings opportunities as well as non-quantifiable benefits may be found that can be leveraged for future initiatives. Together this will then lead to more informed decisions in the future and consequently more effective climate and energy projects. Additionally, this information can be used to give recognition both externally by publicizing progress and internally by rewarding participants for their accomplishments.

## STEP 7. RECOGNITION OF ACHIEVEMENT

It is important to celebrate your successes and recognize all who were involved. Providing and seeking recognition for energy and climate action is a proven step for sustaining momentum and support for your program. Providing recognition to those who helped achieve these results motivates staff and brings positive exposure to the energy management program. Receiving recognition from outside sources validates the importance of the energy management program to both internal and external stakeholders, and provides positive exposure for the City as a whole. For these reasons it is highly recommended that each year the City give recognition both internally and externally for your accomplishments (see Resource CD for more information).

Internal recognition could include certificates for key participants or for individuals with good conservation ideas (draft certificates are included on the Resource CD). Also consider providing incentives to workers for energy conservation. A percentage of the money saved through energy conservation could go to fund a worker appreciation lunch or some other incentive. External recognition may include posting on the City website, articles in local newspapers, enrollment in an Energy Star program, or seeking an Energy Star plaque. These types of simple recognition let staff know that their efforts are appreciated can encourage greater participation.

## CONTRIBUTING TO AND MANAGING AN ENERGY SAVINGS ACCOUNT

The Energy Savings Account will act as a mechanism to maintain sustainability of this Climate Action Plan. Annual contribution will be made to the savings account for all energy and climate measures based on actual energy savings generated. This savings account started with limited application as part of an MPSC grant. Seeing the value and benefits of reinvestment the Green Team created a proposal and got approval of the City Commissioners to expand it to include all facilities and all grant funding.

This reinvestment process will begin with projects that have been funded through EECBG and MPSC grants and continue in to the future. Each year, energy consumption will be monitored with Portfolio Manager, and actual documented cost savings versus 2009 consumption will be contributed to the Energy Saving Account. This account will then be used exclusively to fund future energy and climate projects. This reinvestment will continue for all new projects and continue indefinitely.

*San Francisco voters approved a $100 million bond for renewable energy investments that pays for itself through energy savings.*

**Documenting Savings**

Energy savings for energy and climate measures will be verified using Energy Star Portfolio Manager (ESPM). ESPM will serve as the primary tool for collecting and documenting facility energy performance, however it may be advisable to create a spreadsheet to track Energy Savings Account contributions and expenditures. Each year following the implementation of the measures, energy usage data for each facility that received improvements will be downloaded from Energy Star Portfolio Manager. Using this energy consumption data, actual total cost savings versus the 2009 baseline will be calculated based on current utility rates.

## CONCLUSION

City of Traverse City is setting an example for the community and other local governments by proactively developing this Climate Action Plan. Actively pursuing this plan will protect the environment and help meet current budget challenges, as well as prepare for escalating energy costs in the near future

This action plan lays a foundation for a transition toward energy independence and sustainability through the establishment of clear goals and objectives. Throughout the planning process these objectives provided direction. Care was taken to make sure the objectives were met.

- *The action plan selected and ranked measures based on analysis of environmental effectiveness, economic efficiency, and operational feasibility so that it maximized impact and minimized cost.*
- *The action plan was structured to outline the process, timeline, and rationale for implementing short and mid-term reduction strategies towards short, mid, and long-term greenhouse gas reduction goals.*
- *The action plan created a mechanism to establish sustainability of the project by establishing an Energy Savings Account to reinvest savings.*
- *The action plan was designed to be dynamic and adaptive document to be iteratively updated as progress is achieved, goals are advanced, and opportunities emerge by utilizing a cyclical process outlined in Figure 1.*
- *The action plan strives to create a culture of energy conservation and environmental stewardship among local government employees through educational materials and resource conservation initiatives.*
- *The action plan sets an example of energy conservation and environmental stewardship for the Grand Traverse community by proactively taking action to protect the environment and conserve resources.*

In conclusion, this plan will act as road map to meeting the climate and energy goals and objectives, while also being a living process that is adapted to changing needs. It intended to be implemented incrementally with this report acting as both a guide and reference material for implementation. It is a model of sustainability through its use of the Energy Savings Account to fund its climate and energy measures. The hope is to make environmental stewardship economically viable by bridging the gap between fiscal and environmental responsibility, creating a win-win situation. The Climate Action Plan provides specific strategies for reducing GHGs, while also acting as a framework for decision making, thus acting as a guide to meeting the climate goals and objectives. By following this plan City of Traverse City can move towards economic and environmental sustainability while educating their staff and standing as leader in climate stewardship.

## CLIMATE AND THE GREENHOUSE EFFECT

The gases that trap heat in the Earth's atmosphere are sometimes referred to as greenhouse gases (GHG). When sunlight enters the Earth's atmosphere, some of this solar radiation is immediately reflected and leaves the planet without turning into heat. Some of it is absorbed by the ground, which then re-emits thermal radiation, heat. To maintain a consistent range of temperatures, incoming solar radiation must be balanced by the loss of heat escaping to space.

Greenhouse gases – including Carbon Dioxide ($CO_2$), Methane ($CH_4$), and Nitrous Oxide ($N_2O$) and others – create the atmospheric blanket that prevents large fluctuations between night and day temperatures. For example, the moon, which has no GHGs, fluctuates from night-time temperatures of 300°F below zero to over 200°F during the day. GHG traps the heat absorbed by the earth, slowing its escape into space.

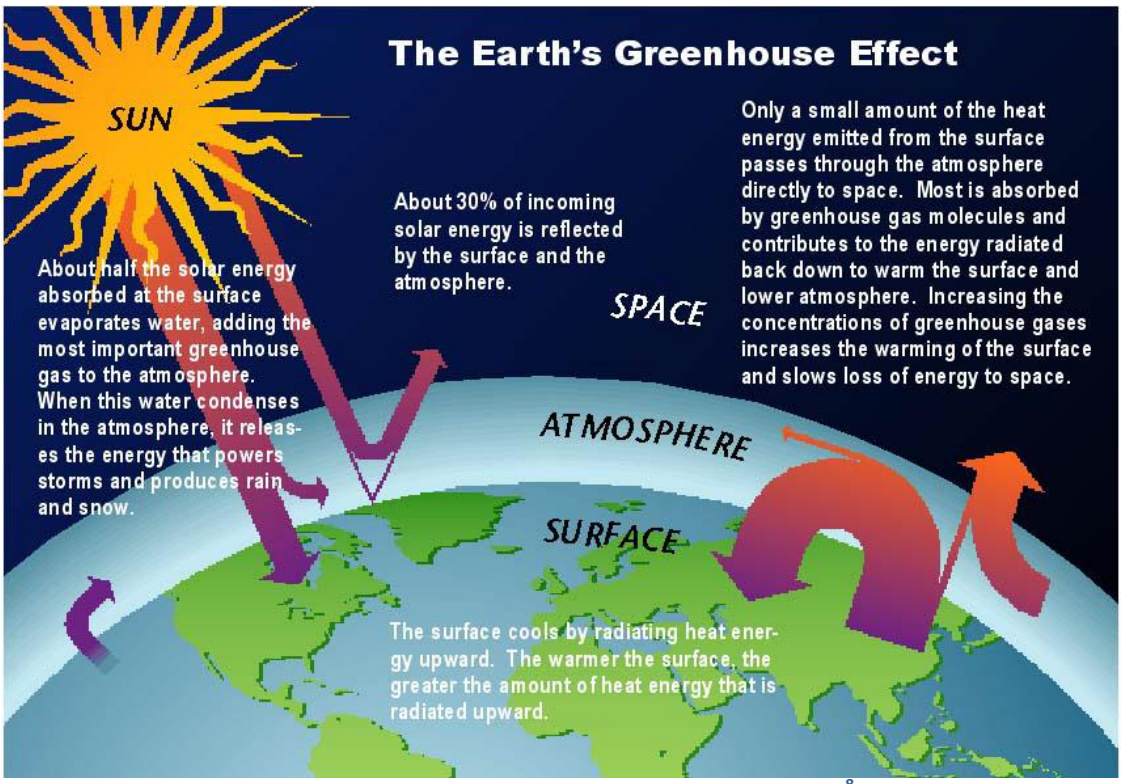



**Figure 9: The Greenhouse Effect**[8]

This greenhouse effect is a natural occurrence. It happens on Earth and is in effect on every planet that has an atmosphere, including Venus. However, on Venus, the high concentration of GHGs in its atmosphere means that its surface temperature is a consistently sweltering >800°F.

[8] Source: US Global Change Research Information Office

We cannot survive without our atmosphere and the greenhouse gases it contains, but the concentration of these gases in our atmosphere is triggering change in Earth's climate.

## GREENHOUSE GAS LEVELS AND TRENDS

From the time humans first appeared on the planet to the beginning of the Industrial Revolution, the atmospheric concentration of $CO_2$ remained consistently well under 300 parts per million (ppm). Beginning in the 18th century, humans started burning coal and gas, taking carbon that was stored under the earth for millions of years and releasing it into the atmosphere in a matter of decades.

Our current atmospheric concentration of $CO_2$ is now over 380 ppm and rising. This rise is has been correlated with global warming[9], which may lead to glacial melting, increased drought, increased storm intensities, rising sea levels, and the spread of insect-borne diseases like Lyme and malaria. And because it takes time for our climate to adapt, we are not yet experiencing the full effect of our current level of $CO_2$, which continues to increase unabated[10].

International scientific and political communities recognize that we are facing alterations in weather patterns, ocean behavior, and biological processes. As James Hansen of National Aeronautics and Space Administration (NASA) wrote recently, "If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, paleoclimate evidence and ongoing climate change suggest that $CO_2$ will need to be reduced from its current 387 ppm to at most 350 ppm."[11]

Previous efforts to set GHG reduction goals, such as the Kyoto Protocol, were based on stabilizing atmospheric $CO_2$ to 550 ppm, 200 ppm more than the updated target. The current scientific consensus is that our climate and way of life is at much greater risk within a shorter timeframe than previously thought.

## CLIMATE CHANGE: GLOBAL & LOCAL EFFECTS

Globally, increases in GHG's subsequently mean global temperatures are expected to affect water availability, ecosystem health, food production, coastal security, and human health. Figure 2 charts the Intergovernmental Panel on Climate Change's expectations for the occurrence and severity of effects with increasing temperature above the temperatures of the late 20th century.

[9] US Global Change Research Program, Our Changing Planet: US Climate Change Science Program for Fiscal Year 2009

[10] Hansen, James, et al. Target Atmospheric $CO_2$: Where Should Humanity Aim? Submitted April 7, 2008.

[11] Hansen, James, et al.

Locally, by the end of this century climate change is expected to shift Northern Michigan's climate to mimic winters typical of Ohio and summers typical of Missouri as depicted in Figure . This shift would likely affect Northern Michigan in some of the following ways:

- More severe weather and susceptibility to flooding
- Reduced air quality and water quality
- Economic threats due to crop damage and reduced snow
- Higher rates of infectious diseases and heat-related illnesses and deaths
- Increased spread of mosquito and tick-borne diseases such as Lyme disease
- Damage to many natural resources including the sugar maple
- Fluctuations in water levels
- Higher prices and shortages of basic goods, such as food and energy.

