PUBLIC WORKS AND UTILITIES COMMITTEE

11-0359R

RESOLUTION ENDORSING THE DULUTH CITY OPERATIONS ENERGY ACTION PLAN FOR YEARS 2011-2015 TO REDUCE ENERGY AND RESOURCE USE IN CITY OPERATIONS.

BY COUNCILOR HARTMAN:

WHEREAS, the city of Duluth has pledged to take a leadership role in increasing energy efficiency and reducing greenhouse gas emissions from municipal operations (Resolution 01-0350); and

WHEREAS, the city recognizes the need to reduce dependency on fossil fuel based energy sources; and

WHEREAS, the city wants to demonstrate that energy efficiency and conservation practices can be applied to the daily government operations and infrastructure projects; and

WHEREAS, the city seeks to find methods of service delivery and operations that conserve energy and resources, reduce use of unsustainable energy resources, saving taxpayer dollars and protecting and preserving the environment; and

WHEREAS, the city recognizes that sound energy efficiency and conservation practice can reduce government costs over the long term; and

WHEREAS, Minnesota Power and Comfort Systems offer rebates and incentives to encourage the city to deliver energy efficiency.

NOW, THEREFORE BE IT RESOLVED, that the city council of the city of Duluth endorses the Duluth City Operations Energy Action Plan for Years 2011-2015, substantially the same as that on file in the office of the city clerk as Public

Document No. _____, to pursue reductions in energy and resource use in city operations and practices.

Approved as to form:

Attorney

CCREQ/ATTY GBJ:dma 06/28/2011

STATEMENT OF PURPOSE: This resolution endorses the Duluth City Operations Energy Action Plan for Years 2011-2015 to achieve the following target reductions in energy and resource use and GHG emissions from 2008 levels in existing buildings, new buildings, decorative street lights, operating practices, water, landfill waste, and in transportation:

Energy in Existing Building Stock - Reduce combined energy use from electricity, natural gas and steam in audited City buildings and facilities by 15% by December 31, 2015.

Energy in New Building Stock - Adopt LEED®-NC new construction standards, except energy standards (certification not required), combined with a higher energy efficiency standard for new municipal buildings by June 30, 2013.

Energy in Street Lights - Reduce energy use for decorative street lighting by 15% by June 30, 2015.

Energy in Street Signals - Improve vehicle travel times by continuing the signal timing optimization program and by efficient signal placements and lamp replacements.

Operating Best Practices - Reduce overall energy use from operations (other than building measures such as lights and heating equipment) by 5% by June 30, 2015.

Procurement - Adopt energy related environmentally preferable purchasing (EPP) or green purchasing standards for products and services by December 31, 2012.

- Increase use of recycled content materials as an indirect way to reduce energy use.

Water - Implement water conservation measures and equipment and piping replacements to City-owned facilities to reduce water use and treatment costs for waste water.

Waste - Reduce waster generated from City operations by 10% per year from 2012 volumes by December 31, 2013.

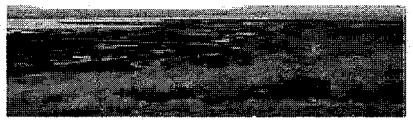
- Increase volume of materials recycled by 20% from 2011 volumes by December 31, 2013.

Transportation - Increase Class 1 vehicles' (cars and light trucks) and Class 2 vehicles' average fleet MPG by 15% by June 30, 2015.

- Reduce gallons of gasoline used by City fleet vehicles by 12% by June 30, 2014.

- Reduce gallons of diesel fuel used by City fleet vehicles by 10% by June 30, 2015.

- Decrease total on-the-job vehicle miles traveled by City employees by at least 10% by June 30, 2015.



PROPOSED

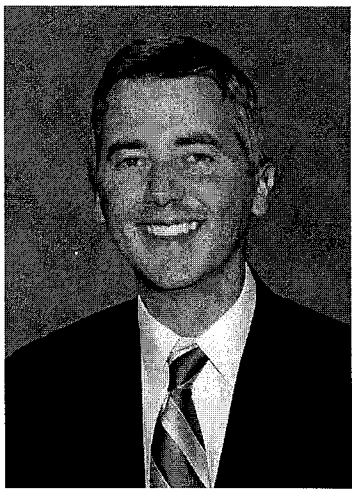
Duluth – City Operations

ENERGY ACTION PLAN

2011 - 2015

June 2011

A letter from the Mayor



April 22, 2011

Dear Citizens of the City of Duluth:

I would like to take this opportunity to thank the members of the Energy Action Plan Work Group—along with City staff—who participated in the development of this Duluth City Operations Energy Action Plan.

Increasing costs for energy present the City of Duluth with a tremendous challenge, at a time when we are already experiencing substantial budgetary constraints. This energy action plan offers an opportunity for us to lower our operating costs for purchased energy, including electricity, natural gas, steam, water, gasoline, and diesel fuel. The Plan also identifies strategies and actions that City operating departments will implement to reduce our environmental impact.

The Plan clearly lays out reduction targets for energy use over the course of the five-year period 2011 through 2015. The Plan details investments in energy efficiency and energy conservation strategies that will save energy, reduce energy costs, and reduce greenhouse gas emissions over time. The investments in energy efficiency will translate into work opportunities for community and regional trades, professional engineers, contractors as well as lighting and equipment vendors.

We are moving forward on our journey to sustainable government.

Ultimately, of course, the City can't achieve the results we are looking for on our own. All of us will have to work together to make Duluth sustainable and more resilient. I appreciate all the work that already has been done, and I look forward to engaging our community on this topic as we work to make a stronger and greener Duluth.

Sincerely,

Don Ness
Mayor

Table of Contents

Summary Call to Action 4

Background Information 4

Summary Conclusion 7

Energy Action Plan Framework Development 7

City Operations Energy Action Plan Work Group & Contributors 9

Energy Action Plan Targets for 2011 – 2015 10

Energy Action Plan Targets, Strategies & Actions

Energy -Existing Buildings 11-13

New Buildings 14

Street Lights 15

Street Signals 16

Operating Best Practices 17-18

Procurement Policies 19

Water 20

Waste 21

Transportation 22-23

Long-range Transportation Planning Activities 24

Summary – Goals, Strategies & Actions 25-28

Appendices 29

Appendix 1 2008 Electric Energy Use in City Operations
Appendix 2 Life Cycle Cost Analysis for Buildings
Appendix 3 Considerations for Renewable Energy
Appendix 4 Duluth Authorities – Energy Management Accomplishments
Appendix 5 Glossary of Terms & Related Links

Summary Call to Action

This energy action plan is a 5-year plan to achieve direct and indirect energy use reductions in City operations. Reducing energy use will reduce energy costs borne by the City and will effectively reduce greenhouse gas emissions. The time to act cannot be delayed. The City is incurring cost increases on a weekly basis for oil derived products like gasoline that fuels our fleet vehicles and oil derived products that become part of the cost of materials and services that the City purchases. The insatiable world-wide demand for oil and current market speculation is driving higher prices in the cost of materials and services used to provide government services to Duluth's residents and businesses. Energy cost instability is driving increased costs in our national, regional and local economies. We know from experience that to achieve measurable reductions in energy use and the resulting reductions in operating costs and greenhouse gas emissions, we must set bold targets and set specific dates to achieve those targets. Duluth, like every other city in the United States, must reduce dependency on fossil fuel energy sources.

Implementing the Duluth City Operations Energy Action Plan is an important step toward community-wide development of a local action plan to address energy, emissions and sustainability.

Background Information

A decade ago, the Duluth City Council resolved to reduce green house gas emissions. In May 2001, Councilors Ness and Stewart introduced Resolution 0350, Pledging Cooperation of The City of Duluth to Reduce Greenhouse Gas Emissions. The resolution recognized:
...that energy consumption, specifically the burning of fossil fuels, coal, oil and gas, accounts for more than 80% of US greenhouse gas emissions;
...that local governments greatly influence their community's energy use by exercising key powers over land use, transportation, building construction waste management and, in many cases, energy supply management, and
...that local government actions taken to reduce GHG emissions and increase energy efficiency provide multiple benefits by decreasing air pollution, creating jobs, reducing energy expenditures and saving money for the city government, its businesses and its citizens.....

On May 4, 2001, the Duluth City Council Adopted Resolution 01-0350:

BE IT RESOLVED, that the City of Duluth pledges to join with jurisdictions from all over the world in the cities for climate protection campaign and, as a participant in the Cities for Climate Protection campaign, Duluth pledges to:

- Take a leadership role in increasing energy efficiency and reducing greenhouse gas emissions from municipal operations;
- Develop and implement a local action plan which describes the steps our community will take to reduce both greenhouse gas and air pollution emissions. The plan will include:

1. A greenhouse gas emissions analysis and forecast to determine the source and quantity of greenhouse gas emissions within the jurisdiction;

2. A carbon dioxide or greenhouse gas emissions reduction target;

3. The strategy for meeting Duluth's GHG reduction target, including outline of the programs and measures to be implemented to achieve the target.

The City of Duluth has completed two of the three plan milestones identified in Resolution 0350:

√ Community-wide GHG emission analysis and inventories have been reported for years 1999 (2001 report) and 2008, and City operations GHG emissions have been reported for years 1996 (2001 report) and 2008.