**Global Mean Average Temperature Relative to 1980-1999 (°C)**

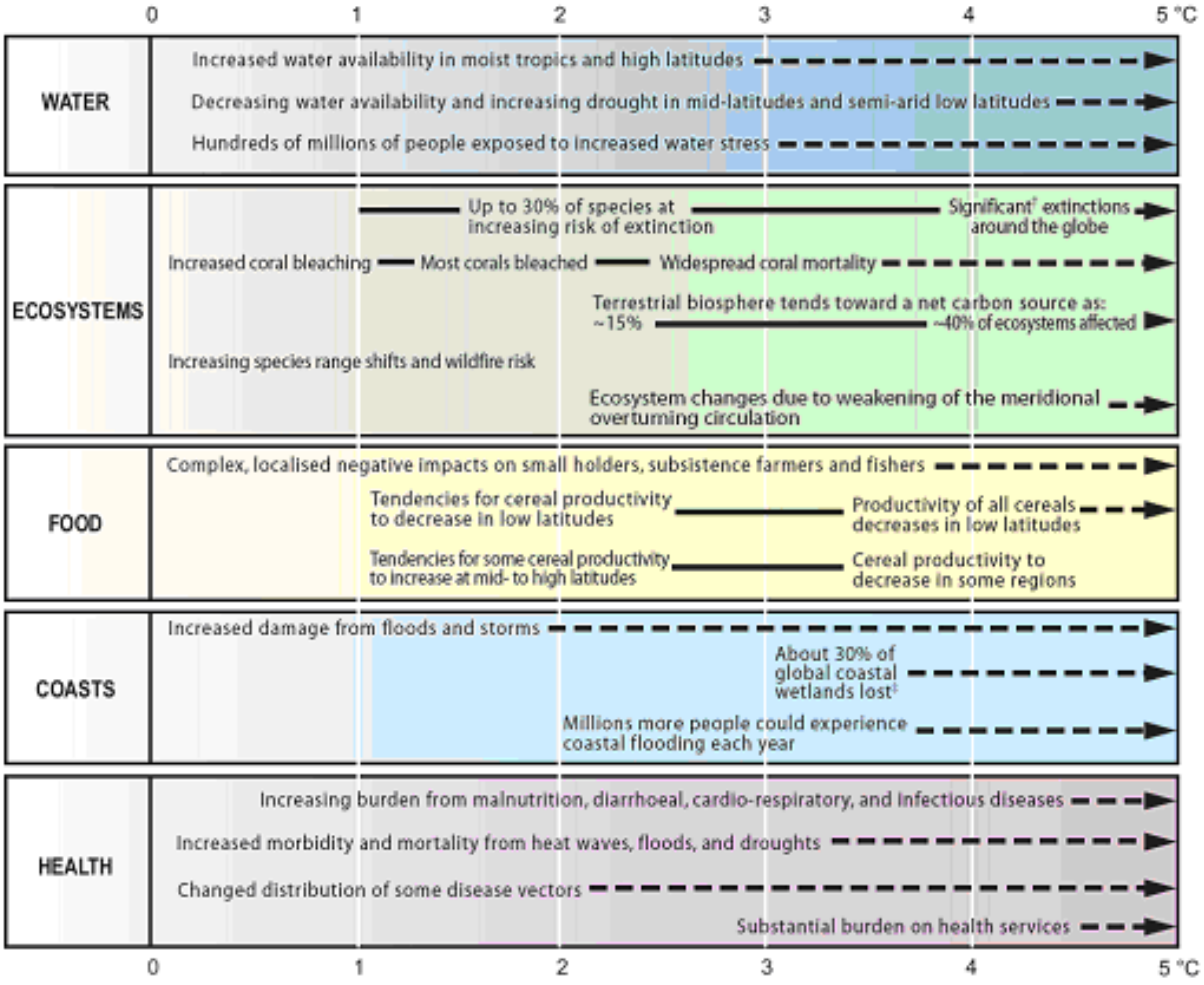



**Figure 10: Expected effects with rising temperature (Adapted from: IPCC AR4 Synthesis Report[12])**

[12] IPCC Assessment Report 4 – Climate Change 2007: Synthesis Report

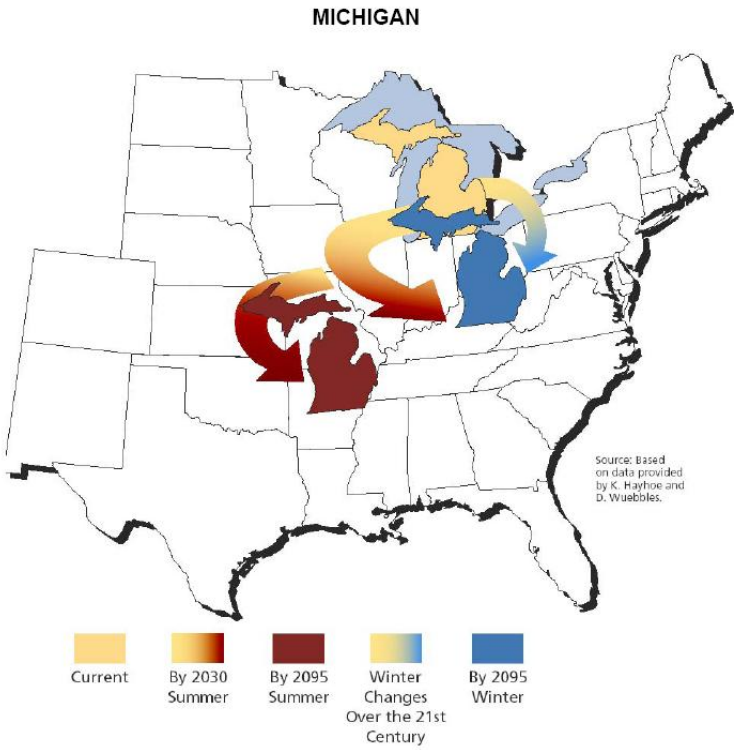



**Figure 11: Expected Change in Michigan Climate (Source: Union of Concerned Scientists)**

Already the incremental change in local temperatures is apparent in the frequency of winter freezing of Grand Traverse Bay over the previous 150 years.

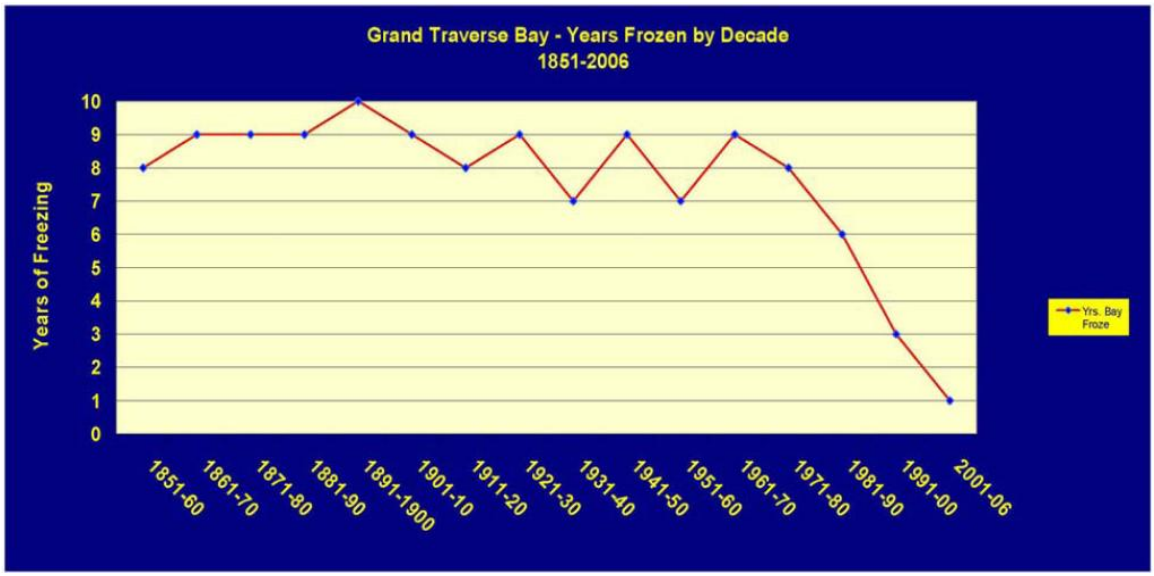



**Figure 12: Grand Traverse Bay's Documented Decline in Freezing (Source: Anderson 2007)[13]**

[13] Adapted by the Center for Integrative Environmental Research, original data obtained from Traverse City Chamber of Commerce

With 5% of the world's population, the United States accounts for approximately 25% of the world's human GHG emissions and 30% of the world's waste[14]. Human or anthropogenic sources of GHG emissions include,

FOSSIL FUEL COMBUSTION – Carbon dioxide emitted from the combustion of fossil fuels for heating, transportation, and electricity production represents by far the largest fraction of global GHG emissions;

DEFORESTATION & LAND USE CHANGE – When biologically productive ecosystems are disturbed, carbon dioxide may be released from soils and decrease the ability of ecosystems to uptake and retain carbon.

AGRICULTURE – Methane and nitrous oxide, two potent greenhouse gases, are emitted from livestock, manure, soil, and synthetic fertilizer management.

LANDFILLS – Methane and carbon dioxide are released as organic waste (paper, food, wood, etc.) decomposes in landfills without oxygen;

REFRIGERANTS AND INDUSTRIAL CHEMICALS – Extremely potent greenhouse gases including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride ($SF_6$) are used and emitted in a variety of products and industrial processes.

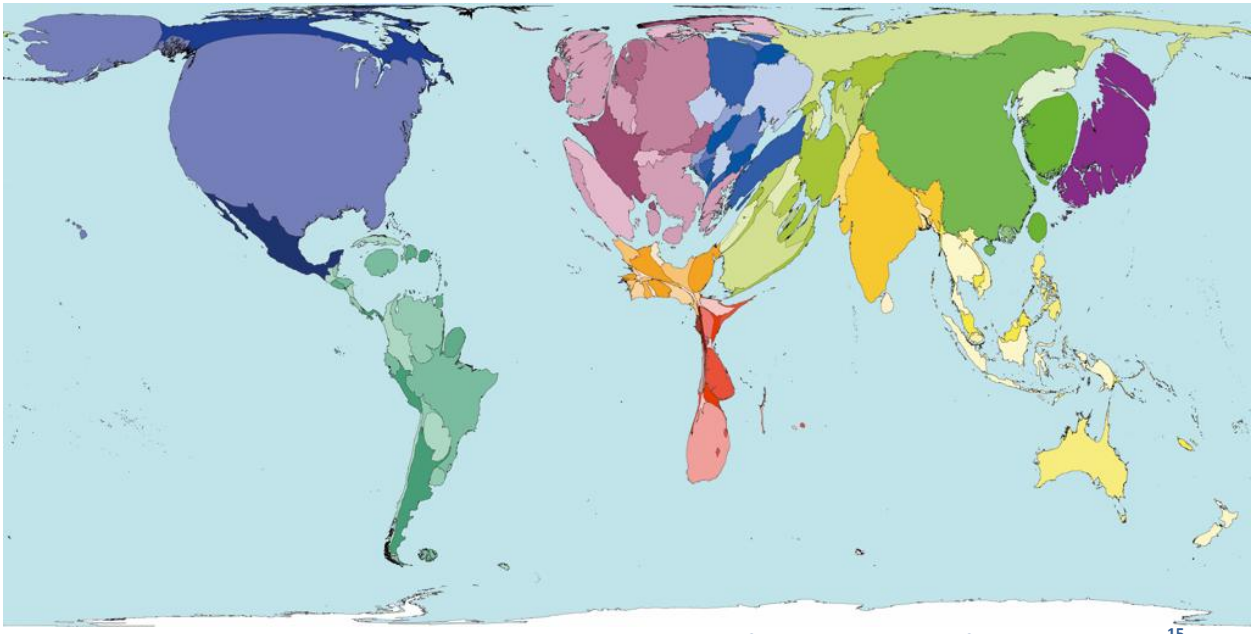


**Figure 13: Territory size shows proportion of all GHG emissions from each country[15]**

[14] Halls, Chris, et al. Living Planet Report 2006 (Gland, Switzerland: World Wildlife Fund International 2006)

[15] © Copyright 2006 SASI Group (University of Sheffield) and Mark Newman (University of Michigan). Worldmapper, Map #299 http://www.worldmapper.org/

A vast body of extensively peer-reviewed research indicates that our actions as a global civilization have become the primary driver of climate change and global warming[16]. If we do not change our present course, the scientific community overwhelmingly agrees that the Earth's response will be a nearly ice-free planet, preceded by a period of chaotic weather and shoreline changes. This decade is perhaps the last chance we have of changing course and avoiding a climactic tipping-point[17].

## GREENHOUSE GAS REDUCTION INITIATIVES

Eleven states have enacted mandatory GHG reduction laws, and 13 others have set voluntary targets. Many more are focusing on energy-efficiency policies as a cost-effective approach to reducing GHG emissions. Although comprehensive Federal greenhouse gas legislation is still uncertain, the US Environmental Protection Agency has begun regulating greenhouse gas emissions under the existing Clean Air Act. These regulations which will begin to go into effect in 2011 establish stricter standards for new vehicles and restrict emissions from power plants and refineries through permits and performance standards. The cost of these regulatory measures will likely be passed on to consumers, who will see increased prices at the pump and on their utility bills. Although it is unlikely that small businesses and local governments will be directly regulated under the current rules, units of government that enact energy policies now will be a step ahead of rising energy costs.

There is no single, 'silver-bullet' solution to the problems associated with climate change, atmospheric greenhouse gas concentrations, or the inefficient use of resources. It takes multiple measures and initiatives, including those at the local level. Many of these strategies are uniquely available to those that have the capacity to influence how energy is generated, transportation and land use patterns, and citizen or constituent behavior.

## REDUCTION BENEFITS: ECONOMIC

Maintaining and improving our quality environmental resources goes hand-in-hand with long-term financial viability and stewardship. Monitoring GHGs in conjunction with finances is one way to quantify progress. Many GHG reduction measures are directly linked to financial savings and economic benefits such as:

- Inter-Departmental Coordination – Departments that work cooperatively, sharing tools and resources, will be more cost effective from a purchasing perspective.
- Reducing Energy & Resource Consumption – From public transportation to electricity use, to waste management, activities that reduce energy and resource consumption have quantifiable financial returns.

[16] Intergovernmental Panel on Climate Change 4th Assessment Report: Climate Change 2007 – Policymaker Summary Section 2. Causes of Change http://www.ipcc.ch/publications_and_data/ar4/syr/en/spms2.html

[17] Hansen, James, et al.

- Local Economic Development – For example, a study conducted by the Institute for Local Self Reliance[18] found that for every 15,000 tons of waste:
    - Landfilling the waste creates - 1 job
    - Composting the waste creates - 7 jobs
    - Recycling the waste creates - 9 jobs.
- Opportunity Costs – Cost avoidance from reducing GHGs makes dollars available for priorities such as economic investments in the community.

## REDUCTION BENEFITS: HEALTH

Taking action to reduce GHG emissions also improves local health and wellbeing. Decreasing electricity consumption and vehicle miles driven will reduce local and regional criteria air pollutants that negatively affect human health, like sulfur and nitrogen oxides, carbon monoxide, lead, and particulates. These reduction strategies include land use planning that gets people out of their cars, keeps downtowns dense and diverse, and preserves woodlands, farmlands, and open space. This kind of planning:

- Reduces traffic congestion,
- Reduces air and water pollution,
- Prevents the need for large new infrastructure development, allowing resources to be directed to updating existing infrastructures,
- Minimizes the urban heat island effect, and
- Enhances public health.

The bottom line is that many actions taken to reduce GHG emissions result in the preservation and improvement of the City's environmental health, economic and social wellbeing. These are the same factors that make our community a desirable destination for families, visitors, and businesses.

The first step for many communities in achieving the goals of these agreements is to join the ICLEI Climate Mitigation program.

## ICLEI'S PROGRAM OF ACTION

ICLEI – Local Governments for Sustainability is an international association, founded in 1990, comprised of government organizations that have made a commitment to sustainable development. Targeting a need for capacity building, this organization provides technical consulting and information to share knowledge and support local governments in the implementation of sustainability initiatives.

ICLEI's Climate Mitigation program provides a framework for measuring greenhouse gas emissions and implementing quantifiable measures to reduce GHG emissions. This campaign was developed to reduce GHGs by internationally encouraging local action. To date, over 450 local municipalities have formally joined the campaign worldwide.

[18] Institute for Local Self Reliance, *Wealth to Waste Homepage* http://www.ilsr.org/recycling/

The ICLEI's program is structured around five milestones:

1. Conduct a baseline emissions inventory and forecast of GHG emissions,
2. Adopt an emissions reduction target for a forecast year,
3. Develop a Local Action Plan,
4. Implement plan strategies, and
5. Monitor and verify results.

This management and mitigation process guides municipal governments in adopting policies and implementing quantifiable measures to reduce local greenhouse gas emissions, improve air quality, and enhance community livability and sustainability.

This report represents the completion of the first milestone and provides a recommended target for emissions reduction. By formally adopting an emissions reduction target the City will complete the second milestone and complete the first phase of action.

Milestones three through five happen over a period of years, starting with the development of real strategies to implement changes that will allow the City to achieve its goals and then monitor in comparison with the baseline inventory numbers to see where change is actually taking place.

## APPENDIX B – 2005 BASELINE INVENTORY & 2009 INVENTORY UPDATE REPORTS

## APPENDIX C- DETAILED DESCRIPTION OF MEASURES

## REDUCE UNNECESSARY ELECTRICAL LOADS (OFFICE OPERATIONS)

There are many different electrical loads that comprise the power consumption of a building. It is not uncommon to find devices that are using electricity unnecessarily. This action will involve reducing unnecessary electrical loads through intelligent application of technology and procedure. In general it makes sense to inventory buildings for any equipment that is consuming unneeded power and try to eliminate these unnecessary electrical loads. Some areas that should be addressed include: phantom loads of office equipment, cold beverage machines, drinking fountains, exhaust fans, and circulation pumps for domestic hot water.

### REDUCE UNNECESSARY ELECTRICAL LOADS - REDUCE PHANTOM LOADS

A vampire (or phantom) load is the electric current consumed by an appliance (e.g. computers, copiers, printers, coffee makers, and A/C adapters for rechargeable laptops, cell phones, etc.) to perform noncritical functions when it is switched to its "off" position. This measure would involve taking action to reduce these unwanted energy drains. Some equipment could utilize timers such as copiers (if left on nights and weekends can consume more than $150 worth of power) or printers. Other could utilize simple switches or power strips. For equipment with auxiliary components it may be wise to use a smart power strip. Smart power strips have auto load sensing for a primary components and it will shut down auxiliary components when the primary is “off”, in addition to having surge protection. Vampire Loads usually average around 5% of total electricity usage for businesses and 10% in homes. It is estimated that vampire loads could be cut in half by using power strips or timers to shutdown equipment when it is not in use.


Left: 7 Day 24 hour Power strip Timer
Right: Smart Strip with Autosensing
Below: 7 Day 24 hour Outlet Timer

#### *Potential Impact*

It is estimated that 6% of total electricity usage is associated with vampire loads. That load could be potentially cut in half by using power strips or timers to shutdown equipment when it is not in use. It is estimated that it would cost $7 per power strip and $20 per timer.

| Description of Measure | Estimated Capital Cost | Estimated Annual Savings | Payback Period (years) | 10yr $ per MT CO2 |
|---|---|---|---|---|
| Reduce Phantom Loads | $1685 | $1,601 | 1.1 | ($107) |

### *Implementation*

A reasonable timeline for implementation would be 1-3 months depending on staff availability. Maintenance department will be responsible with possible help from the IT department.


Watt Meter

1. Inventory and decide on equipment that would be well suited for having a timer or switch to reduce phantom loads. Consider purchasing a Watt meter to measure loads to help identify the biggest phantom loads (see Appendix C - Resources for Energy Conservation).
2. Purchase appropriate number of timers and power strips or switches.
3. Install timers, switches, and power strips.
4. Inform users of any necessary usage instructions
5. Post signs to remind users to turn off power strips.

### *Barriers, Opportunities, and Co-Benefits:*

It may be difficult to get employees to remember to turn off a power strip. However this is an activity that gets employees involved in the process of energy savings and sends a message about the importance of saving energy. It also has the benefit of potentially carrying over to behavior of employees at home.

## REDUCE UNNECESSARY ELECTRICAL LOADS- ENERGY EFFICIENT COMPUTER PRACTICES


Computer usage makes up a significant portion of the base electrical load of a building. By simply setting up USEPA recommended hibernation and sleep settings a significant amount of energy can be saved. Power management settings can be controlled at a network wide level using free software available on the internet; saving significant time (search for “Enterprise Level Computer Power Management” on the resource CD). On average $50-$80 per year per desktop is saved and $6-10 per year per laptop by using USEPA recommended hibernation and sleep settings. Consider adopting a policy of using USEPA recommended hibernation settings and the disabling of screen savers on all computers. In addition leaving computers and peripherals on at night and over the weekend can add up to a significant amount of power. Consider adopting a policy that would be to require all computers and peripheral equipment to be tuned off at night and over the weekend. When purchasing new equipment look for the Energy Star Label. The newer LED LCD monitors are a good choice because they save 40% over conventional LCD monitors.

### *Potential Impact*

It was assumed that the annual savings would be $70 per desktop and $7 per notebook and that 25% of computers were notebooks. It was also assumed that, 15% of computers already had proper settings and that number would be increased to 90%. It would not cost any money but would take a few minutes per computer to set hibernation settings.

| Description of Measure | Estimated Capital Cost | Estimated Annual Savings | Payback Period (years) | 10yr $ per MT CO2 |
|---|---|---|---|---|
| EE Computer Practices | $0 | $2,340 | 0 | ($119) |

### *Implementation*

A reasonable timeline for implementation would be 1-6 months depending on IT staff availability. The IT department would be responsible for implementation.

1. Establish policies governing computer settings and use.
2. Set a date to begin adjusting computer setting.
3. Inform computer users of new policies and of the upcoming change to computer settings.
4. Begin adjusting computer settings
5. Post signs to remind users to turn computers off at the end of the day.

### *Barriers, Opportunities, and Co-Benefits:*

This action may be perceived as being time intensive by the IT staff. However it is possible to implement at a network level. Setting need to be such that they do not interfere with updates.

## REDUCE UNNECESSARY ELECTRICAL LOADS- INSTALL VENDING MACHINE MISER

Typical cold beverage machines operate continuously and consume considerable amounts of energy and cost on average over $300 dollars per year to operate. VendingMiser® is a quick, inexpensive, and easy way to save energy immediately.

Energy consumption is reduced an average of 46% -- typically saving $150 per machine annually. This savings is accomplished by using a passive infrared sensor to power down the machine when the surrounding area is vacant. Even when the area is vacant the system will continue to ensure the product stays cold by cycling on occasionally. The VendingMiser® (shown on right) will not shut the machine down while the compressor is cycling, which can be harmful, and is approved by several of the major soft drink companies. In addition, maintenance savings is generated through reduced running time of vendor components, estimated at $40 - $80 per year, per machine.

Frequently machines will have display lighting running continuously. This lighting produces heat which adds to the refrigeration cost. Disconnecting the ballast and lamps can save over $75 per year.

### *Potential Impact*

| Description of Measure | Estimated Capital Cost | Estimated Annual Savings | Payback Period (years) | 10yr $ per MT CO2 |
|---|---|---|---|---|
| Vending Misers | $700 | $563 | 1.2 | ($101.14) |

### *Implementation*

A reasonable timeline for implementation would be 1-6 months depending on maintenance staff availability.

1. Count all cold beverage vending machines
2. Purchase Vending Misers
3. Install Vending Miser

## REDUCE UNNECESSARY ELECTRICAL LOADS- DRINKING FOUNTAIN TIMER

Drinking fountains are often refrigerated types that keep chilled water available on a continuous basis. Much of the time, these units can be modified to save energy consumed by the compressor to refrigerate the water. Overnight or during periods the building is unoccupied, the drinking fountain can be turned off (chilling of water during winter months is often unnecessary, too). Because a drinking fountain can cost as much to operate as a small refrigerator over the course of one year, the savings potential for turning it off when possible makes this measure worth consideration, especially if your facility has several units.

**Control with Plug-In Timer**

**7 Day, 24-hour Outlet Timer**

Short of shutting off power to the drinking fountain permanently, the best option is to install a 7-day timer to automatically control the hours of operation to coincide with building hours. A 24-hour timer is less expensive and can be utilized if the building schedule is the same most days of the week. An inexpensive *plug-in timer* can be installed if a drinking fountain is the plug-in type. If the drinking fountains are hard-wired but on a separate circuit, a time clock can be installed at the electrical service box. For hard-wired drinking fountains on the same circuit with other equipment, individual time clocks have to be wired into each unit. In most of these cases, the savings will not justify the expense.

*A licensed electrician can be contacted for further evaluation of drinking fountain timers for your facility.*

### *Potential Impact*

For a plug in type drinking fountain, a timer would cost around $15 and be very easy to install. It would usually save from $10-$20 per year in electricity depending on rates.

### *Implementation*

A reasonable timeline for implementation would be 1-6 months depending on maintenance staff availability.

1. Take an inventory of all drinking fountains
2. Purchase appropriate timers
3. Install timers
4. Set an appropriate schedule for the timer

## REDUCE UNNECESSARY ELECTRICAL LOADS- CIRCULATION PUMP FOR HOT WATER ON A TIMER

With long hot water runs, circulator pumps are often utilized to ensure adequate supply and distribution to all of the fixtures. Circulator pumps regularly operate twenty-four hours a day, which causes the water heating system to cycle frequently to maintain temperature. Shutting off circulator pumps overnight or whenever a building is unoccupied is recommended. Electricity savings are gained, of course, but 75-90% of the total savings is due to reduced water heater cycling.

A heavy duty electric timer is a good choice for controlling a hot water circulator pumps that are hard-wired. If the pump plugs directly into a wall outlet, a much lower cost option is a 24-hour plug-in timer. Either way, the savings will usually justify the cost so a timer is well worth considering.

Caution should be observed utilizing this measure during winter months where pipe freeze-ups are a potential hazard. It may make sense to cycle it on for an hour in the middle of the night during winter months or simply not use it for three months. Controlling water heating circulator pumps for even nine months out of twelve is usually a very cost-effective measure.

*An electrician or plumbing contractor can provide further information on this measure.*

7 Day 24 hour Outlet Timer

Heavy Duty Electric Timer

### *Potential Impact*

This measure will usually save enough money to pay for the investment in less than one year and can save hundreds of dollars in energy each year.

### *Implementation*

A reasonable timeline for implementation would be 1-6 months depending on maintenance staff availability.

1. Take an inventory of all domestic water heater with circulation pumps that run continuously
2. Purchase appropriate timers
3. Install timers
4. Set an appropriate schedule for the timer

## PURCHASING ENERGY EFFICIENT EQUIPMENT (OFFICE OPERATIONS)

This action involves setting a policy to only purchase energy efficient products at time of replacement. The use of energy efficient products will save a significant amount of both energy and money. Look for the USEPA's "Energy Star" labeled products; they represent the most efficient in class. The additional cost of purchasing energy efficient products will be recovered quickly and rebates are frequently offered. In some cases the cost savings is enough to justify replacement even when the product has not exceeded its lifecycle as with compact fluorescent light bulbs or refrigerators made before 1992.

### *Potential Energy Savings*

- **Energy Star copiers** with an output of greater than 20 -40 cpm typically save $50-$70 per year and those with outputs above 40 cpm typically save $150 -$180 per year. Price differences are usually minor.
- **Energy Star printers** typically save $20-$70, depending on output. Price differences are usually minor.
- **Energy Star refrigerators** typically save $40-$50 per year over similar models. Current Energy Star refrigerators are considerably more efficient than older models often saving over $100 per year. Energy Saved by replacing refrigerator made before 1992 with a new Energy Star refrigerator will often pay for the replacement cost in only a few years. A calculator of savings potential is offered at http://www.energystar.gov/index.cfm?fuseaction=refrig.calculator
- **Energy Star LCD monitors** typically save $25-$30 per year over CRT monitors.

### *Implementation*

The City already has a policy in place to purchase energy efficient equipment at replacement. However, it still makes sense to pursue finding and replacing outdated equipment.

## RESOURCE CONSERVATION POLICIES OR INITIATIVES (OFFICE OPERATIONS)

Although the City already has a recycling program and lighting policies in place there is potential to promote greater participation. This action involves adopting and actively promoting policies and initiatives that encourage responsible resource usage. Education on the importance of resource conservation as well as getting staff feedback can lay the foundation for policies or goals. Through a collaborative effort, staff will be more likely to both support and participate in energy conservation efforts.

## RESOURCE CONSERVATION POLICIES OR INITIATIVES - SMART PAPER USAGE

A typical office disposes of about 350 pounds of wastepaper per employee per year.[19] The production of paper takes an enormous environmental toll, significantly reducing forests, emitting toxic pollution from production processes, and creating a great quantity of paper products in landfills. Taking a few simple measures can save

[19] http://www.nrdc.org/enterprise/greeningadvisor/pa-reducing.asp

resources as well as money. Some examples of ways to save paper are listed below with other ideas and information available on the resource CD.

- Set Computer Defaults to Print Double-Sided. Set up computer software for default two-sided printing including word processing, spreadsheets, electronic mail, and others.
- Go Paperless Whenever Possible. Save paper by making meeting and memos electronic.
- Format Standard Forms for Paper Reduction. Reduce and double-side standard forms. When possible, automate standard forms as templates. Electronic forms are easier to use and eliminate the need for blank hard copy forms.
- Provide Trays to Collect and Reuse One-Sided Paper. Encourage employees to save and reuse paper printed on only one side at their desks. Collect paper that has been printed on one side for reuse in copiers and fax machines. Also, use the one-sided paper to make scratch pads.
- Provide Paper Recycling Bins
- Send Information Electronically. Use e-mail for forms, document transmittals and faxes. Think carefully before printing electronic information. Organize and save it so it is easy to look up. This way you won't need to make hard copy files of important information. Do make backups on floppy disks regularly!
- Let employees know that their paper reduction efforts not only save paper, but also postage costs (from reduced mail volume), and storage space requirements. All these savings add to a leaner, more efficient office that benefits everyone.
- Promote a "Think Before You Print or Copy" Attitude.
- Post Paper Reduction Reminders by Printers and Copiers.
- Consider Formalizing your Efforts in a Paper Reduction Campaign.