√ In 2002, the CCP advisory committee set a 20% Reduction in GHG emissions from 2001 levels by 2020.

Achieving the third milestone to develop and implement a local action plan that presents a strategy for meeting Duluth's GHG reduction target has taken a slower path and remains to be completed. During the years 2002 to 2010, energy saving measures were incorporated in projects, photovoltaic solar arrays were installed at the Duluth Main Library and at the Duluth Zoo, alternative transportation vehicles were purchased, and other energy saving activities were conducted. Implementation of the 2011 Duluth City Operations Energy Action Plan is a giant step that will lead to development of a Duluth community-wide action plan.

√ In 2011 – a Duluth City Operations Energy Action Plan for 2011 - 2015 is developed.

During the decade since adopting Resolution 0350, other supporting resolutions have been adopted by the City Council.

Duluth Joined ICLEI in 2001, forms CCP committee and Measures Greenhouse Gas Emissions

Following adoption of Resolution 01-350 in 2001, the City of Duluth joined the US ICLEI, Local Governments for Sustainability, organization, and the Mayor formed a Citizens for Climate Protection Advisory Committee (CCP).

In 2001, City staff conducted a baseline inventory of Year 1999 emissions for the community and Year 1996 emissions for City operations, Figure 1. The resulting 2001 GHG Baseline Inventory Report also included a 36% projected increase in greenhouse gas emissions by Year 2020 if no reduction interventions were made to reduce the emissions -- in other words, a business as usual scenario.

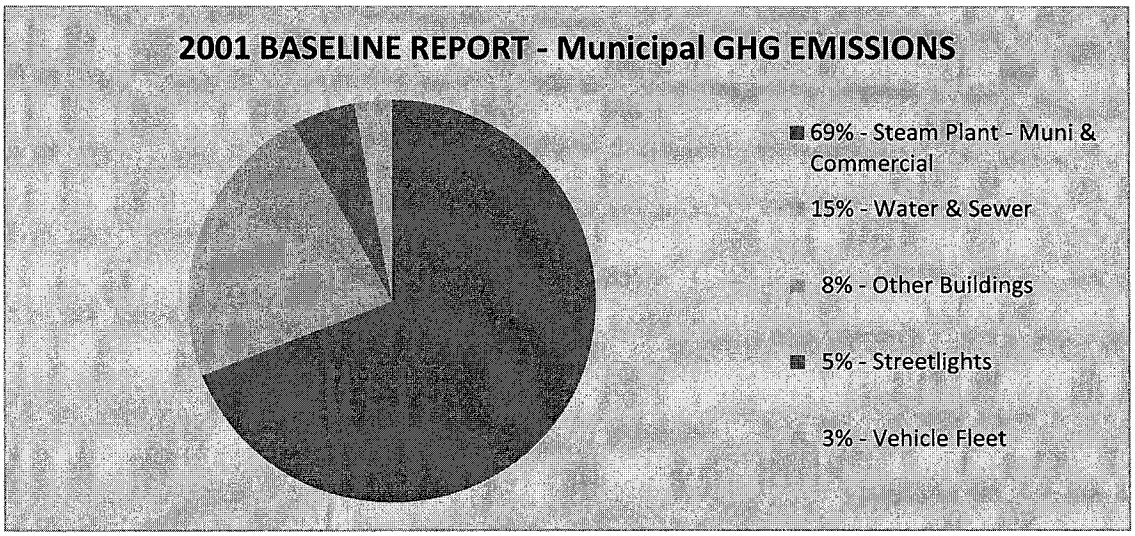


Figure 1: 2001 Baseline (1996) City Operations GHG Emissions

The CCP advisory committee established a target to reduce GHG emissions by 20% from 2001 levels by Year 2020. Over the decade, City staff has implemented energy saving measures and the CCP advisory committee has functioned as a clearinghouse and as a resource for City staff, meeting monthly to recommend and advance energy saving and greenhouse reduction projects.

In 2008-2009, the CCP advisory committee recommended that a second GHG inventory was needed to determine where the Community and City operations were in terms of greenhouse gas emissions. The 2008 GHG Inventory revealed that GHG emissions had increased by 16% overall in the community and increased by 22% in City operations and owned facilities, Figure 2, including the Duluth Steam Plant, Figure 3.

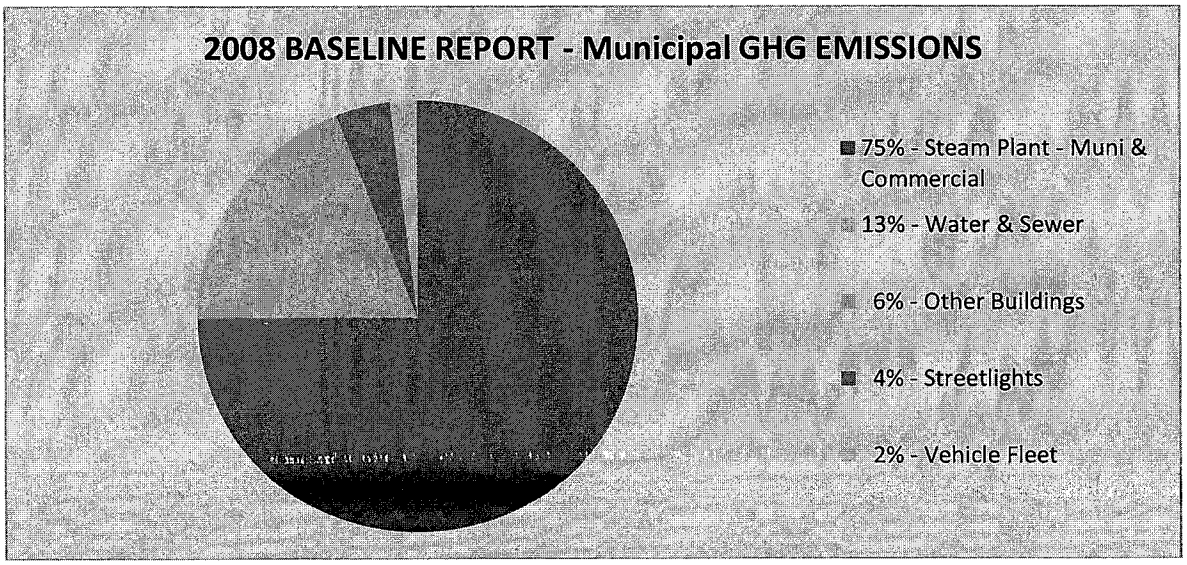


Figure 2: 2008 Baseline City Operations GHG Emission

GHG Emissions from the Duluth Steam Plant for the two periods are presented in Figure 3 below. Emissions increased by 34% between 1996 and 2008. The Steam Plant serves over 200 commercial buildings in Duluth's downtown district and currently serves 4 City-owned buildings and a City-owned parking ramp: City Hall, Fire Station #1, Main Library, Washington Center, and Tech Village Parking Ramp.

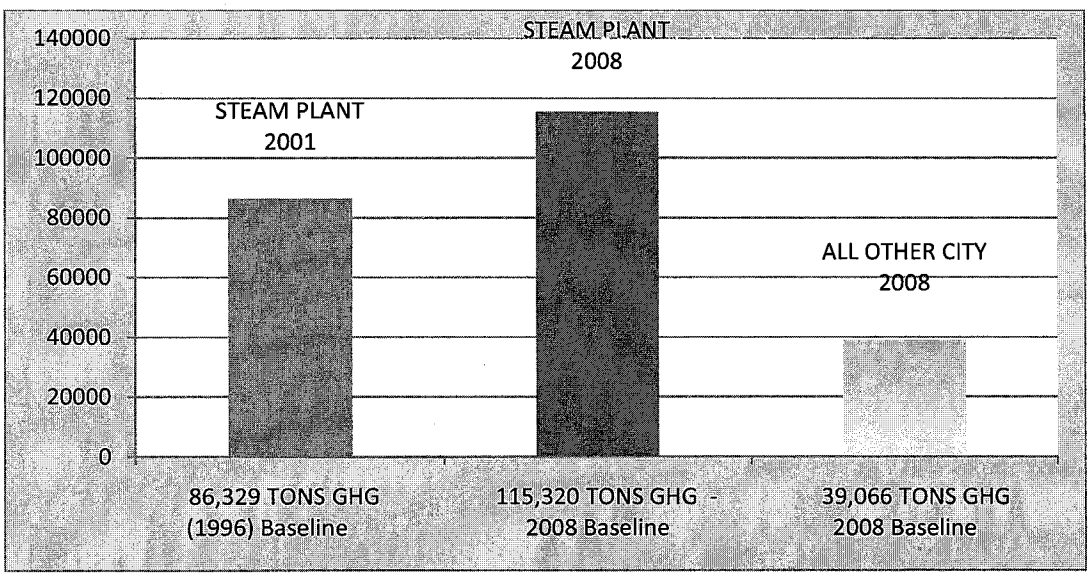


Figure 3: Steam Plant vs. All Other City Operations GHG Emissions

While the physical steam plant is owned by the City of Duluth, it is excluded from the energy action plan for City operations because it is organized as a cooperative form of business and governed by a board of members who are customers of the cooperative.