### *Implementation*

1. Start with an idea or goal
2. Consider doing an initial assessment of inefficient paper use (see the “Paper Reduction Worksheet” on the Resource CD)
3. Identify and prioritize paper reduction efforts (see the “Top Ten Reduction Strategies” on the Resource CD)
    a. Ask staff for ideas
    b. Identify at least one effort that will involve widespread staff participation and education—create an office culture of conservation
    c. Identify at least one effort that will significantly reduce paper use and cost
4. Encourage involvement (see the “Paper Reduction Pledge” on the Resource CD)
    a. Publicize the specific goal (see the “Sample Internal Memo” on the Resource CD)
    b. Promoting the campaign: signs and posted instructions in office (see the “Paper reduction Posters” folder on the Resource CD)
    c. Distributing educational materials to individuals:

        Give basic list of ideas to all employees (see the “Top Ten Reduction Strategies” folder on the Resource CD)

Educational tools—posted on website; reminder email every few months

5. Continuously find ways to improve and additionally reduce paper use

## RESOURCE CONSERVATION POLICIES OR INITIATIVES - LIGHTING CONSERVATION INITIATIVE

Lighting constitutes a major portion of electricity usage and represents significant potential for energy savings. Generally lighting represents between 10-30% of the total energy use in commercial buildings. A simple conservation initiative could have a big impact. Consider creating a policy that mandates that lights be turned off when not in use and at night. Let your local police know that you have a "lights out" policy so that they can investigate if they see lights or activity after hours. Placing signs above or on light switches encouraging people to turn off lights can be very effective. See Resource CD for printable sticker sheets.


### *Potential Impact*

It was assumed that buildings in City of Traverse City other than the WWTP and WTP had lighting usage that 39% of total electricity cost. It was assumed that with a conservation initiative electricity use for lighting could be reduced 4%. This measure would not cost any money but would require some time to implement.

| Description of Measure | Estimated Capital Cost | Estimated Annual Savings | Payback Period (years) | 10yr $ per MT CO2 |
|---|---|---|---|---|
| Lighting Conservation | $0 | $1,407 | 0 | $(119) |

### *Implementation*

A"lights off" policy is already in place so this is more of a campaign to encourage participation. A reasonable timeline for implementation would be 1-3 months depending on staff availability.

1. Inform staff of lighting conservation initiative (an email for a general conservation is included in the Resource CD "Employee_Memo_Energy_Conservation_Initiative.doc")
2. Post signs to remind staff to turn off lights (Wall Signs available on Resource CD).
3. Consider formalizing a policy regarding lights

## RESOURCE CONSERVATION POLICIES OR INITIATIVES - REDUCE USAGE OF PERSONAL APPLIANCES

Employees often bring in appliance to work for convenience and/or to improve their comfort. Common appliances include space heaters, fans, coffee makers, desk lamps, and mini refrigerators. These plug loads can become a significant part of the electrical bill. Consider creating policies to reduce energy by limiting use of personal appliances. Space heaters are one of the largest draws averaging from 1000-1500 Watts. A heating mat for your feet is an alternative that can be just as effective as a space heater for warming the body while using a fraction of the energy (60-100 Watts). Mini refrigerators are another major energy

Personal Foot Heating Pad

consumer and often use more energy than a much larger energy star refrigerator. Rather than allowing personal mini refrigerators it may make sense to purchase an energy star refrigerator that employees can use.

## OPTIMIZE INTERIOR LIGHTING (FACILITIES)

Artificial light is essential to working indoors and is a significant expense, on average making up 30-40% of energy usage in commercial buildings in the United States. Proper lighting creates a positive and productive work environment, while poor lighting can lead to low morale, reduced productivity, and increased errors. This action involves optimizing lighting to provide good quality lighting, while also reducing energy usage.

### OPTIMIZE INTERIOR LIGHTING – UPGRADE LIGHTING (T12 TO T8)

T8 fluorescent lamps contain special, rare earth phosphors and are powered by electronic ballasts. The result is better color rendition and less energy use, compared to standard fluorescent lamps. The T8s are thinner in size (1-inch in diameter rather than 1½-inches), as the graphic on the right shows.

T12 Fluorescent

T8 Fluorescent

High efficiency fixtures using the new T8 fluorescent lamps can save 30-40% over standard fluorescent fixtures. If an existing fixture is in good condition, it is possible to replace just the ballast(s) and lamps. T8 lamps are available in common lengths, but the four-foot T8 is by far most popular. Fixtures with eight-foot lamps can be retrofitted with four-foot lamps (end to end); the four-footers are more stable, less expensive and have a 33% longer life than eight-foot lamps.

T8s also provide higher quality illumination over that of standard fluorescent lighting. Besides improved color rendition, there is no detectable flicker (often exhibited by standard fluorescent fixtures). As a result, eyestrain is reduced. There are even studies showing increased productivity under T8 lighting. Regardless, the people most appreciative of a T8 fluorescent lighting retrofit are usually those who are affected by it; they notice the difference and like it.

*A licensed electrician or lighting engineer should be consulted regarding this measure.*

#### *Potential Impact*

| Description of Measure | Estimated Capital Cost | Estimated Annual Savings | Payback Period (years) | 10yr $ per MT CO2 |
|---|---|---|---|---|
| Remaining T-12 to T-8 Conversion w/ DeLamping | $18,000 | $2,550 | 7.1. | $(35) |

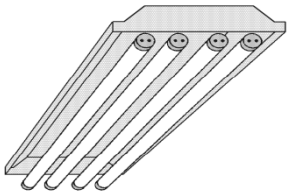
### *Implementation*

The maintenance department would be responsible for implementation.

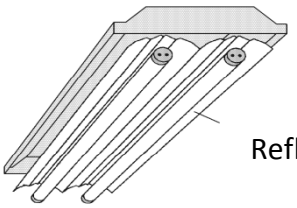
1. Identify light to be replaced.
2. Set a date to begin adjusting computer setting.
3. Inform computer users of new policies and of the upcoming change to computer settings.
4. Begin adjusting computer settings
5. Post signs to remind users to turn computers off at the end of the day.

## OPTIMIZE INTERIOR LIGHTING – OPTIMIZE LIGHT LEVELS

Proper light levels are critical to a good lighting design. It's important to choose appropriate light level depending on the nature of the work (see the table of suggested light levels). It is highly recommended that indoor light levels be checked and adjusted to recommended levels. In some areas it may be possible to remove lamps where the light is brighter than necessary in order to save money. Also in some areas, a specular reflector may be installed in a fluorescent fixture, improving reflectance and allowing the removal of one or two lamps from multiple-lamp fixtures with just a 10-25% reduction in the lighting level. The reflector focuses the light more efficiently; standard fixtures absorb some of the light output and reflect the rest in a diffuse and unfocused manner. In areas where computers are in use, parabolic louvers or egg-crate louvers are highly recommended to reduce glare. Task lighting should be used wherever possible to reduce ambient lighting costs and give the user better control. Ultimately a good lighting design should provide adequate light for an effective working environment, but no more than is necessary.



Standard 4 Lamp Fixture



2 Lamp with Reflector

Reflector

| Suggested Light Levels | |
|---|---|
| **Space Type** | **Light Level** |
| Offices, Classrooms | 30-100 (foot candles) |
| Hallways, Corridors | 5-10 (foot candles) |
| Industrial High-bay | 30-50 (foot candles) |
| Manufacturing (on task) | 30-150 (foot candles) |

Another important factor in optimizing lighting is preventative maintenance. Because fluorescent bulbs loose luminosity over there life, it usually makes sense to not wait until failure, but to change them out before the end of their average rated life. At this time it also makes sense to clean the fixtures. A thin film of dust can absorb 10% to 15% of the light without anyone realizing it.

### *Implementation*

The maintenance department would be responsible for implementation.

1. Conduct a lighting audit, including measurement of lighting levels.
2. Make a plan for the lighting changes
3. Purchase and install specular deflectors were needed
4. Remove any unnecessary bulbs

## OPTIMIZE INTERIOR LIGHTING – OCCUPANCY SENSORS

Lighting can be controlled by occupancy sensors and allow operation whenever someone is within the area being scanned. When motion can no longer be detected, the lights shut off.

**Passive Infrared Occupancy Sensor**

Passive infrared sensors react to changes in heat, such as the pattern created by a moving person. The control must have an unobstructed view of the building area being scanned such as doors, partitions, stairways, etc. will block motion detection and reduce its effectiveness. The best applications for passive infrared occupancy sensors are open spaces with a clear view of the area being scanned.

Microphonic sensors detect sound and can see around obstructions and are best for areas with cabinets and shelving, restrooms and open areas requiring 360-degree coverage.

Occupancy sensors utilizing both passive infrared and microphonic technology are usually more expensive. They can be used to control one lamp, one fixture or many fixtures. The ideal use for occupancy sensors is an area where lighting is often left on after the last person has left the area. The table on the left provides typical savings achievable for specific building areas, as determined by the USEPA studies. The average savings produced by occupancy sensors, according to the USEPA, is 60%.

| BUILDING AREA | SAVINGS |
|---|---|
| Private Offices | 25 to 50% |
| Open Offices | 20 to 25% |
| Rest Rooms | 30 to 70% |
| Corridors | 30 to 40 % |
| Storage Areas | 45 to 65% |
| Conference Rooms | 45 to 65% |

Consider the use of occupancy sensors to control lighting. Rooms with lights controlled by a single switch can be retrofit with a wall switch occupancy sensor. Rooms that have multiple switches can have the lighting circuit controlled by an occupancy sensor to allow continued use of switches for preferred lighting level. Any rooms with irregular use, restrooms, storage areas and offices are usually the best possibilities. You may have to experiment with several types of sensors at several different room locations to find the best fit for your situation. A qualified lighting engineer can help determine the best occupancy sensor solution for your buildings.

### *Potential Impact*

| Description of Measure | Estimated Capital Cost | Estimated Annual Savings | Payback Period (years) | 10yr $ per MT CO2 |
|---|---|---|---|---|
| Install Occupancy Sensors | $600 | $214 | 2.7 | ($87) |

### *Implementation*

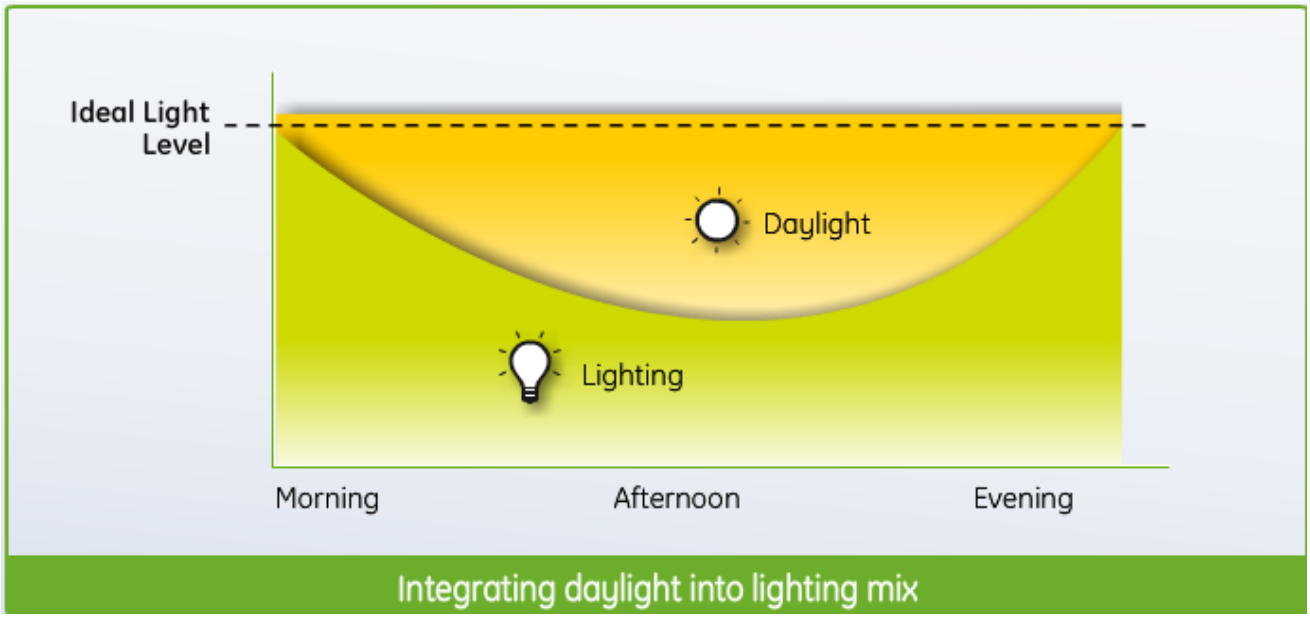
The maintenance department would be responsible for implementation.

1. Determine areas that would work well for occupancy sensors
2. Purchase appropriate sensors
3. Install sensors

## OPTIMIZE INTERIOR LIGHTING – UTILIZE DAY LIGHTING

Daylight should be utilized whenever possible. Utilizing natural light can save money on lighting as well as have a positive effect on mood and productivity. The simplest way to do this is to manually adjust lighting when daylight is present. This works well in some cases, but is not always practical. Often a more effective method is to utilize a control system to automatically harvest daylight. This method involves using digital photo sensors to detect daylight levels and automatically adjust the output level of electric lighting to create a balance (see Figure 4). Daylight harvesting is rapidly gaining popularity in the controls industry. Studies indicate that electric lighting energy use can be reduced as much as 84% by utilizing daylighting.

**Figure 2, Day Light Harvesting Through Automated Controls**




### *Implementation*

The maintenance department would be responsible for implementation.

1. Determine areas that would work well for daylight harvesting
2. Purchase appropriate sensors and equipment
3. Install sensors and equipment

## OPTIMIZE HVAC PERFORMANCE (FACILITIES)

Energy used to heat, cool, and ventilate contributes to the majority of energy use in buildings. An intelligently designed, well tuned, and properly maintained HVAC system can provide a healthy and safe work environment while also saving money. This action involves optimizing the functions of the existing HVAC equipment to ensure that everything is running at peak performance as well as upgrading HVAC equipment to high efficiency equipment at the time of replacement.

Ventilation refers to either exhausting indoor air to the outside or bringing drawing outside air in with a fan. This is done to maintain indoor air quality. Otherwise $CO_2$ or other contaminant levels will rise. The current version of ASHRAE Standard 62 requires 15 cfm of fresh air ventilation per building occupant. Some earlier versions of the standard called for higher ventilation rates, so in many cases buildings are over ventilating. Also because energy was cheap, ventilation systems in older building were commonly oversized, moving more air than necessary. When a ventilation reduction is possible, significant energy savings are possible.