Summary Conclusion

A common purpose and comprehensive, department-wide City operations energy action plan is needed to achieve energy use reduction targets going forward. The development of the first, 5-Year City Operations Energy Action Plan in 2011 and the continual refinement, plan implementation monitoring, data collection and reporting is needed to keep the energy use reductions and resulting greenhouse gas reductions on target.

Energy Action Plan Framework Development

The City Operations Energy Action Plan declares implementation target dates for reduction measures and, for budgeting purposes, identifies required investments and estimated annual cost savings for major strategies and actions where available. City staff will need to further evaluate the recommended strategies and actions and implement them as feasible to achieve energy savings. Additional strategies and actions will need to be determined as conditions and technologies change to achieve savings by the target dates. City staff will present more specific cost-benefit analysis to City Council before major implementations.

A City Operations Energy Action Working Group (Energy Team) was formed in January 2011 to develop the action plan and to assist in plan implementation and monitoring. The energy team is comprised of City

department representatives and representatives from three of the City authorities: the Duluth Airport Authority, the Duluth Entertainment & Convention Center (DECC), and Spirit Mountain. Team members reviewed best practices identified in action plans developed by other cities including Ely's Energy Action Plan adopted in December 2010, Seattle's Climate Action Plan adopted in September 2006, and Grand Rapids, Michigan's FY 2011 - FY 2015 Sustainability Plan adopted in June 2010. These three plans and other city and county plans, including the September 2009 Dakota County Energy Efficiency and greenhouse Gas Emissions Reduction Report, provided substantial guidance, strategies and targets to consider and incorporate into the Duluth City Operations Energy Action Plan development.

An **Energy Action Plan (EAP)** is part of a climate action plan and a broader, more comprehensive sustainability plan (Figure 4). The City Operations Energy Action Plan will become part of a more comprehensive sustainability plan for City operations at a future date.

A **Climate Action Plan (CAP)** is a set of strategies intended to guide community efforts for reducing GHG emissions known to contribute to climate change, to conserve energy and other natural resources, and to prepare the community for the expected effects of global warming.

A **Sustainability Plan** is a more comprehensive plan that seeks to ensure a city can continue to meet its current and ongoing environmental, social, and economic needs without compromising the future for succeeding generations.

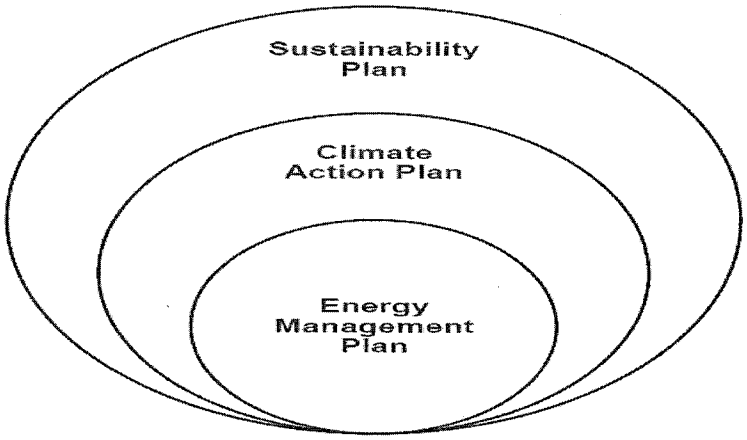


Figure 4: An energy action plan is part of a climate action plan and a sustainability plan.

The City Operations Energy Action Plan for 2011 – 2015 is an action plan to ensure a systematic process to implement energy saving and performance measures. The action plan is to be regularly updated, most often on an annual basis to reflect current achievements and changes in plan activities.

City Operations Energy Action Work Group Team Members

Terri Fitzgibbons	Administration, Business & Community Development
Adele Hartwick	Finance
Carla Powers	Public Administration -- Library
DyAnn Andybur	Public Administration
Sgt. Sharon Montgomery	Police Department
Eric Schlacks	Public Works & Utilities
Blaine Peterson	Duluth Airport Authority
Chelly Townsend	Duluth Entertainment & Convention Center
Gretchen Ransom	Spirit Mountain

To develop the energy action plan, we assessed proposed actions using three main criteria: potential for reducing energy use and global warming pollution; overall feasibility; and catalytic potential – that is, the likelihood that the action would produce multiple benefits in Duluth's city operations, and the likelihood that it would accelerate action by community-wide business and organizations.

In developing our recommendations, we: scanned the horizon for best practices and good ideas, discussed targets and strategies with department representatives, and reviewed the best available information.

Energy Action Plan Contributors:

Brad Wick	Police Operations
Kelly Fleissner	Operations & Maintenance Division
Arlen Bordenkircher	Fleet Services
John McIntyre	Fleet Services
Collin Hillman	Fleet Services
Jenn Moses	Urban Development
Cindy Voigt	Engineering
Dennis Sears	Purchasing Department
Terry Groshong	City Architect/Facilities Management
Tari Rayala	Facilities Management
Earl Stewart	Traffic Operations Department
Chris Kleist	Public Works & Utilities
Nan Stubenvoll	Sustainable Twin Ports
Dean Talbott	CCP, Duluth DEEP Program
Deanne Roquet	CCP, Lake Superior College
Dan Russell	DECC
Jim Heilig	Duluth Transit Authority

Energy Action Plan Targets for 2011 – 2015

Energy reduction targets and dates to reduce energy use and GHG emissions from 2008 levels:

Energy

Existing Building Stock - Reduce combined energy use from electricity, natural gas and steam in audited City buildings and facilities by 15% by December 31, 2015.

New Building Stock - Adopt LEED®-NC new construction standards, except energy standards, (certification not required) combined with a higher energy efficiency standard for new municipal buildings by June 30, 2013.

Street Lights - Reduce energy use for decorative street lighting by 15% by June 30, 2015.

Street Signals - Improve vehicle travel times by continuing the signal timing optimization program and by efficient signal placements and lamp replacements.

Operating Best Practices - Reduce overall energy use from operations (other than building measures such as lights and heating equipment) by 5% by June 30, 2015.

Procurement - Adopt energy related environmentally preferable purchasing (EPP) or green purchasing standards for products and services by December 31, 2012.

- Increase use of recycled content materials as an indirect way to reduce energy use.

Water - Implement water conservation measures and equipment and piping replacements to City-owned facilities to reduce water use and treatment costs for waste water.

Waste - Reduce waste generated from City operations by 10% per year from 2012 volumes by December 31, 2013.

- Increase volume of materials recycled by 20% from 2011 volumes by December 31, 2013.

Transportation – Increase Class 1 vehicles (cars & light trucks) and Class 2 vehicles Average Fleet MPG by 15% by June 30, 2015.

- Reduce gallons of gasoline used by City fleet vehicles by 12% by June 30, 2014.
- Reduce gallons of diesel fuel used by City fleet vehicles by 10% by June 30, 2015.
- Decrease total on-the-job vehicle miles traveled by City employees by at least 10% by June 30, 2015.

Long-range Transportation Planning Activities

By December 31, 2012, conduct feasibility studies for a new line of Compressed Natural Gas (CNG) fleet vehicles, for electric vehicles and for use of Biofuels to replace or augment fossil fuel use.

ENERGY - EXISTING BUILDING STOCK

Nationally, buildings are the single largest source of energy use and source of greenhouse gas emissions, followed by street lighting and signals.

For the City of Duluth, implementing energy efficiency measures in existing buildings and facilities represents a substantial opportunity for energy savings and greenhouse gas reduction within City government operations.

Added benefit of greening the buildings

Any project that can generate savings possesses a unique opportunity to include and pay for a broad range of sustainability initiatives as part of the project.

Actions already taken or in progress:

B3 Benchmarking

In 2009, The City contracted with Minnesota Resource Conservation Inc. (MRC) to complete the State of Minnesota B3 energy benchmarking that required all municipalities in Minnesota to input historical energy usage for all buildings over 5,000 square feet in size into an on-line database called the B3 Benchmarking Database. The B3 Energy Benchmark program uses an Energy Use Intensity (EUI), typically expressed in units of energy consumption per floor area per year, expressly, Btu/Square Foot/Year. The on-line benchmarking software can be used to track energy use, costs, and carbon dioxide on an ongoing basis to measure the performance of a building or group of buildings month to month or year to year.

Building & Facility Energy Audits and Energy Measure Recommendations

In 2010, the City took a further step to measure and document building energy use by designating part of the American Recovery and Reinvestment Act (ARRA) funded Energy Efficiency and Conservation Block Grant (EECBG) program grant to contract energy audits for 86 City buildings and facilities. The energy audits were completed by mid-December 2010 when individual energy assessment reports for each building and an accompanying file of all recommended energy measures were submitted to the City's Energy Coordinator.

Over 700 individual energy measures were recommended for the 86 buildings and facilities. The following table provides a summary of potential energy savings indicated in the reports.

City of Duluth Energy Assessment Summary		
Date:	December 22, 2010	
Total Gas Usage	352,835	Therms
Total Electric Usage	20,763,011	kWh
Total Steam Usage	9,292,000	Pounds
Total Fuel Oil Usage	1,004	Gallons
Total Water Usage	37,922	CCF
Total Potential Gas Savings	157,637	Therms
Total Potential Electric Savings	4,216,024	kWh
Total Potential Steam Savings	1,775,501	Pounds
Total Potential Fuel Oil Savings	231	Gallons
Total Potential Propane Savings	54	Gallons
Total Potential Water Savings	8,986	CCF
Total Energy Savings	28%	
Total Water Savings	24%	
Potential Carbon Credits	$22,130	

The energy assessment summary indicates that implementing the recommended energy saving measures could save as much as 28% annually of the combined energy used from electricity, natural gas, water, and steam, based on energy use for the 12 month period, June 2009 – May 2010, and would reduce GHG emissions by the equivalent of 5,532 Tons of CO2, as detailed in Figure 5. The 28% reduction is not wholly achievable, however, because the total energy savings indicated is a sum of all calculated energy savings for each of the individual

Greenhouse Gas Savings			
Description	Units	US Tons CO2	Equivalent Homes
Electricity (kWh)	4,216,024	3,337	367
Gas (Therms)	157,637	788	87
Steam (Pounds)	1,775,501	1,405	155
Oil (Gallons)	231	2	0
Total		5,532	609

Figure 5: Energy Assessment Summary of GHG Savings

energy measures recommended for the individual buildings and facilities. Installation of any one measure could impact energy savings for a different measure, for example, the combined energy savings would be lower if walls are insulated (one recommendation) and a furnace is installed (another recommendation) in a building. This means that the actual achievable energy savings will depend on the combination of measures installed and will most likely be lower than the sum of individual savings measures when several energy measures are combined at implementation.

Energy Action Plan - EXISTING BUILDINGS

Goals & Target Dates

• Reduce combined energy use from electricity, natural gas, steam, and water in audited City buildings and facilities by 15% by December 31, 2015.

- Required 5-Year energy efficiency measure investment: $2,500,000
- Estimated Annual Cost Savings: $440,000

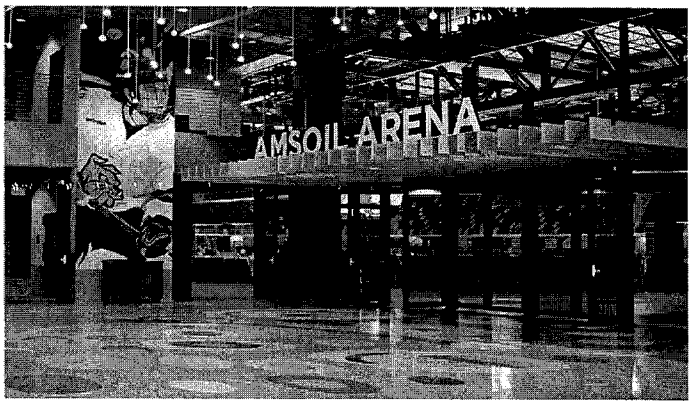
Strategies & Action Steps:	City Investment	Est. Annual Cost Savings
• Develop and implement a 5-Year plan to install energy efficiency measures in buildings and facilities to meet the targeted savings by December 31, 2015. • Discuss energy measures with building and facility occupants. • Complete recommended annual energy saving operating tasks. • Install energy efficiency lighting, controls, HVAC, ventilation, motors, and drive equipment, building envelope and water saving measures. • Apply for all qualifying utility rebates.	$2,330,000	$410,000
• Incorporate energy saving operating practices in facility operations by June 30, 2011. • Setback thermostats temperatures in unoccupied facilities.		
• Conduct an internal review of Building Design & Construction Standards recommended by City Architect and adopt the codes by December 31, 2011.		
• Install Energy Management System or convert pneumatic building controls to digital controls in 4 City owned and operated buildings by December 31, 2014.	$170,000	$30,000
• Provide Building Operator Certification (BOC) training to 4 building operations and maintenance staff members who operate the buildings by December 31, 2014.	$8,000	$40,000
• Accelerate tree planting by 200 additional trees per year near City owned buildings to promote shade in the summer and to provide tree-stand wind breaks by June 30, 2012.		

How we will measure our progress

• Track measures and dates implemented, cost to implement, energy savings and cost savings.

• Calculate, compare, and report electricity, gas, and steam use for each full year following major energy measures are implemented in a facility as compared to baseline year 2008.

Energy Action Plan - NEW BUILDINGS



Green building projects that are well integrated and are comprehensive in scope can result in lower or neutral project development costs.

The Duluth Entertainment Convention Center (DECC) AMSOIL Arena is one of three new City-owned buildings in Duluth designed to meet higher energy efficiency standards.

Actions already taken or in progress

The new AMSOIL Arena will be certified LEED® Silver. The Duluth Airport Authority is constructing a new Duluth International Airport terminal to achieve higher energy efficiency and near LEED® silver standards. The new City of Duluth Police headquarters scheduled for completion in 2011 will meet energy efficiency standards that are much higher than the state building code standards.

ENERGY – New Buildings - Goal & Target Dates

• Adopt LEED®-NC new construction standards, except energy standards, (certification not required) combined with a higher energy efficiency standard for new municipal buildings by June 30, 2013.

Strategies & Action Steps:	Added Investment	Est. Annual Cost Savings
• Adopt LEED®-NC new construction standards for new buildings with the exception of energy efficiency standards, and select and adopt higher energy efficiency standards, such as: Passive House Standards for North American climate zones, or other higher energy standards to achieve optimum energy efficiency by June 30, 2013.		
• Replace 2 end-of-life high energy use municipal buildings with net zero energy use buildings by June 30, 2014. Evaluate based on life cycle cost savings.	$50,000	

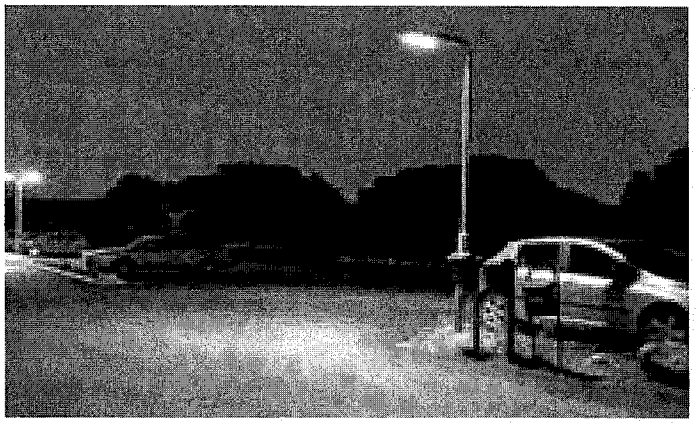
How we will measure our progress

• Complete LEED®-NC for New Construction Project checklist for new buildings.

• Document energy efficiency measures included in construction, compared to Passive House for US energy standards, track costs to implement, energy savings and life cycle cost savings.

• Record and report electricity, gas, and steam use for each new building for each year full year of operation through 2015.

Energy Action Plan - STREET LIGHTS



The street light in this photo directs the light downward, with no loss of light to the sky. Human-produced light pollution not only mars our view of the stars, poor lighting disrupts ecosystems, affects human circadian rhythms, and wastes energy to the tune of $2.2 billion per year in the U.S. alone, according to the International Dark-Sky Association.

Overhead and decorative street lights consumed over 8% of the City operations electric energy in 2008. Reducing or eliminating light pollution will also provide energy savings and cost saving benefits.

Actions already taken or in progress:

LED lights were installed on East 4th Street at Whole Foods Coop as a demonstration site, and LED luminaires will be installed at MN Power Plaza in April, 2011. Parking lights at Duluth International Airport are dimmed by 50% every night from midnight to 3:30 AM.

ENERGY – Street Lights - Goals & Target Dates

• Reduce energy use for decorative street lighting by 15% by June 30, 2015.

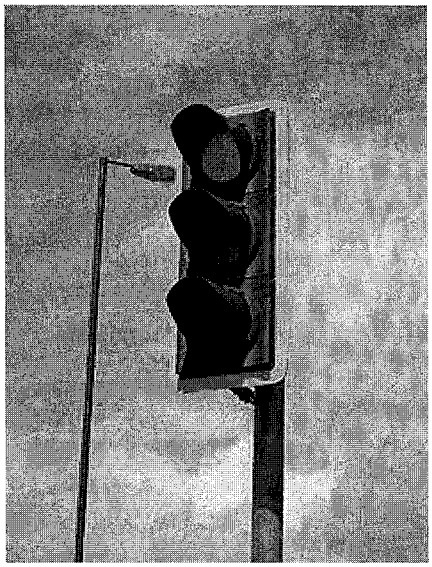
Strategies & Action Steps:	Added Investment	Est. Annual Cost Savings
• Replace 200 decorative 2-lamp 100 watt high pressure sodium lamps with LED single or double lamp decorative luminaires by December 31, 2013.	to be determined	
• Reduce the number of evening hours that decorative street lights are on by 5% by December 31, 2012.	0	$ 20,000

How we will measure our progress

• Document lamp replacements.

• Record and report electric use for decorative street lights for 2010 through 2015 compared to 2008 baseline.