Methods of dealing with excessive ventilation include:

1. Shutting off unnecessary exhaust fans;
2. Reducing the operating hours of ventilation equipment;
3. Reducing the quantity of outdoor air brought into the HVAC systems;
4. Repairing and calibrating controls on automatic ventilation equipment (including dampers);
5. Having an air balance done;
6. Installing a Demand Controlled Ventilation system

Timers can be used to cycle the ventilation equipment (exhaust fans) when continuous air change is not required. The newer electric timers offer greater versatility over the more common and less expensive electro-mechanical units, allowing for a wider range of time settings and a greater number of cycles. Most electronic timers use a 9-volt battery to back up the programmed settings.

Staff should never arbitrarily reduce ventilation air to conserve energy. Proper ventilation is not only required to maintain indoor air quality but, for most public buildings, it is the law. It is recommended that a discussion take place regarding the ventilation air requirements with the mechanical engineer, HVAC contractor or air balance contractor.

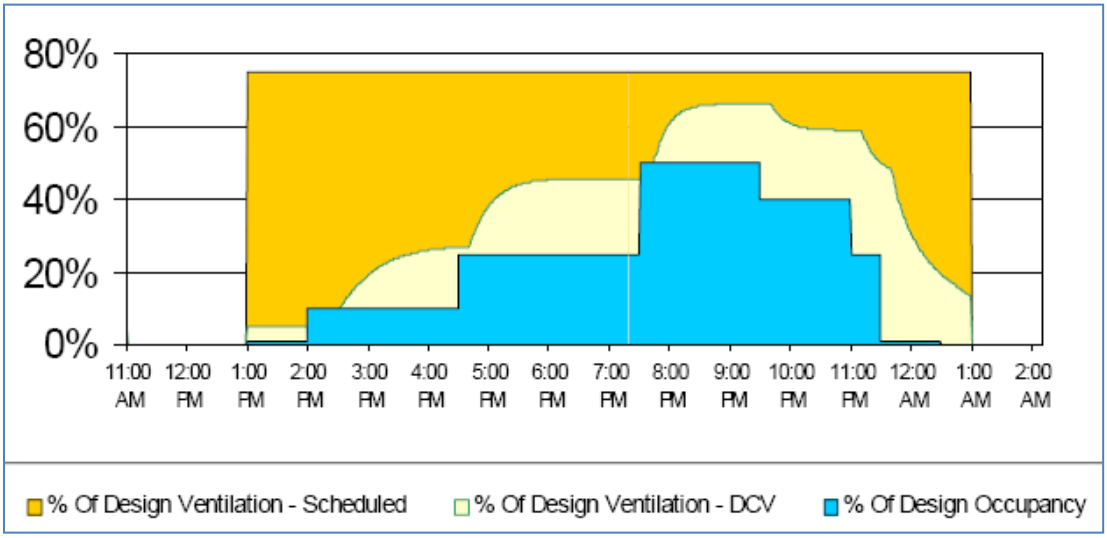
**Demand Controlled Ventilation (DCV)**

The traditional method of meeting ASHRAE ventilation rates was to set the outdoor air quantity to maximum design occupancy. This can result in a tremendous waste of energy when the occupant load is not at maximum or intermittent use of the space. Demand Controlled Ventilation is a system of controlling ventilation by directly measuring air quality and adjusting ventilation to maintain the required levels. $CO_2$ sensors are the most widely accepted technology currently available for implementing DCV. The sensors are either place in the return air duct or in the ventilated space to measure actual $CO_2$ levels in real time. DCV saves energy by avoiding the heating, cooling, and dehumidification of more ventilation air than is needed. In addition DCV can improve indoor air quality and reduce run time of major HVAC equipment.

Savings for DCV are estimated to be from $0.05 to more than $1 per square foot annually. The highest payback can be expected in high-density spaces in which occupancy is variable and unpredictable (e.g., auditoriums, some school buildings, meeting areas, and retail establishments), in locations with high heating and/or cooling demand, and in areas with high utility rates. For a new system, the installed cost will generally be about $600 to $700 per zone. For a retrofit system, the cost is estimated at from $700 to $900 per zone for systems with an existing DDC programmable controller and from $900 to $1200 per zone for systems with pneumatic, electronic, or application-specific DDCs. DCV frequently provides excellent payback. A report by Lawrence Berkeley National Laboratory cited five case studies in large office buildings with CO2-based DCV, all

of which reported energy savings that resulted in payback times of from 0.4 to 2.2 years. Figure 5 shows the ventilation savings potential (area in gold) for a typical application where DCV replaces fixed scheduled ventilation in a building that has a changing occupancy level.

**Figure 3, Ventilation and Occupancy**




It is interesting to note that in the next revision of its building code, California will begin requiring $CO_2$ based DCV in all buildings housing 25 people or more per 1000 ft2. ASHRAE 90 requires $CO_2$ sensors for DCV in high-density applications. Also the U.S. Green Building Code gives points in its Leadership in Energy and Environmental Design (LEED) rating system for use of $CO_2$- based ventilation control in buildings.

## OPTIMIZE HVAC PERFORMANCE - OPERATIONS AND MAINTENANCE FOR HIGH PERFORMANCE

**Examine Air Handling System Dampers**

Air handling units play an important role in providing a comfortable environment, but if they are not adjusted correctly, they can be wasting a significant amount of heating and cooling energy.

There are three primary dampers associated with an air handling unit (AHU) -- outside air, relief or exhaust, and mixed air -- with the first two being most important. If either damper fails to close completely or modulate correctly, excess outside air is brought in which needs heating or cooling energy added, or it allows excess amounts of conditioned air to exit the building. Energy usage for cooling can be even more costly when the AHU gets its outside air from a roof intake louver because the air above the roof is superheated by the sun. Damper operations need to be inspected and re-calibrated periodically by qualified staff or HVAC contractor.

**HVAC Night Shutdown**

The devices that control the shutdown of the HVAC units will fail for various reasons, leaving the unit running in full daytime mode. Gone unchecked, energy is wasted. Generally, staff members notice or will not inform maintenance of this condition, unless the unit that has failed does not come back on.

It is an important part of the maintenance program to verify that (1) the units are shutting down as scheduled and (2) the outside air intake and exhaust dampers are closed and the mixed air damper is open. Finally, the unit needs to be inspected during night operation to verify the dampers remain in the position described above when it runs on a temperature demand cycle.

**Filters and Coils Maintenance**

Filters are essential to efficient operation of air handling units because they keep HVAC components and coils free of dust and debris. Dirty filters, coils, and heat exchangers increase the static pressure in the ductwork causing an additional electrical load on the fan motor. Build-up of dirt, dust and other materials on coils reduces heat transfer efficiency for radiant heating. Dirty condensing and refrigerant coils in the air conditioning (cooling) system significantly increase energy use as well. Routine inspection, replacement of filters, and cleaning of coils should be a regular part of every maintenance program.

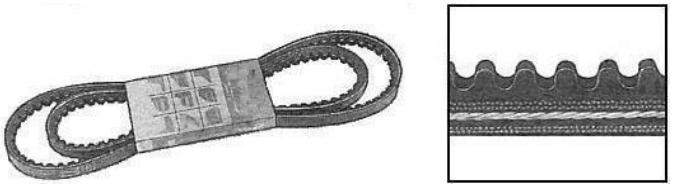
**Boiler Reset Control**

A boiler reset control monitors outdoor conditions and resets the water temperature to the lowest level required to heat the building, saving significant energy. This control device is also utilized to start and stop the circulation pumps. This control device needs to be re-calibrated periodically by qualified staff or HVAC contractor.

**Cogged V-Belts**

Motors and belts are commonly utilized for heating, ventilating and air-conditioning (HVAC) systems and air compressors. One of the natural inefficiencies in these systems is the *slip* that occurs between a standard v-belt and the sheaves on which it is mounted. This reduces power transmission from the motor to the equipment being driven. Studies show that replacing standard v-belts with cogged v-belts can reduce slip and improve system efficiency by as much as 8%.

Cogged v-belts cost a little more than standard v-belts but they also have a longer life cycle, which more than offsets the extra cost. The energy savings produced by improved system efficiency often pay for the cost of installing cogged v-belts in a matter of months.



**Optimize Start/Stop Time for HVAC Systems**

An efficient operating schedule for heating, ventilating and air-conditioning (HVAC) equipment conserves fan, heating and cooling energy consumption. When energy was cheap, HVAC systems were commonly oversized and moved more air than necessary for longer periods of time than what was required. An energy penalty is paid when outside air is brought into a building because the air has to be conditioned, heated or cooled depending on the time of year. Schedules should be developed having the least amount of run time to closely match occupancy.

*Developing a schedule for each HVAC unit requires the following considerations:*

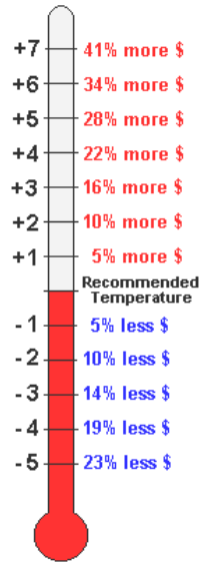
1. Know what areas are served by each unit
2. Start HVAC units as to close to scheduled normal occupancy as possible.
    a. Mondays may need to start a little earlier during really cold or hot months.
    b. Do not create the schedule for a few individuals who elect to start earlier than normal, particularly if the unit serves a large area, several office areas or the entire building.
3. Shut HVAC units down 30 minutes before the end of the normal occupancy schedule.
4. Night meeting dates, times and locations can impact energy use, especially if the meeting is a one-time event and controls the schedule.
    a. House the meeting in an area that will utilize the smallest air handling unit.
    b. Don't over-schedule times for the exceptions (i.e. for meetings once or twice a year).
5. Each HVAC schedule needs to be reviewed weekly and adjustments made.

6. Seasonal scheduling is important because of the different needs of the building: spring and fall are neutral, requiring no heating or cooling. Winter is different than summer.
7. If, for some reason, maintenance feels that the HVAC needs to run significantly longer than suggested, then your mechanical engineer and/or HVAC contractor need to be brought in to positively identify the problem or problems.

**Adjust Heating Temperatures**

| Building Area | Recommended Temperature °F |
|---|---|
| Offices | 68°F |
| Conference Rooms | 68°F |
| Computer Rooms | 65°F |
| Restrooms | 65°F |
| Shop Areas | 65°F |
| Corridors | 62°F |
| Storage Areas | 55°F |

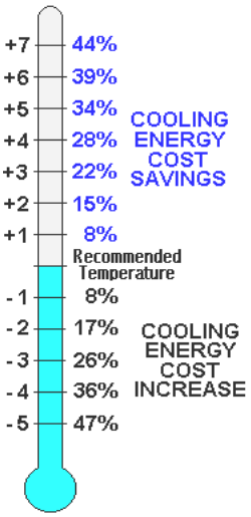
You may want to consider reviewing current heating temperatures in comparison to recommended levels. Energy savings can be achieved for free by adjusting thermostats or energy management systems.




Heating requirements in buildings vary with the type of activity being conducted. For example, the recommended heating temperature for offices is 68°F, while cooler levels are often possible in other areas such as computer rooms, corridors, and storage areas. Generally speaking, you should try to keep the temperature at the lowest possible level while still maintaining comfort for the occupants. The use of electric space heaters can become a big problem if temperatures are too low. It can be very useful to ask employees about their comfort levels because problems may just be a result of air diffuser location that can easily be resolved. As the graphic on the right illustrates, the savings can be quite significant for this measure. For example, it can cost up to 22% more to heat offices to 72°F rather than the recommended setting of 68°F.

Recommended heating temperatures for various building areas during occupied hours are shown to the left. A reduction to 55°F is recommended when building areas are unoccupied, but studies show that over half of the savings are achieved in the first 5-degree setback, so even a minor temperature setback during unoccupied building hours can produce a substantial savings.

**Adjust Cooling Temperatures**




The City may want to consider reviewing current cooling temperatures in comparison to recommended levels. Energy savings can be achieved for free by adjusting thermostats or energy management systems.

Cooling requirements vary with occupancy schedules and the type of activities being conducted. For example, the recommended heating temperature for offices is 76°F when the building is occupied. Higher settings are often possible in corridors, storage areas, and restrooms, while lower settings may be required in computer rooms. When air conditioning a building, you should try to keep the cooling temperature at the highest possible level while still maintaining comfort for the occupants.

As the graphic above illustrates, the savings can be quite be significant for this measure. For example, it can cost up to 36% more to cool offices to 72°F rather than the recommended 76°F.

Recommended heating temperatures for various building areas during occupied hours are shown on the left. Ideally, the air conditioning should be shut off when the building is unoccupied, but studies show that over

half of the savings are achieved with just a 5-degree increase, so even a minor temperature setback during unoccupied building hours can produce a substantial savings.

When outdoor temperatures are below 65°F, air conditioning energy can often be saved by using the outdoor air for cooling purposes. Economizer controls allow the introduction of outdoor air into the HVAC system to supplement cooling when proper outdoor conditions exist. With the addition of an enthalpy control, economizer operation is further limited to meet both temperature and humidity conditions in order that unwanted humidity from outdoor air is not introduced into the building.

| Building Area | Recommended Temperature °F |
|---|---|
| Offices | 76°F |
| Conference Rooms | 76°F |
| Computer Rooms | 74°F |
| Restrooms | 78°F |
| Shop Areas | 78°F |
| Corridors | 80°F |
| Storage Areas | 82°F |

### *Potential Energy Savings*

Measures related to optimizing the performance of HVAC equipment frequently have an excellent return on investment. Researchers at three of the foremost building-commissioning think tanks in the U.S.- Lawrence Berkeley National Laboratory (LBNL), Portland Energy Conservation Inc., and the Energy Systems Laboratory at Texas A&M University—concluded in a study published in December 2004 that retrocommissioning is one of the most cost-effective means of improving energy efficiency in commercial building.[20]

## OPTIMIZE HVAC PERFORMANCE - UPGRADE HVAC EQUIPMENT

Energy used to heat, cool, and ventilate contributes to the majority of energy use in buildings. This action involves upgrading HVAC equipment to high efficiency equipment at the time of replacement. The additional cost of purchasing energy efficient products will be recovered quickly and rebates are frequently offered. In some cases the cost savings may be enough to quickly pay for the entire cost of replacement.

**Boiler**

Older boilers often have seasonal efficiencies of 55-60%. Improvements to burners, heat exchangers and controls have pushed efficiencies above 85% on the new high efficiency boilers; in fact sealed, pulse combustion boilers being rated above 90%. Substantial savings can be achieved by replacing older boilers with the high efficiency systems now available.

**Chiller**

Air conditioning is a major user of electricity in commercial buildings. Replacing older chillers with new high efficiency chillers that are appropriately- sized can reduce energy used for cooling by 30%.

**HVAC Fans**

Replacing fans with high efficiency fans can generate significant savings that will often pay for the cost of equipment and installation quickly.

[20] http://www.energystar.gov/ia/business/EPA_BUM_CH5_RetroComm.pdf

**Rooftop HVAC Equipment**

A rooftop HVAC unit provides heating, ventilation and air-conditioning in one package. Newer models provide significant improvement in efficiency of both heating and cooling. When replacing a rooftop unit look for high efficiency features like: modulating burners on the heating side, scroll compressors on the cooling side, direct-drive fan motors controlled by variable frequency drives, economizer functions, and energy recovery technology. Also evaluate the size of the unit to make sure it is not oversized because according to the Consortium of Energy Efficiency, at least 25% of all rooftop HVAC units are oversized, resulting in increased energy costs and equipment wear. Properly sized equipment dramatically cuts energy costs, increases the life of the equipment, and reduces pollution.

### *Potential Energy Savings*

Upgrading HVAC equipment to higher efficiency technologies can significantly reduce energy consumption.

### *Implementation*

1. Conduct a thorough evaluation of existing HVAC systems.
2. Create a prioritized list of equipment to be replaced.
3. Get capital either through maintenance budget or energy savings account.
4. Replace equipment.

## OPTIMIZE EXTERIOR LIGHTING (FACILITIES)

Substantial amounts of electricity are consumed through outdoor lighting, much of which is unnecessary. This measure involves upgrading equipment, and optimizing usage to save energy, cut down on light pollution, and reduces associated GHG emissions.

### OPTIMIZE EXTERIOR LIGHTING – UPGRADE STREET LIGHTS TO LED

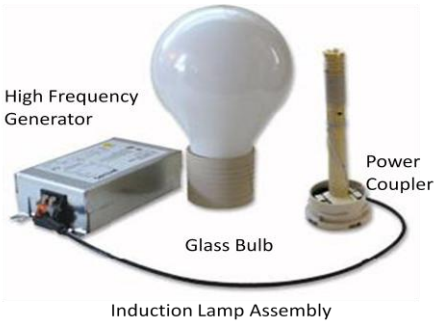
This measure involves upgrading efficiency of street by replacing HID technologies such as high pressure with LED lighting. This retrofit will save lots of energy and associated GHG emissions. Comparing to High Pressure Sodium Lamps, LED street lights use 50% - 70% less energy. In addition, the lifespan of LED street lamp is 3 - 5 times to Sodium Lamp's.

### *Potential Impact*

Replacing conventional streetlight with LED streetlight generally saves 70%-90% on electricity consumption.

### OPTIMIZE EXTERIOR LIGHTING – UPGRADE EFFICIENCY OF FACILITY EXTERIOR LIGHTING

This measure involves upgrading exterior lighting to save electricity. Several high efficiency options exist for updating older outdoor lighting they include; T5 fluorescent lighting, induction lighting, and LED lighting. A great deal of electricity can be saved by upgrading older HID technologies like mercury, metal halide or high pressure sodium lamps.



**Induction lamps** frequently offer 60% savings in electricity. In addition induction lamps typically last 50,000-100,000 hours, much longer than other light sources. Besides possessing a service life that makes this technology almost maintenance-free, induction lamps are energy-efficient, provide long-term stable white light with high lumen maintenance and have instant-on capability.

**T5 fluorescent lamps** generally offer a 40%-80% savings in electricity. They provide very bright white illumination, have instant on capability, last as long as HID lamps, are less expensive, and provide more stable light levels over time.

**LED lamps** are likely to be the future of exterior lighting. Currently they are generally not as efficient or cost effective as induction lighting. However technology continues to improve they are becoming cheaper and more efficient. They have extremely long life, up to 100,000 hours, they are dimmable, and do not contain any hazardous materials.

LED Pole Mounted Light

T5 Fluorescent Pole Mounted

### *Potential Impact*

| Description of Measure | Estimated Capital Cost | Estimated Annual Savings | Payback Period (years) | 10yr $ per MT CO2 |
|---|---|---|---|---|
| Upgrade all Remaining Exterior Lighting | $140,000 | $14,216 | 9.8 | ($2) |

### *Implementation*

The maintenance department would be responsible for implementation.

1. Inventory existing lighting.
2. Select appropriate alternative lighting.
3. Purchase lighting fixtures.
4. Install lighting fixtures.
5. Monitor energy savings.

## OPTIMIZE EXTERIOR LIGHTING- MANAGE LIGHTING USAGE

This measure involves saving electricity by optimizing usage of exterior lighting. It is useful to ask “what is the desired function of the exterior lighting?” Set lighting controls to provide the minimum lighting to perform the desired function. Also minimize the usage of lighting by reducing hours of usage using timers and/or utilizing motion sensors to control them. Keep in mind that lights alone will not serve to "protect" property and are a poor "security" device. Examine other means of protecting property and to discourage criminal activity. Consider the recommendations listed below and reference “Guidelines for Good Exterior Lighting Plans” or “Outdoor and Streetlight Design Guidelines” adopted in Santa Barbara, California on the Resource CD for detailed information. Something interesting to note, is that at low light levels (and for peripheral vision) white

light is superior to yellow light.

- Avoid "dusk-to-dawn" sensors without a middle of the night shut off control. [21]
- Direct light downward by choosing the correct type of light fixtures. This can reduce energy use as well as reduce light pollution.
- Utilize "shut off" controls such as sensors, timers, motion detectors, etc.

On February 1, 2001, Governor Davis of California issued an executive order requiring retail business to substantially reduce unnecessary outdoor lighting wattage during non-business hours.[22]

## WATER SYSTEM UPGRADES AND CONSERVATION MEASURES

The process of supplying water, as well as heating it, requires considerable amounts of energy and money. Fairly low cost investments in water conservation can yield quick paybacks for water customers and reduce energy consumption at a facility level as well as for water supply and wastewater management operations. This strategy targets water conservation at City facility and community levels through education and devices as well as efficient water and wastewater pumping equipment to reduce water and energy use.

### FACILITY-LEVEL WATER CONSERVATION MEASURES

This action employs the use of water conservation devices and efficient equipment to reduce resource consumption. Through simple retrofits of faucets, and fixtures water consumption can be significantly reduced. In addition, water heating cost and energy consumption can be significantly reduced through the use of on demand water heating versus conventional water heaters.

Above: Typical Low Flow Faucet Aerator

Left: 1.5-gpm Multi-spray Faucet Aerator

**Low Flow Faucets and Shower Heads** - Flow moderators reduce water use through faucets, producing a substantial water/sewer cost savings. In the case of hot water, energy savings is also achieved. Premium moderators maintain adequate pressure and provide an effective, full stream of water while reducing the flow rate up to 50%.

Below: Low flow Shower Options

A wide variety of flow moderators can be installed on both kitchen and bathroom faucets; some of the more common are pictured here. Currently recommended are the 1.5-gpm moderators for

[21] Guidelines For Good Exterior Lighting Plans by The Dark Sky Society

[22] http://www.energy.ca.gov/efficiency/lighting/outdoor_reduction.html

kitchen faucets and 1.0-gpm moderators for bathroom faucets.

About 75% of typical water consumption can be attributed to bathroom uses, so this area presents a great opportunity for reducing water/sewer costs. Water saving showerheads can often reduce shower water consumption by 25-50%. While some are hesitant to try this measure, studies have shown that acceptance of water saving showerheads is directly linked to the quality of the model installed… and not all are alike. The best ones not only reduce water flow but also increase water velocity to provide sufficient results.

Most showerheads in use today draw water at a rate of 2.5-gallons per minute (gpm) or more, while new models use as little as 1.5-gpm for standard models and handheld units. While most fall somewhere in between, studies have shown that even a ¼-gpm reduction with water saving showerheads is usually cost-effective. The most effective showerheads under 2.0-gpm generally aerate the water flow.

**High Efficiency Toilets** - Water saving toilets use 1.6-gallons per flush (gpf) compared to the 3.5-gpf models of recent years and the 5.0-gpf models of over 40 years ago, of which many are still in place. A new high efficiency toilet (HET) uses 1.28-gpf and can reduce water consumption by 60-75% over the older fixtures and even save 20% over water saving toilets. Institutional models, like the ones shown on the right, come with manual or automatic flush options. Auto-flush units generally assure the savings and are usually worth the additional cost.

**Zurn EcoVantage Wall-Mount HET & Falcon Waterless Urinal**

Waterless urinals offer a step further into water conservation and savings for institutional and commercial applications. A study by the Army Corps of Engineers found the payback on waterless urinals retrofits to vary between ½ and 3 years and another independent study found them to be practical measures in all but the most extreme institutional environments such as jails and dorm rooms.

**High Efficiency Water Heaters -** Replacing an old water heating system with a high efficiency tankless system can often provide a substantial energy savings. Tankless models heat water on an as needed basis and utilize a more efficient method to heat the water through improved burner design. Eliminating the storage tank saves 10-15% by itself and, with the 93% efficient condensing heaters now available, high efficiency tankless systems can save up to 50% compared to conventional water heaters.

Tankless water heaters have an average service life of 20 years, 50-60% longer than conventional models. Plus, tankless water heaters are serviceable and can be repaired, whereas tank-type models are often replaced when problems arise. The longer life cycle, in general, negates the higher initial cost of these systems. Commercial applications with substantial hot water requirements are no longer an issue for tankless systems. By plumbing together a series of units and utilizing just a single controller, virtually any hot water requirement can be met. The picture on the right shows a high efficiency

tankless water heating system for a large hotel that is capable of providing enough hot water to meet all of their needs… and never run out. Notice the PVC exhaust and outside air intakes, common trademarks of a 90%+ efficient system.

### *Implementation*

1. Inventory existing equipment
2. Select appropriate alternatives and make a plan for implementation.
3. Install new equipment.
4. Monitor energy savings.

## COMMUNITY–LEVEL WATER CONSERVATION CAMPAIGN

This action focuses on energy and emissions reduction at City water supply and wastewater treatment facilities through community-wide water conservation. The US EPA's WaterSense program offers information materials, programs, and guidances for governments, utilities, businesses, homeowners, educators, and students and is a great place to develop a water conservation campaign.

**General Education on Water Conservation Practices & Products**

Numerous resources exist within WaterSense and elsewhere for outreach for municipal water suppliers to educate customers on the advantages of water conservation and how to achieve them. Using analysis of previous programs successes and failures can be valuable in establishing or advancing a water conservation education campaign.

**Rate Changes**

Changing rates or restructuring rates that disincentivize excessive water use, particularly for irrigation, can be effective especially when coupled with incentives or resources for implementing water conservation practices.

**Conservation Device & Practice Rebates or Financial Assistance**

Numerous cost-effective devices for water conservation at the residential, commercial, and institutional level exist, including those listed in the previous action for municipal facilities. Other devices and practices targeting lawn and athletic field irrigation, such as weather sensitive irrigation control switches and water conserving soil amendments have been proven to be significant water saving measures. Providing rebates or offering easier access to these materials through bulk purchasing may advance their use.

**Technical Assistance & Water Audits**

Providing large water users or those most economically impacted by the current or future cost of municipal water with technical assistance in indentifying the most cost effective water use reduction strategies can also be an effective method for realizing water conservation.

### *Potential Impact*

Assuming a 5% reduction in community wide municipal water use and wastewater generation the estimated resulting reduction in electricity consumed by water treatment and water and wastewater pumping would amount to a 60.9 MT $CO_2e$ reduction in greenhouse gas emissions. Although the energy saved through this measure would offer cost savings as well, if the currently pricing structure remained, the 5% water reduction

would likely also reduce City revenues.

### *Co-Benefits*

- End-users of City water save money on water bills and possibly water heating bills based on their water conserving practices.
- Community-wide water heating energy and associated emissions may also be reduced.

### *Implementation*

1. Join the EPA WaterSense program and get connected with its resources.
2. Assess current rate structure and operating costs influenced by water consumption and wastewater generation.
3. Investigate the feasibility of strategies for promoting water conservation including those mentioned above.
4. Survey users, including those that use the most water, stand to save the most money, are best positioned to action following a targeted education campaign.
5. Select strategies that are likely to be most net energy and cost effective and implement.
6. Monitor water, energy, cost, and carbon savings.

## UTILIZE RENEWABLE ENERGY (FACILITIES)

Renewable energy represents an environmentally friendly alternative to the use of fossil fuels. This measure involves employing clean energy technologies like solar water heating, solar PV, and wind energy. Keep in mind, that it generally makes economic sense to tackle high yielding energy efficiency and conservation projects before starting a transition to renewable energy sources. However with improvements in technology and reducing costs this is not always true. This transition to locally generated renewable energy will keep money the in local economy; help create jobs, as well as reduce energy costs, and environmental impacts. Michigan is geographically well suited for renewable energy technologies, as well as having the technological knowledge to implement them. Some renewable energy options to consider include solar water heating, solar photovoltaic (PV) electricity, passive solar heating, and wind turbine electricity.

**Solar Water Heating** for domestic use or heating pools is an excellent technology that can significantly reduce energy use especially at facilities that use a lot of hot water such as jails and recreational facilities. Solar water heating often provides the fastest payback of renewable energy options. Solar heating for pools provides even better paybacks than domestic systems because the equipment is less costly.

**Solar PV** is a simple low maintenance way to produce clean energy directly from the sun that can be done on virtually any scale from small to very large. The price of solar PV has significantly reduced and will likely continue to become more affordable. Germany has the highest concentration of solar PV in the world and they receive a similar amount of sun to Michigan.