Energy Action Plan - STREET SIGNALS



In 2004 and 2005, the majority of the City's incandescent green traffic signal lights were replaced with high efficiency LED lights, estimated to save 362,015 kWh of electricity annually. LED traffic signals have a very long life, as high as 7 to 10 years, reducing operating costs to maintain and replace lamps. LED signals are also brighter compared to incandescent traffic signals, which enhances intersection safety.

Actions already taken or in progress:

In 2011, the Duluth Traffic Operations Division installed the first flashing yellow left-turn signal in Duluth at the intersection of Trinity Road and Mall Drive. The division also utilizes a continuous signal timing optimization program to create vehicle traffic efficiencies. Department staff uses Synchro traffic simulation software to develop signal timing plans and to perform signal optimization. Signal optimization reduces fuel consumption and emissions, and improves vehicle travel times, transportation safety, and mobility without additional capital investment.

ENERGY – Street Signals - Goals & Target Dates

• Improve vehicle travel times by continuing the signal timing optimization program and by efficient signal placements and lamp replacements.

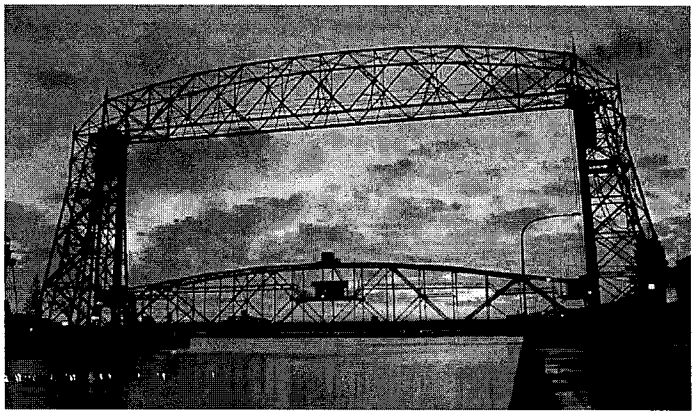
Strategies & Action Steps:

- Continue signal timing optimization planning and program.
    - Optimize signals in the Mall area in 2011.
    - Optimize signals in the 21st Ave. East corridor through Woodland by June 30, 2012.

How we will measure our progress

- Document and track measures implemented.
- Record and report electric use for street signal lights for years 2010 through 2015 compared to 2008 baseline.

Energy Action Plan - OPERATING BEST PRACTICES



The City's landmark Aerial Lift Bridge is a beautiful sight with what appears to be minimal artifical lighting when this photo was taken.

The most valuable kilowatt hour is the one we never use. That is a beneficial way to think about the pay-off of making our offices and operations more energy efficient. Every dollar we save on the City's utility bills benefits our City as a whole.

Actions already taken or in progress:

In 2010, the Public Utilities & Utilities Department replaced pumps and motors with energy efficient models and installed variable frequency drives. These measures will reduce electric energy use by an estimated 568,212 kWh per year. In 2011, the City's MIS Department replaced physical computer servers with virtual servers. The server change and space consolidation were projected to save 1,142.7 MMBtu annually with an estimated reduction in CO_2 emissions of 258.2 metric tons. The MIS Department is also replacing CRT monitors with more energy efficient LCD screens and older computers with more efficient laptop and desktop computers.

ENERGY – Operating Practices - Goals & Target Dates

• Reduce overall energy use from operations (other than building measures such as lights and heating equipment) by 5% by June 30, 2015.

Strategies & Action Steps:	Added Cost	Est. Annual Cost Savings
• Provide energy efficiency and conservation information and training to all City employees by December 31, 2012, and to new employees within 30 days of hire by December 31, 2011.	0	
• Conduct department and staff division meetings to identify energy conservation strategies and include energy planning in business plans by December 31, 2011.	0	
Install computer software to automatically shut down computers at night and over weekends by June 30, 2012.	$20,000	$5,000
Replace 200 desktop computers with EPEAT® registered, Gold rated desktops or notebook computers by December 31, 2014. Products registered in EPEAT must meet 23 required environmental performance criteria.	$20,000	$5,000

Connect 200 computers to surge protector power strips that will shut off all connected equipment when computer is shut off at night to reduce phantom load energy use by 20% by June 30, 2011.	$ 5,000	$5,000

Additional Strategies & Action Steps:

• Reduce the use of gas-powered lawn mowers and other equipment by 20% by December 31, 2012.

• Replace 10 acres of mowed grass with low maintenance landscaping materials such as prairie grass in parks and other City-owned and maintained public areas by December 31, 2014.

• Perform compressed air leak study and implement measures that will achieve positive return on investment in 10 years or less by December 31, 2015.

• Require Energy Star or higher rated appliances in all City-owned buildings by June 30, 2011. Remove pre-1985 model year refrigerators by December 31, 2011.

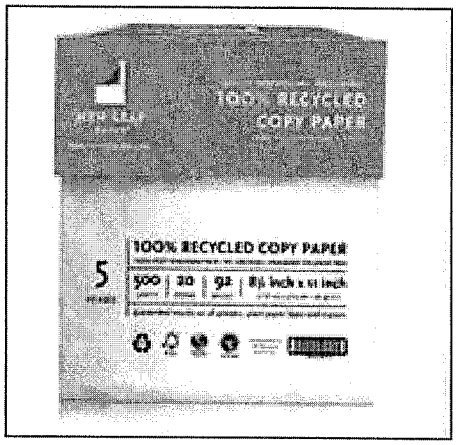
• Require that all incandescent light bulbs will be replaced with high efficiency CFL or LED bulbs and prohibit the use of incandescent bulbs, unless the occupant can substantiate the need for the high wattage bulbs, i.e., use at certain Zoo locations to provide heat for animals, by June 30, 2012.

• Increase use of on-line services for residents and utility customers to reduce driving requirements.

How we will measure our progress

•Document, track, and report measures implemented.

Energy Action Plan – PROCUREMENT POLICIES



Purchasing decisions can have a substantial impact on overall and indirect energy costs. Purchasing from manufacturers of commodities used and procured as near to Duluth as possible can reduce indirect transportation costs, and purchasing green or more environmentally friendly products can support local vendors and often helps recycling programs by creating markets.

Basically, using recycled paper saves water in the manufacturing process - recycled paper uses much less water to be manufactured than paper from trees.

Actions already taken or in progress

The Finance Department sells reusable City equipment and furniture, according to procedures established by code and state statute. Paper with up to 50% recycle content is purchased for some departments. The City purchases Energy Star rated equipment and has incorporated energy efficient construction practices in procurement contracts.

PROCUREMENT - Goals & Target Dates

• Adopt energy related environmentally preferable purchasing (EPP) or green purchasing standards for products and services by December 31, 2012.

• Increase use of recycled content materials as an indirect way to reduce energy use.

Strategies & Action Steps

• Adopt a policy to purchase Energy Star computers, fax machines, copiers, printers, and other office equipment by June 30, 2011.

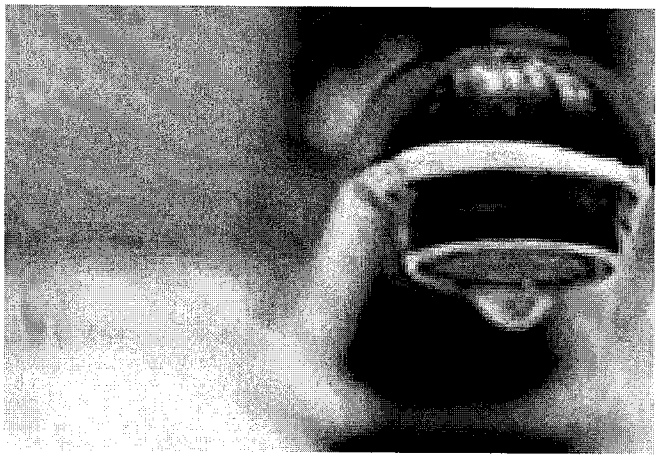
• Adopt a policy to purchase paper products which contain no less than 50% recycle content for all paper needs other than for letterhead paper, legal, and other official notifications that require higher quality paper by June 30, 2012.

• Combine purchases of like items by departments at yearly or monthly order levels to increase efficiencies in ordering and receiving processes.

How we will measure our progress

• Track and report annual energy related purchase contracts.

Energy Action Plan – WATER



Automatic sensor faucets use only 0.5 gallons of water per minute. Whenever we reduce water use, we also save energy. In fact, several of the most cost-effective energy saving strategies — projects with the quickest payback — are water conservation improvements that reduce hot water use.

Over 50% of the City's electricity use in 2008 (see Appendix 1) was used to pump and treat water, to run pumps and motors in lift stations, and to support other water related activities.

Actions already taken or in progress:

The Public Works & Utilities Department is conducting a cost of service study in order to establish water conservation rates. Faucet aerators and low flow faucets are being installed in City owned buildings.

WATER - Goals & Target Dates

• Implement water conservation measures and equipment and piping replacements to City-owned facilities to reduce water use and treatment costs for waste water.

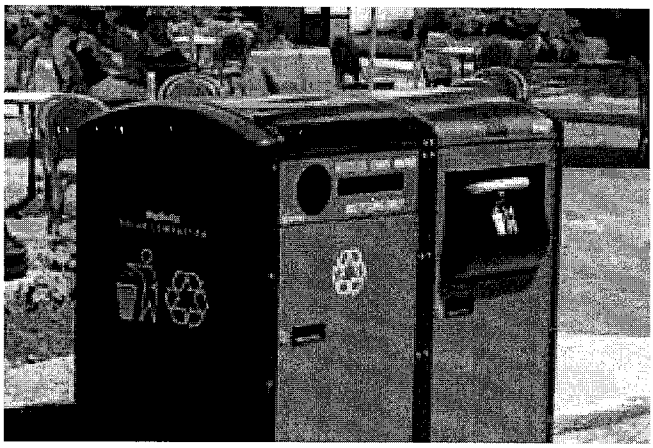
Strategies & Action Steps:

- Reduce the temperature of water heaters to a maximum 120 degrees by June 20, 2011.
- Find ways to conserve hot water use in City facilities.
- Complete installation of low flow showerheads and low flow devices for sink faucets and toilet flushing in City facilities where appropriate.
- Install low flow devices and high pressure equipment for vehicle washing.
- Plant drought tolerant plants, trees, and shrubs to reduce watering activities.

How we will measure our progress

• Track installations and report water use for years 2011 through 2015 compared to 2008 baseline.

Energy Action Plan - WASTE



Solar powered, off-grid trash compactors with recycling containers are located along Duluth's Lakewalk. Visitors using the Lakewalk are now able to recycle cans, bottles, newspapers, and other office papers. For every short ton of paper we recycle, we save seven thousand gallons of water. It also saves trees, electricity, landfill space, and oil.

Actions already taken or in progress:
Parks & Recreation Department placed solar powered, off-grid trash compactors with recycling containers along Lakewalk in 2011. The Finance Department will implement paperless payroll statements in 2011. The City purchases recycled plastic content products and reclaimed rubber such as tire chips for playgrounds. Recycled content carpet is placed in City-owned buildings and the old carpet is recycled.

WASTE- Goals & Target Dates

- Reduce waste generated from City operations by 10% by December 31, 2014.
- Increase reuse of materials or recycling of materials by 20% by December 31, 2013.

Strategies & Action Steps:

- Provide employees with information on the benefits of recycling.
- Set copiers for double sided printing as default by June 30, 2011.
- Replace paper documents with electronic documents were feasible.
    - Vendor payments will be by electronic funds transfer (EFT) rather than by checks by June 30, 2012.
- Require that the contracted recycler recycle additional material types.
- Incorporate higher recycling standards in recycling contract for years 2012-2015 and award the contract on a point system that assigns points for the bidder's environmental strategy.
- Reduce the use of plastics and keep plastics out of the waste stream by collecting all plastics for recycling.

How we will measure our progress

- Document and report tons of waste and recycled materials for each year from 2010 - 2015.

Energy Action Plan – TRANSPORTATION

"No one can tell us when we'll run out of oil, but we will. Everyone will tell you we will."
John W. Mendel, Executive Vice President, Honda, Acura Auto Sales in `*Racing against Time* – Dreams.Honda.com/alternative-energy

Federal fuel efficiency standards will raise the fuel economy standards of America's cars, light trucks, and SUVs to an average of at least 35 miles per gallon by 2020. Getting more miles per gallon out of our fleet cars and trucks and reducing unnecessary trips is essential. Rising oil prices will necessitate increasing fuel efficiency of our City fleet. We can improve our use of energy for transportation by encouraging smart driving, less idling, proper tire pressure, and bundling errands.

Actions already taken or in progress:
The Public Works & Utilities Department implemented automatic meter reading (AMR) in 2008 which has reduced vehicle miles. The trash compactors placed along the Lakewalk in 2011 will reduce the number of City truck miles for this activity. The GPS (Global Positioning System) that will be installed in City fleet vehicles by 2012 is expected to save $59,000 each year and achieve a 7% reduction in fuel consumption. In 2011, the Duluth Police Department will replace up to 10 higher mileage V-8 Ford Crown Victoria patrol cars with 2011 Dodge Charger V-6 models which have an average fuel economy of 27.8 MPG, compared to 21.7 MPG for the Crown Victoria.

TRANSPORTATION - Goal & Target Dates

• Increase Class 1 vehicle (cars and light trucks) and Class 2 vehicle Average Fleet MPG by 15% by June 30, 2015.

	Est. Cost Savings
•Reduce gallons of gasoline used by City fleet vehicles by 12% by June 30, 2014.	$90,000
• Reduce gallons of diesel fuel used by City fleet vehicles by 10% by June 30, 2015.	$70,000
• Decrease total on-the-job vehicle miles traveled by City employees by at least 10% by June 30, 2015.	$115,000

Strategies & Action Steps	Added Cost
• Provide information on fuel use and ways to reduce consumption to employees	0

ENERGY in TRANSPORTATION (continued)

	Added Cost
• Promote the City vehicle anti-idling policy for non-emergency vehicles.	0
• Implement planned vehicle retirement and replacement program.	
	Added Life Cost
• Purchase the most fuel efficient vehicle for the job, as feasible.	
√ Replace 4 heavy-duty trucks with light-duty or hybrid trucks or cars by December 31, 2013.	($40,000)
√ Replace 4 non-pursuit fleet vehicles with fuel efficient hybrids by December 31, 2014.	$10,000
• Purchase 4 hybrid, or electric or high mileage (34 MPG or greater in City) cars to replace high annual use fleet vehicles by December 31, 2014.	$30,000
• Plan more efficient routes using the Global Positioning System (GPS).	

• Implement a comprehensive alternate commuting program, (public transit, walking, biking, carpooling and ridesharing) for City employees by December 31, 2012.

	Added Cost
• Develop a web-based ride share match site for City employees by December 31, 2011.	$1,000
• Set up payroll deduction for City employees to buy DTA bus passes by December 31, 2011.	0
Map bike routes between City facilities by December 31. 2011.	$2,000
Survey employees on where they could ride bikes by June 30, 2012.	0
Purchase 20 bicycles, provide bike stations and bike checkout for City employees by June 30, 2012.	$10,000
Increase bike parking spaces at all City facilities.	$5,000

• Increase on-line services for residents and businesses to reduce required driving to City offices.

• Replace face-to-face meetings with webinars.

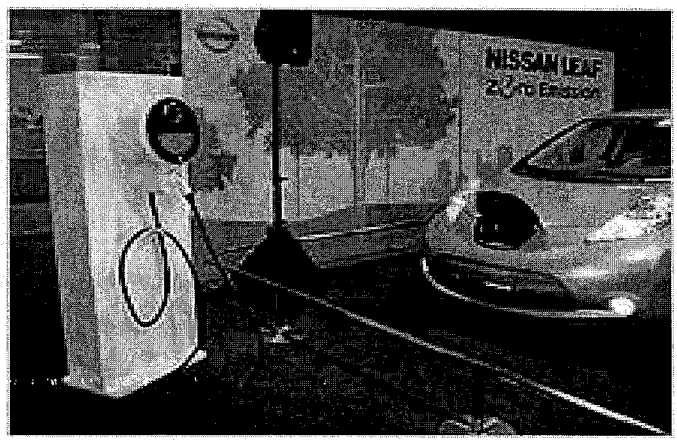
How we will measure our progress

• Track and report vehicle replacements, rated MPG, fuel use, and annual vehicle mileage.

• Track other transportation measures implemented.

Long-range TRANSPORTATION Planning Activities

EV or electric cars have come out of the shadows to move forward once again. The internal combustion engine is only about 15 percent efficient, losing 85 percent of its available energy to the air in the form of heat. The EV is more efficient at 25 percent efficiency.



Long-range transportation planning activities to be completed by December, 31, 2012

1. Study the feasibility of replacing 5 City vehicles with electric vehicles and adding charging stations at strategic sites.

2. Study the feasibility of a new line of Compressed Natural Gas (CNG) Fleet Vehicles and constructing 2 fueling stations.

    • Evaluate feasibility of sharing cost and ownership of CNG fueling stations with other fleet operators, and

    • Evaluate converting selected fleet vehicles to CNG to reduce use gasoline and diesel fuel.