**Wind Energy** generation has great potential in Michigan both on land and offshore. Wind turbines are available in a wide variety of sizes from large scale commercial units to small units designed for residential application. As interest in wind energy increases and technology improves the cost of installing turbines will likely come down.

### *Potential Impact*

| Description of Measure | Estimated Capital Cost | Estimated Annual Savings | 10yr $ per MT CO2 | Life Span (years) |
|---|---|---|---|---|
| Solar Hot Water | $18,500 | $907 | $197 | 20.4 |
| Solar PV | $28,000 | $1,597 | $219 | 17.5 |

*Implementation*

1. Conduct a site evaluation to assess feasibility of renewable energy (RE).
2. Analyze options.
3. Select appropriate RE, develop a plan, and select an installer.
4. Install renewable energy.
5. Monitor energy savings.

## PROMOTE SMART TRANSPORTATION OPTIONS (EMPLOYEE COMMUTE AND FLEET)

### PROMOTE LOW CARBON COMMUTER OPTIONS


The commute to and from work comprises an easily overlooked but significant source of GHG emissions. This action involves promoting forms of transportation that have lower impacts on the environment. Potential alternatives forms of transportation may include: carpooling, bus riding, bicycling, or walking. **Carpooling** is an excellent way to both save money and protect the environment while also promoting employee camaraderie. **Buses** save energy and protect the environment by consolidating usage. **Telecommuting** and teleconferencing are environmentally friendly technological alternatives to commuting that may work to replace some travelling or commuting. It is recommended that Traverse City and Grand Traverse County actively promote these environmentally friendly forms of commuting to reduce their ecological footprint. The campaign could include flyers or email messages promoting alternative forms of transportation. The City might also offer an incentive such as, a Low Carbon Commuters Lunch for those employees that have chosen alternative forms of transportation. Consider membership in the Best Workplaces for Commuters program; find info at www.bestworkplaces.org.

*Implementation*

1. Develop a Low Carbon Commute Campaign strategy.
2. Implement Low Carbon Commute strategies.
3. Publicize the campaign and any incentives.
4. Give recognition.

## PROMOTE SMART FLEET USAGE

Fleet emissions represent a very significant portion of both County and City GHG emissions. This action includes a variety of measures intended to reduce use of fossil fuels and emissions associated with fleet usage, while also saving money. These measures could potentially be incrementally implemented.

**Reduce Fleet Mileage** – This measure involves making an effort to minimize fleet mileage. It may involve a specific goal or just a general reduction goal however in either case it should include be publicized to all relevant staff. Way of reducing millage could include: calling into a meeting rather than driving, eliminating unneeded trips, or combining errands.

**Use Smaller Fleet Vehicles** - This measure would involve promoting the use and purchase of smaller vehicles. It does not make sense drive a large vehicle to perform tasks that could just as easily be done with a compact car.

**Training on Energy Efficient Driving** - This measure involves training staff on efficient driving. According to the USEPA efficient driving can save from 5%-33% in fuel.

**Vehicle Maintenance Policy** – This measure involves setting a preventative maintenance schedule for fleet vehicles. Maintenance would include; regularly checking tire pressure, and regular tune ups.

**Use Bikes on the Job** – This measure involves providing and promoting the use bicycles on the job. Tasks that may be good can candidates for bike use include; checking parking, building inspections, downtown police patrol, short errands, and getting to in town meetings.

**Alternative Vehicles (Electric, Hybrid, Hydrogen, etc.)** – This measure involves the purchase of environmentally friendly fleet vehicles. The difference in price will usually more than be recovered over the life of the vehicle.

**Alternative Fuels (B20, Ethanol)** – This measure involves purchasing lower carbon fuels for fleet vehicles.

### *Potential Impact*

| Description of Measure | Estimated Capital Cost | Estimated Annual Savings | Payback Period (years) | 10yr $ per MT CO2 |
|---|---|---|---|---|
| Efficient Driving Campaign (DPS) | NA | $10,219 | NA | $(202) |
| Efficient Driving Campaign (City) | NA | $5,720 | NA | $(195) |
| Use Smaller Cars | NA | $5,157 | NA | $(300) |
| Use Bikes on the Job | NA | $1,340 | NA | $(300) |

Because this action includes a variety of measures; it may make sense to implement them incrementally over time. The measures are listed in order of payback relative to cost and effort.

1. Develop a Smart Transportation strategy.
2. Publicize the campaign.
3. Implement Measures.
4. Give recognition.

# APPENDIX D – STRATEGIES FOR CREATING A CULTURE OF ENERGY CONSERVATION

## CONTINUE GETTING FEEDBACK AND IDEAS FROM EMPLOYEES

Understanding employees' motivations, current energy conservation practices, and a willingness to make changes can help guide creation of an energy and climate initiatives. Employees are a great resource to generate new ideas for energy savings, as well as identify existing issues that might be wasting energy.

## CONSIDER DISTRIBUTING AN ENERGY CONSERVATION NEWSLETTER

This action could potentially help staff save energy at home as well as at work. The two newsletters supplied in the Resource CD are divided into winter and summer since these are the most energy intensive seasons. They provide tips on saving energy at work and home; some energy facts; and some brief information on why energy conservation makes sense. These could be distributed at the beginning of their respective seasons each year as a reminder of things that can be done to save energy. Recognizing that it is unlikely that someone would implement all measures in a single year the newsletter could be distributed annually as an energy savings reminder.

## CONSIDER ADOPTING CONSERVATION POLICIES

In order to create a successful ongoing energy management strategy it is highly recommended that the City administration adopt and actively promote policies that encourage responsible energy use. Education on the importance of energy conservation as well as getting staff feedback can lay the foundation for policies or goals. Through a collaborative effort, staff will be more likely to both support and participate in energy conservation efforts. It is suggested that once the City decides what polices are best suited for them, they be formally adopted by the Board of Commissioners or appropriate authorities. A list of potential policies that could be ratified is listed below (an email to announcing these policies can be found in the Resource CD.

Potential Conservation Policies

- Light Out when Not in Use and Lights Out at Night
- Computers Off at Night
- No Screen Savers and place EPA Recommend Hibernation Setting on all possible Computers
- Double Sided Printing as default
- No personal heaters (allow foot heating pads as an alternative)
- No changing of thermostat temperatures by non-maintenance staff
- No Idling for all (non-emergency) City vehicles
- Policy of Buying Energy Star Equipment whenever possible

## CONSIDER UTILIZING USEPA'S ENERGY STAR "BRING YOUR GREEN TO WORK" RESOURCES

The USEPA's Energy Star Website has many valuable resources for saving energy. The "Bring your Green to Work" initiative provides an all-in-one educational resource for saving energy and protecting the environment (available online at http://www.energystar.gov/index.cfm?fuseaction=bygtw.showSplash).

### CONSIDER TRAINING FACILITY OR DEPARTMENT MANAGERS ON ENERGY EFFICIENCY

A knowledgeable facilities manager can have a tremendous impact on energy use. Training the building operator can yield significant reductions in energy use as well as occupant comfort. For these reasons, it is highly recommended that the facilities manager take a Building Operator Certification course to learn how to more efficiently manage buildings operation (http://www.theboc.info/).

Often the most effective way to convey information to staff is through direct communication. Consider educating department and facility managers on measures that can be taken to increase energy conservation and efficiency in their building. This could begin by reading this action plan and potentially utilizing materials from the Resource CD. Then conservation initiatives or policies could be communicated to fellow employees and instituted in a more direct and personal manner.

### GIVE RECOGNITION/PROVIDE INCENTIVES

Celebrate your successes and recognize those who were involved. Simple recognition to let staff know that their efforts are appreciated can encourage greater participation (draft certificates are included on the Resource CD). Also, consider getting recognition locally by publicizing conservation efforts.

Consider providing incentives to workers for energy conservation. A percentage of the money saved through energy conservation could go to fund a worker appreciation lunch or some other incentive.

## GRANTS, TAX INCENTIVES, AND REBATES

A wealth of tax incentives and rebates have emerged at the Federal, State, and regional level that make implementing energy efficiency and energy conservation measures a smarter investment than ever before. Governments can increase their competitiveness for these grants by establishing a track record of concerted effort and action— including tracking their facility energy usage over time and instituting measures to reduce energy use. It is important to stay abreast of emerging grants and their requirements so that opportunities are not missed. The Database of State Incentives for Renewables and Efficiency is an excellent resource that is updated regularly. It is recommended that this database and others are checked monthly. (http://www.dsireusa.org/). An additional valuable resource for staying current with funding opportunities is the US EPA's State and Local Climate and Energy Program (http://www.epa.gov/statelocalclimate/local/) which hosts an email list-serv that offers updates on funding, training, and resource offerings monthly. To sign up follow the instructions at this site (http://www.epa.gov/statelocalclimate/listservs/index.html). Additional information can be found on the Resource CD.

*Energy-Efficient Commercial Buildings Tax Deduction* - A tax deduction for expenses incurred for energy efficient building expenditures made by a building owner or project designer. In the case of public buildings the tax deduction is applied to the designer. This measure could potentially apply to many energy efficiency measures but will require a designer/installer familiar with this tax credit. The deduction is up to $1.80 per square foot of the property, with allowances for partial deductions for improvements in interior lighting, HVAC and hot water systems, and building envelope systems. This program expires on December 31st, 2013.

*Links:* http://www.lightingtaxdeduction.org/tax_deduction.html and http://www.efficientbuildings.org/

## REVOLVING LOAN FUNDS

Revolving Loan Funds (RLFs) are funds of capital used to provide loans for energy efficiency and renewable energy improvements and the loan repayments recapitalize the funding pool to enable additional lending.

Michigan has an *Energy Efficiency Revolving Loan Fund* that is slated to start providing low cost loans for public energy efficiency projects in November of 2010. Funds are limited so check for availability and try to apply early. Contact the Michigan Department of Labor & Economic Growth at 517-241-6228 for an application, David Binkley is in charge of the fund.

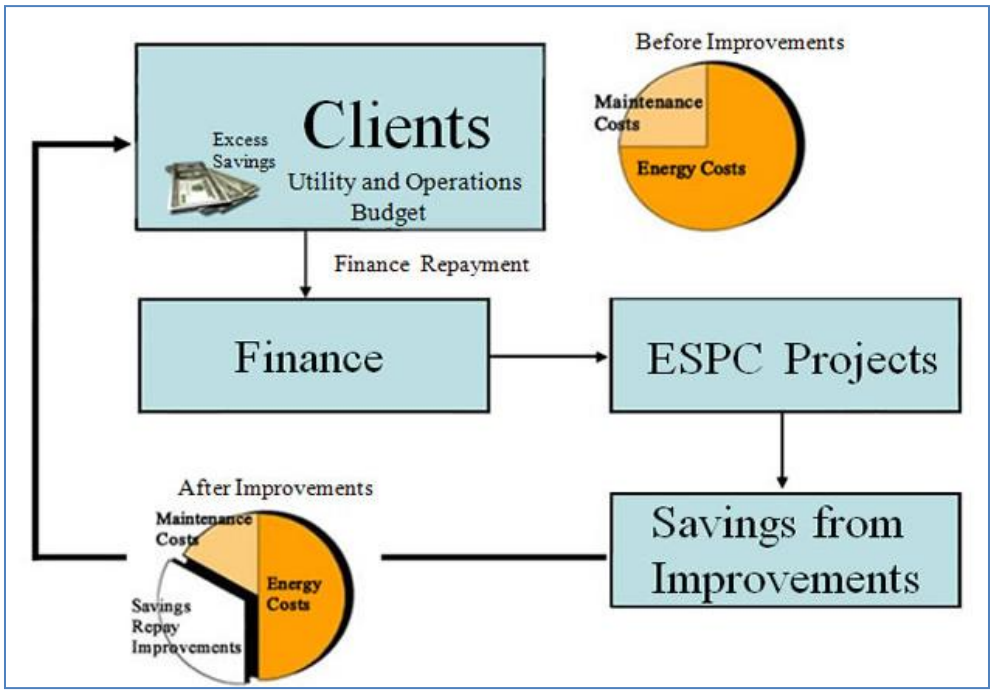
## THIRD PARTY LOANS

Third party lenders are another option for receiving financing. Some local banks may offer loans that could be used for energy projects. As an example, Chemical Bank offers commercial loans that could potentially be used to fund energy projects. They have competitive rates (usually 3-5%) and a term length of 7 years or less. Missaukee County was successful in utilizing loans through Chemical Bank. Contact Chemical Bank for more information.

## ENERGY SAVINGS PERFORMANCE CONTRACTING

An energy performance contract is made with an energy service company (ESCO) or energy service provider (ESP). The ESCO or ESP helps determine a number of energy efficiency improvements that can be made throughout facilities and bundles them together into a single package to be financed through projected energy savings. Using this mechanism, local governments have been able to pay for significant facility improvements completely through energy savings with no initial capital investment. This measure is worth considering if other financing is not available, but caution should be taken to understand the details of the contract before entering in to an agreement. Keep in mind that the ESCO or ESP while offering a valuable service, are operating to make money so one way or another they are charging you for this service. However, as noted in the *Tax Deduction* section above, ESCOs and ESPs may be eligible for tax credits that are not available to local governments creating opportunity for win-win scenarios for both local governments and their ESCOs. Figure 3 shows the process of Energy Performance Contracting (see the Resource CD for more information).

**Figure 4, Energy Performance Contracting Flow Chart**




## LEASE- PURCHASE AGREEMENT

A lease-purchase agreement is yet another financing mechanism that has been successfully employed by local governments. The agreement allows public entities to finance purchases and installation over long-term periods using operating budget dollars rather than capital budget dollars. They are suggested for use when the projected energy savings are greater than the cost of financing the purchase.