3. Study the use of Biofuels. Flex fuel cars cost no more than standard cars.

Summary – City Operations Energy Action Plan - Goals, Strategies & Actions

CITY OPERATIONS ENERGY ACTION PLAN - GOALS, STRATEGIES & ACTIONS - 2011 - 2015	TARGET DATE		
ENERGY - EXISTING BUILDINGS		INVESTMENT COST	Est. Annual COST SAVINGS
Reduce combined energy use from electricity, natural gas and steam in audited City buildings and facilities by 15% by December 31, 2015.	**Dec. 31, 2015**	**$2,500,000**	**$440,000**
• Develop and implement a 5-Year plan to install energy efficiency measures in buildings and facilities to meet the targeted savings.	Dec. 31, 2015	$2,330,000	$410,000
• Incorporate energy saving operating practices in facility operations.	Jun. 30, 2011		
Setback thermostats temperatures in unoccupied facilities.			
• Conduct an internal review of Building Design & Construction Standards recommended by City Architect and adopt the codes.	Dec. 31, 2011		
• Install Energy Management System or convert pneumatic building controls to digital controls in 4 City owned and operated buildings.	Dec. 31, 2014	$ 170,000	$ 30,000
• Provide Building Operator Certification (BOC) training to 4 building operations and maintenance staff members who operate buildings.	Dec. 31, 2014	$ 8,000	$ 40,000
• Accelerate tree planting by 200 additional trees per year near City owned buildings to promote shade in summer and to provide tree-stand wind breaks.	Jun. 30, 2012		

ENERGY - NEW BUILDINGS			
Adopt LEED®-NC new construction standards, except energy standards, (certification not required) combined with a higher energy efficiency standard for new municipal buildings by June 30, 2013.	**Jun. 30, 2013**		
• Adopt LEED®-NC new construction standards for new buildings with the exception of energy efficiency standards and select and adopt higher energy efficiency standards, such as, Passive House Standards for North American climate zones, or other higher energy standards to achieve optimum energy efficiency.	Jun. 30, 2013		
• Replace 2 end-of-life high energy use municipal buildings with net zero energy use buildings. Evaluate based on life cycle cost savings.	Jun. 30, 2014	$ 50,000	

ENERGY - STREET LIGHTS			
Reduce energy use for decorative street lighting by 15% by June 30, 2015.	**Jun. 30, 2015**		
• Replace 200 decorative 2-lamp 100 Watt high pressure sodium lamps with LED single or double lamp decorative luminaires.	Dec. 31, 2013		
• Reduce the number of evening hours that decorative street lights are on by 5%.	Dec. 31, 2012		

CITY OPERATIONS ENERGY ACTION PLAN - GOALS, STRATEGIES & ACTIONS - 2011 – 2015	TARGET DATE	INVESTMENT COST	Est. Annual COST SAVINGS
ENERGY - STREET SIGNALS			
Improve vehicle travel times by continuing the signal timing optimization program and by efficient signal replacements and lamp replacements			
• Continue signal timing optimization planning and program.			
Optimize signals in the Mall area in 2011.	Dec. 31, 2011		
Optimize signals in the 21st Ave. East corridor through Woodland.	Jun. 30, 2012		

ENERGY - OPERATING PRACTICES			
Reduce overall energy use from operations (other than building measures such as lights and heating equipment) by 5% by June 30, 2015.	**Jun. 30, 2015**		
• Provide energy efficiency and conservation information and training to all City employees.	Dec. 31, 2012		
• Provide energy efficiency and conservation information and training to new employees within 30 days of hire.	Dec. 31, 2011		
• Conduct department and staff division meetings to identify energy conservation strategies and include energy planning in business plans.	Dec. 31, 2011		
Install computer software to automatically shut down computers at night and over weekends.	Jun. 30, 2012	$ 20,000	$ 5,000
Replace 200 desktop computers with EPEAT registered, Gold rated desktops or notebook computers.	Dec. 31, 2014	$ 20,000	$ 5,000
Connect 200 computers to surge protector power strips that will shut off all connected equipment when computer is shut off at night to reduce phantom load energy by 20%.	Jun. 30, 2011	$ 5,000	$ 5,000
• Reduce the use of gas-powered lawn mowers and other equipment by 20%.	Dec. 31, 2012		
• Replace 10 acres of mowed grass with low maintenance landscaping materials such as prairie grass in parks and other City owned and maintained public areas.	Dec. 31, 2014		
• Perform compressed air leak study and implement measures that will achieve positive return on investment in 10 years or less.	Dec. 31, 2015		
• Require Energy Star or higher rated appliances in all city-owned buildings by June 30, 2011. Remove pre-1985 model year refrigerators.	Jun. 30, 2011		
• Require that all incandescent light bulbs will be replaced with high efficiency CFL or LED bulbs and prohibit the use of incandescent bulbs, unless the occupant can substantiate the need for the high wattage bulbs, i.e., use at certain Zoo locations to provide heat for animals.	Jun. 30, 2012		
• Increase use of on-line services for residents and utility customers to reduce driving requirements.			

CITY OPERATIONS ENERGY ACTION PLAN - GOALS, STRATEGIES & ACTIONS - 2011 – 2015	TARGET DATE	INVESTMENT COST	Est. Annual COST SAVINGS
PROCUREMENT			
Adopt energy related environmentally preferable purchasing (EPP) or green purchasing standards for products and services by December 31, 2012.	**Dec. 31, 2012**		
Increase use of recycled content materials as an indirect way to reduce energy use.			
Adopt a policy to purchase Energy Star computers, fax machines, copiers, printers and other office equipment.	Jun. 30, 2011		
• Adopt a policy to purchase paper products which contain no less than 50% recycle content for all paper needs other than for letterhead paper, legal and other official notifications that require higher quality paper.	Jun. 30, 2012		
• Combine purchases of like items by departments at yearly or monthly order levels to increase efficiencies in ordering and receiving processes.			
WATER			
Implement water conservation measures and equipment and piping replacements to city-owned facilities to reduce water use and treatment costs for waste water.			
• Reduce the temperature of water heaters to a maximum 120 degrees.	Jun. 30, 2011		
Find ways to conserve hot water use in City facilities.			
Complete installation of low flow showerheads and low flow devices for sink faucets and toilet flushing in City facilities where appropriate.			
Install low flow devices and high pressure equipment for vehicle washing.			
Plant drought tolerant plants, trees and shrubs to reduce watering activities.			
WASTE			
Reduce waste generated from city operations by 10% by December 31, 2014.	**Dec. 31, 2014**		
Increase reuse of materials or recycling of materials by 20% by December 31, 2013.	**Dec. 31, 2013**		
• Provide employees with information on the benefits of recycling.			
• Set copiers for double sided printing as default.	Jun. 30, 2011		
• Replace paper documents with electronic documents were feasible.			
Vendor payments will be by electronic funds transfer (EFT) rather than by checks.	Jun. 30, 2012		
• Require that the contracted recycler recycle additional material types.	Dec. 31, 2011		
• Incorporate higher recycling standards in recycling contract for years 2012-2015 and award the contract on a point system that assigns points for the bidder's environmental strategy.	Dec. 31, 2011		
• Reduce the use of plastics and keep plastics out of the waste stream by collecting all plastics for recycling.			

CITY OPERATIONS ENERGY ACTION PLAN - GOALS, STRATEGIES & ACTIONS - 2011 - 2015	TARGET DATE	INVESTMENT COST	Est. Annual COST SAVINGS
TRANSPORTATION			
Increase Class 1 vehicle (cars and light trucks) and Class 2 vehicle Average Fleet MPG by 15% by June 30, 2015.	**Jun. 30, 2015**		
Reduce gallons of gasoline used by City fleet vehicles by 12% by June 30, 2014.	**Jun. 30, 2014**		$ 90,000
Reduce gallons of diesel fuel used by City fleet vehicles by 10% by June 30, 2015.	**Jun. 30, 2015**		$ 70,000
Decrease total on-the-job vehicle miles traveled by City employees by at least 10% by June 30, 2015.	**Jun. 30, 2015**		$115,000
• Provide information on fuel use and ways to reduce consumption to employees		$ -	
• Promote the City vehicle anti-idling policy for non-emergency vehicles.		$ -	
• Implement planned vehicle retirement and replacement program.			
• Purchase the most fuel efficient vehicle for the job, as feasible.			
√ Replace 4 heavy-duty trucks with light-duty or hybrid trucks.	Dec. 31, 2013	-$ 40,000	$ 16,000
√ Replace 4 non-pursuit fleet vehicles with fuel efficient hybrids.	Dec. 31, 2014	$ 25,000	$ 2,500
• Purchase 4 hybrid, or electric or high mileage (34 MPG or greater in City) cars to replace high annual use fleet vehicles.	Dec. 31, 2014	$ 30,000	
• Plan more efficient routes using the Global Positioning System (GPS).			
• Implement a comprehensive alternate commuting program, (public transit, walking, biking, carpooling and ridesharing) for City employees.	Dec. 31, 2012		
Develop a web-based ride share match site for City employees.	Dec. 31, 2011	$ 1,000	
Set up payroll deduction for city employees to buy DTA bus passes.	Dec. 31, 2011	$ -	
Map bike routes between City facilities.	Dec. 31, 2011	$ 2,000	
Survey employees on where they could ride bikes.	Jun. 30, 2012	$ -	
Purchase 20 bikes, provide bike stations, purchase 20 bikes and provide bike checkout for city employees.	Jun. 30, 2012	$ 10,000	
Increase bike parking spaces at all City facilities.	Jun. 30, 2012	$ 5,000	
• Increase on-line services for residents and businesses to reduce required driving to City offices.			
• Replace face-to-face meetings with webinars.			