## APPENDIX F - OTHER RANKING TABLES

PAYBACK

ANNUAL $ SAVINGS

ANNUAL CO2E REDUCTION

ANNUAL 10YR $/MT CO2E

## Potential $CO_2$ Reduction (Greatest to Least)

| Description of Measure | Potential Reduction CO2e (metric tons) | Potential % of Goal | Annual $ Saved | 10 Year Avg $ per MT CO2e | Payback Period (years) |
|---|---|---|---|---|---|
| Green Electricity Purchase for Government Center | 539.0 | 17.3% | NA | $29 | NA |
| Upgrade Exterior Lighting | 119.5 | 3.8% | $14,216 | -$2 | 9.8 |
| Upgrade all State/City Traffic Signals | 108.1 | 3.5% | $15,693 | $40 | 12.7 |
| Community Water Conservation Initiative (Reduce Use by 5%) | 60.9 | 2.0% | NA | NA | 0.0 |
| Efficient Driving Campaign with Training | 38.7 | 1.2% | $8,601 | -$196 | 0.0 |
| 20% Increase in Recycling | 37.2 | 1.2% | NA | NA | 0.0 |
| Upgrade all Streetlights | 30.0 | 1.0% | $63,725 | $144 | 15.7 |
| HVAC System Retrocommissioning | 26.8 | 0.9% | $3,536 | -$95 | 2.8 |
| Office Resource Conservation Initiative (Reduce Solid Waste 10%) | 26.3 | 0.8% | NA | NA | 0.0 |
| DPS Truck Fleet Change to B20 Biodiesel | 21.5 | 0.7% | NA | $27 | NA |
| Remaining T-12 to T-8 Conversion with DeLamping | 21.4 | 0.7% | $2,550 | -$35 | 7.1 |
| Install Programmable Thermostats or Energy Management Systems | 21.4 | 0.7% | $3,015 | -$126 | 1.1 |
| Ethanol Vehicles | 21.0 | 0.7% | NA | $82 | NA |
| Optimize Interior Lighting with Delamping | 21.0 | 0.7% | $2,498 | -$119 | 0.0 |
| Optimize Exterior Lighting reduce Hours | 19.9 | 0.6% | $2,616 | -$132 | 0.0 |
| Future Potential for Computer Energy Efficient Settings | 19.7 | 0.6% | $2,340 | -$119 | 0.0 |
| Use Smaller Fleet Vehicles | 17.2 | 0.6% | $5,157 | -$300 | 0.0 |
| Reduce Unnecessary Electrical Loads | 13.5 | 0.4% | $1,601 | -$94 | 1.1 |
| Promote Lights Out Policy | 11.8 | 0.4% | $1,407 | -$119 | 0.0 |
| 10kW Solar PV Demonstration Project | 11.0 | 0.4% | $1,597 | $219 | 17.5 |
| Buy Energy Efficient Equipment Policy | 10.9 | 0.3% | $1,293 | -$116 | 0.3 |
| Buy High Efficiency HVAC at Replacement | 10.6 | 0.3% | $1,311 | -$54 | 5.6 |
| Promote Low Carbon Commuter Options | 8.9 | 0.3% | NA | NA | 0.0 |
| Electric Vehicles | 5.4 | 0.2% | $1,137 | -$26 | 8.8 |
| Replace Exit Signs with LEDs | 5.1 | 0.2% | $607 | -$91 | 2.3 |
| Solar Hot Water | 4.8 | 0.2% | $907 | $197 | 20.4 |
| Install Vending Miser on Vending Machines. | 4.7 | 0.2% | $563 | -$104 | 1.2 |
| Use Bikes at on the Job | 4.5 | 0.1% | $1,340 | -$300 | 0.0 |
| Hybrid Vehicles | 3.1 | 0.1% | $765 | -$167 | 3.3 |
| Install Occupancy Sensors | 1.8 | 0.1% | $214 | -$87 | 2.7 |
| Upgrade to High Efficiency Water Heaters | 1.3 | 0.0% | $213 | -$77 | 5.4 |
| **Total of Proposed Measures** | **1246.8** | **40%** | **$136,904** | | |

## Payback Period (Shortest to Longest)

| Description of Measure | Potential Reduction CO2e (metric tons) | Potential % of Goal | Annual $ Saved | 10 Year Avg $ per MT CO2e | Payback Period (years) |
|---|---|---|---|---|---|
| Community Water Conservation Initiative (Reduce Use by 5%) | 60.9 | 2.0% | NA | NA | 0.0 |
| Efficient Driving Campaign with Training | 38.7 | 1.2% | $8,601 | -$196 | 0.0 |
| 20% Increase in Recycling | 37.2 | 1.2% | NA | NA | 0.0 |
| Office Resource Conservation Initiative (Reduce Solid Waste 10%) | 26.3 | 0.8% | NA | NA | 0.0 |
| Optimize Interior Lighting with Delamping | 21.0 | 0.7% | $2,498 | -$119 | 0.0 |
| Optimize Exterior Lighting reduce Hours | 19.9 | 0.6% | $2,616 | -$132 | 0.0 |
| Future Potential for Computer Energy Efficient Settings | 19.7 | 0.6% | $2,340 | -$119 | 0.0 |
| Use Smaller Fleet Vehicles | 17.2 | 0.6% | $5,157 | -$300 | 0.0 |
| Promote Lights Out Policy | 11.8 | 0.4% | $1,407 | -$119 | 0.0 |
| Promote Low Carbon Commuter Options | 8.9 | 0.3% | NA | NA | 0.0 |
| Use Bikes at on the Job | 4.5 | 0.1% | $1,340 | -$300 | 0.0 |
| Buy Energy Efficient Equipment Policy | 10.9 | 0.3% | $1,293 | -$116 | 0.3 |
| Reduce Unnecessary Electrical Loads | 13.5 | 0.4% | $1,601 | -$94 | 1.1 |
| Install Programmable Thermostats or Energy Management Systems | 21.4 | 0.7% | $3,015 | -$126 | 1.1 |
| Install Vending Miser on Vending Machines. | 4.7 | 0.2% | $563 | -$104 | 1.2 |
| Replace Exit Signs with LEDs | 5.1 | 0.2% | $607 | -$91 | 2.3 |
| Install Occupancy Sensors | 1.8 | 0.1% | $214 | -$87 | 2.7 |
| HVAC System Retrocommissioning | 26.8 | 0.9% | $3,536 | -$95 | 2.8 |
| Hybrid Vehicles | 3.1 | 0.1% | $765 | -$167 | 3.3 |
| Upgrade to High Efficiency Water Heaters | 1.3 | 0.0% | $213 | -$77 | 5.4 |
| Buy High Efficiency HVAC at Replacement | 10.6 | 0.3% | $1,311 | -$54 | 5.6 |
| Remaining T-12 to T-8 Conversion with DeLamping | 21.4 | 0.7% | $2,550 | -$35 | 7.1 |
| Electric Vehicles | 5.4 | 0.2% | $1,137 | -$26 | 8.8 |
| Upgrade Exterior Lighting | 119.5 | 3.8% | $14,216 | -$2 | 9.8 |
| Upgrade all State/City Traffic Signals | 108.1 | 3.5% | $15,693 | $40 | 12.7 |
| Upgrade all Streetlights | 30.0 | 1.0% | $63,725 | $144 | 15.7 |
| 10kW Solar PV Demonstration Project | 11.0 | 0.4% | $1,597 | $219 | 17.5 |
| Solar Hot Water | 4.8 | 0.2% | $907 | $197 | 20.4 |
| Green Electricity Purchase for Government Center | 539.0 | 17.3% | NA | $29 | NA |
| DPS Truck Fleet Change to B20 Biodiesel | 21.5 | 0.7% | NA | $27 | NA |
| Ethanol Vehicles | 21.0 | 0.7% | NA | $82 | NA |
| **Total of Proposed Measures** | **1246.8** | **40%** | **$136,904** | | |

## 10 Year Average Annual Cost per Metric Ton $CO_2$ (Least to Greatest)

| Description of Measure | Potential Reduction CO2e (metric tons) | Potential % of Goal | Annual $ Saved | 10 Year Avg $ per MT CO2e | Payback Period (years) |
|---|---|---|---|---|---|
| Use Smaller Fleet Vehicles | 17.2 | 0.6% | $5,157 | -$300 | 0.0 |
| Use Bikes at on the Job | 4.5 | 0.1% | $1,340 | -$300 | 0.0 |
| Efficient Driving Campaign with Training | 38.7 | 1.2% | $8,601 | -$196 | 0.0 |
| Hybrid Vehicles | 3.1 | 0.1% | $765 | -$167 | 3.3 |
| Optimize Exterior Lighting reduce Hours | 19.9 | 0.6% | $2,616 | -$132 | 0.0 |
| Install Programmable Thermostats or Energy Managememt Systems | 21.4 | 0.7% | $3,015 | -$126 | 1.1 |
| Optimize Interior Lighting with Delamping | 21.0 | 0.7% | $2,498 | -$119 | 0.0 |
| Future Potential for Computer Energy Efficient Settings | 19.7 | 0.6% | $2,340 | -$119 | 0.0 |
| Promote Lights Out Policy | 11.8 | 0.4% | $1,407 | -$119 | 0.0 |
| Buy Energy Efficient Equipment Policy | 10.9 | 0.3% | $1,293 | -$116 | 0.3 |
| Install Vending Miser on Vending Machines. | 4.7 | 0.2% | $563 | -$104 | 1.2 |
| HVAC System Retrocommissioning | 26.8 | 0.9% | $3,536 | -$95 | 2.8 |
| Reduce Unnecessary Electrical Loads | 13.5 | 0.4% | $1,601 | -$94 | 1.1 |
| Replace Exit Signs with LEDs | 5.1 | 0.2% | $607 | -$91 | 2.3 |
| Install Occupancy Sensors | 1.8 | 0.1% | $214 | -$87 | 2.7 |
| Upgrade to High Efficiency Water Heaters | 1.3 | 0.0% | $213 | -$77 | 5.4 |
| Buy High Efficiency HVAC at Replacement | 10.6 | 0.3% | $1,311 | -$54 | 5.6 |
| Remaining T-12 to T-8 Conversion with DeLamping | 21.4 | 0.7% | $2,550 | -$35 | 7.1 |
| Electric Vehicles | 5.4 | 0.2% | $1,137 | -$26 | 8.8 |
| Upgrade Exterior Lighting | 119.5 | 3.8% | $14,216 | -$2 | 9.8 |
| DPS Truck Fleet Change to B20 Biodiesel | 21.5 | 0.7% | NA | $27 | NA |
| Green Electricity Purchase for Government Center | 539.0 | 17.3% | NA | $29 | NA |
| Upgrade all State/City Traffic Signals | 108.1 | 3.5% | $15,693 | $40 | 12.7 |
| Ethanol Vehicles | 21.0 | 0.7% | NA | $82 | NA |
| Upgrade all Streetlights | 30.0 | 1.0% | $63,725 | $144 | 15.7 |
| Solar Hot Water | 4.8 | 0.2% | $907 | $197 | 20.4 |
| 10kW Solar PV Demonstration Project | 11.0 | 0.4% | $1,597 | $219 | 17.5 |
| Community Water Conservation Initiative (Reduce Use by 5%) | 60.9 | 2.0% | NA | NA | 0.0 |
| 20% Increase in Recycling | 37.2 | 1.2% | NA | NA | 0.0 |
| Office Resource Conservation Initiative (Reduce Solid Waste 10%) | 26.3 | 0.8% | NA | NA | 0.0 |
| Promote Low Carbon Commuter Options | 8.9 | 0.3% | NA | NA | 0.0 |
| **Total of Proposed Measures** | **1246.8** | **40%** | **$136,904** | | |

## Annual Dollars Saved (Most to Least)

| Description of Measure | Potential Reduction CO2e (metric tons) | Potential % of Goal | Annual $ Saved | 10 Year Avg $ per MT CO2e | Payback Period (years) |
|---|---|---|---|---|---|
| Upgrade all Streetlights | 30.0 | 1.0% | $63,725 | $144 | 15.7 |
| Upgrade all State/City Traffic Signals | 108.1 | 3.5% | $15,693 | $40 | 12.7 |
| Upgrade Exterior Lighting | 119.5 | 3.8% | $14,216 | -$2 | 9.8 |
| Efficient Driving Campaign with Training | 38.7 | 1.2% | $8,601 | -$196 | 0.0 |
| Use Smaller Fleet Vehicles | 17.2 | 0.6% | $5,157 | -$300 | 0.0 |
| HVAC System Retrocommissioning | 26.8 | 0.9% | $3,536 | -$95 | 2.8 |
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| Optimize Interior Lighting with Delamping | 21.0 | 0.7% | $2,498 | -$119 | 0.0 |
| Future Potential for Computer Energy Efficient Settings | 19.7 | 0.6% | $2,340 | -$119 | 0.0 |
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| Buy High Efficiency HVAC at Replacement | 10.6 | 0.3% | $1,311 | -$54 | 5.6 |
| Buy Energy Eficient Equipment Policy | 10.9 | 0.3% | $1,293 | -$116 | 0.3 |
| Electric Vehicles | 5.4 | 0.2% | $1,137 | -$26 | 8.8 |
| Solar Hot Water | 4.8 | 0.2% | $907 | $197 | 20.4 |
| Hybrid Vehicles | 3.1 | 0.1% | $765 | -$167 | 3.3 |
| Replace Exit Signs with LEDs | 5.1 | 0.2% | $607 | -$91 | 2.3 |
| Install Vending Miser on Vending Machines. | 4.7 | 0.2% | $563 | -$104 | 1.2 |
| Install Occupancy Sensors | 1.8 | 0.1% | $214 | -$87 | 2.7 |
| Upgrade to High Efficiency Water Heaters | 1.3 | 0.0% | $213 | -$77 | 5.4 |
| Green Electricity Purchase for Government Center | 539.0 | 17.3% | NA | $29 | NA |
| Community Water Conservation Initiative (Reduce Use by 5%) | 60.9 | 2.0% | NA | NA | 0.0 |
| 20% Increase in Recycling | 37.2 | 1.2% | NA | NA | 0.0 |
| Office Resourse Conservation Initiative (Reduce Solid Waste 10%) | 26.3 | 0.8% | NA | NA | 0.0 |
| DPS Truck Fleet Change to B20 Biodiesel | 21.5 | 0.7% | NA | $27 | NA |
| Ethanol Vehicles | 21.0 | 0.7% | NA | $82 | NA |
| Promote Low Carbon Commuter Options | 8.9 | 0.3% | NA | NA | 0.0 |
| **Total of Proposed Measures** | **1246.8** | **40%** | **$136,904** | | |

## RESOURCE CD