Appendix 1 - 2008 Electric Energy Use in City Operations

CITY OF DULUTH - OPERATIONS	2008 ELECTRIC COST AND USAGE					
RATE CLASS	COST	kWh	kW	Percent of Total Cost	Percent of Total kWh	Percent of Total Demand
AREA LIGHTING	$ 19,542	113,948	-	1%	0%	0%
GENERAL SERVICES	$ 724,532	8,993,209	31,201	30%	27%	39%
LARGE LIGHT & POWER	$ 890,544	15,573,602	30,691	37%	47%	39%
MUNICIPAL PUMP (1)	$ 402,427	5,986,589	15,391	17%	18%	19%
OVERHEAD STREET LIGHTS	$ 344,139	2,243,350	437	14%	7%	1%
ORNAMENTAL STREET LIGHTS	$ 37,073	556,571	1,273	2%	2%	2%
RESIDENTIAL ALL ELECTRIC	$ 238	3,043	28	0%	0%	0%
TOTAL 2008 ELECTRIC COST & USE	$2,418,495	33,470,312	79,021	100%	100%	100%
Overhead & Ornamental Street Lights Combined	$ 381,212	2,799,921	1,710			
Percent of Total	16%	8.4%	2%			

Figure 6: 2008 Electric Use by Class

LARGE LIGHT & POWER CLASS	COST	kWh	kW	Percent of Total Cost	Percent of Total kWh	Percent of Total Demand
City Hall	$ 34,329	441,200	1,562	1%	1%	2%
Lakewood Pumping Station	$ 591,202	10,943,400	18,402	24%	33%	23%
Main Library	$ 36,994	569,760	1,529	2%	2%	2%
Public Works - Garfield Service Center	$ 42,202	584,448	1,794	2%	2%	2%
Tech Village Parking Ramp	$ 32,866	476,928	847	1%	1%	1%
Duluth Steam Plant	$ 152,950	2,557,866	6,557	6%	8%	8%
Total Large Light & Power Class	$ 890,544	15,573,602	30,691	37%	47%	39%
Percent of Total	37%	47%	39%			
(1) Pump/Lift Stations in General Services	$ 42,628	558,868	1,397	2%	2%	2%
Total Pumping, Lift Stations for water	$1,078,460	17,488,857	36,984	45%	52%	47%

source: bill segment files from MN Power, based on ending bill dates

Figure 7: 2008 Electric Cost & Use – Large Light & Power Class and Total Water Related Cost & Use

Appendix 2 - Life-Cycle Cost Analysis for Buildings

Life-cycle cost analysis is a method of determining the entire cost of a structure, product, or component over its expected useful life. The cost of operating, maintaining, and using the item is added to the purchase price. For items that last longer than a couple of years, this is a more realistic way of evaluating cost than simply looking at the purchase price. Conducting a life-cycle cost analysis isn't as difficult as it appears. This report explains why and how to conduct life-cycle cost analyses and includes information on using software tools that reduce the difficulty of performing lifecycle cost analyses.

Don't confuse life-cycle cost analyses with life-cycle assessments. Life-cycle assessments are used to evaluate the environmental costs associated with a product, process, structure, or activity. They identify energy and materials used and wastes released to the environment.

Source: http://www.fs.fed.us/t-d/pubs/htmlpubs/htm08732839/page01.htm

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Life-Cycle Cost Analysis (LCCA)
Sieglinde Fuller, National Institute of Standards and Technology

Life-cycle cost analysis (LCCA) is a method for assessing the total cost of facility ownership. It takes into account all costs of acquiring, owning, and disposing of a building or building system. LCCA is especially useful when project alternatives that fulfill the same performance requirements, but differ with respect to initial costs and operating costs, have to be compared in order to select the one that maximizes net savings. For example, LCCA will help determine whether the incorporation of a high-performance HVAC or glazing system, which may increase initial cost but result in dramatically reduced operating and maintenance costs, is cost-effective or not. LCCA is not useful for budget allocation.

Lowest life-cycle cost (LCC) is the most straightforward and easy-to-interpret measure of economic evaluation. Some other commonly used measures are Net Savings (or Net Benefits), Savings-to-Investment Ratio (or Savings Benefit-to-Cost Ratio), Internal Rate of Return, and Payback Period. They are consistent with the Lowest LCC measure of evaluation if they use the same parameters and length of study period. Building economists, certified value specialists, cost engineers, architects, quantity surveyors, operations researchers, and others might use any or several of these techniques to evaluate a project. The approach to making cost-effective choices for building-related projects can be quite similar whether it is called cost estimating, value engineering, or economic analysis.

Life-Cycle Cost Calculation

After identifying all costs by year and amount and discounting them to present value, they are added to arrive at total life-cycle costs for each alternative:

LCC = I + Repl — Res + E + W + OM&R + O

LCC = Total LCC in present-value (PV) dollars of a given alternative

I = PV investment costs (if incurred at base date, they need not be discounted)

Repl = PV capital replacement costs

Res = PV residual value (resale value, salvage value) less disposal costs

E = PV of energy costs

W = PV of water costs

OM&R = PV of non-fuel operating, maintenance and repair costs

O = PV of other costs (e.g., contract costs for ESPCs or UESCs)

Source: http://www.wbdg.org/resources/lcca.php

Appendix 3 – Considerations for Renewable Energy

Renewable Energy – Energy Efficiency First

Wisconsin's Focus on Energy recommends that before energy users purchase renewable energy system, it is important to maximize the energy efficiency of our buildings. The smaller our energy needs, the lower our monthly energy bills—and the less investment needed for a renewable energy system that's capable of meeting the balance of the facilities needs.

The use of modern renewable energy technologies produces less pollution than burning fossil fuels - especially with respect to net emissions of greenhouse gases. Renewable energy resources also represent a secure and stable source of energy for our country and a potential source of jobs and economic development.
In some cases, the cost of electricity produced from renewable sources is approaching the cost of generating power from conventional sources, and each renewable energy technology is economically feasible in certain applications. There are *direct* economic benefits, including job creation, of investing in renewable energy technologies.

How Renewable Energy Investments Help the Economy

There are two main reasons why renewable energy technologies offer an economic advantage: (1) they are labor intensive, so they generally create more jobs per dollar invested than conventional electricity generation technologies, and (2) they use primarily indigenous resources, so most of the energy dollars can be kept at home.

Source: http://www.nrel.gov/docs/legosti/fy97/20505.pdf

Appendix 4 - Duluth Authorities – Energy Management Accomplishments

Duluth Entertainment & Convention Center - DECC & AMSOIL Arena

The DECC has been widely recognized for its commitment to environmental stewardship. A recent recipient of the Governor's Award for Waste and Pollution Prevention, the facility shares the same passion to limit energy use. The entire complex is heated with hot water circulated in a closed loop from the Duluth Steam Plant Cooperative. The water is heated in the steam plate exchangers with energy that previously was discharged into the atmosphere. The DECC also works closely with Minnesota Power to limit power usage.

The DECC had a unique opportunity to show its commitment to the reduction of energy consumption in the design of the new LEED Certified AMSOIL Arena. The goal was to use 50% less energy than similar arenas. This goal was surpassed using energy modeling, innovative technology, and close attention to energy use through the entire design process.

Duluth Airport Authority

The Duluth Airport Authority has implemented sensor registration on the baggage conveyor system that shuts off the belts when the system hasn't registered any bags for five minutes. DAA has identified this as an obvious opportunity for saving energy by correcting a deficiency in system operations. The correction was rather simple and was a matter of programming logic into the bag system controls. Energy savings continue to be utilized in the new terminal with the addition of a controller for the parking lot lighting system. The parking lot lights are currently programmed to go to 50% power, basically every other light being shut off, during times of virtually no public use of the area. As additional lights are added to the circuit as construction continues, these lights are also added to the program.

As part of prior construction at the airport the Building Automation System (BAS) was upgraded to maximize energy savings with the HVAC components. Boiler efficiency has increased 5% due to the building controls and building area occupied timing has been adjusted accordingly to maximize energy conservation. The Duluth Airport has also recently completed a relamping of the Air Traffic Control Facility to reduce energy consumption. All 32W lamps have been replaced with 28W T8 lamps.

Better things are ahead for the Duluth Airport as construction continues on an ultra modern highly energy efficient terminal. Currently there are plans for low water use plumbing fixtures, LED lights, updated BAS, high efficiency hot water boilers, and valued engineered baggage handling system. Room occupancy sensors will be highly utilized to reduce energy usage in areas that are not occupied such as stairwells and conference rooms. The Airport is also looking into the feasibility of renewable energy such as geo-thermal heating and solar domestic water heat. As these projects reach successful outcomes, energy efficiency projects will follow such as HVAC upgrades at the Air Traffic Control Facility, incorporating the Air Traffic Control Facility and potentially other airport owned buildings into the terminal BAS, as well as implementing an airport wide recycling program.

Spirit Mountain

Spirit Mountain is committed to supporting a sustainable future by reducing energy and water consumption, by minimizing impact on the environment, and by increasing awareness of the local and global challenges facing us all. Every contribution, large and small, put forth by staff and visitors helps realize these goals. In recent years, Spirit Mountain obtained an extensive energy audit and has been implementing recommended measures as resources permit. With the approval and guidance of the Spirit Mountain Master Plan, improvements to the existing facility have been, and are, designed and engineered with energy efficiency as a requirement. Spirit Mountain's alpine coaster, the Timber Twister, features a concession/ticket building specifically fabricated to reduce waste and energy consumption. The innovative building design, created by Sprung Instant Structures, arrives on site pre-assembled, which reduces the nearly 4 pounds (per square foot) of waste which typically ends up in landfills in conjunction with construction projects. These structures experience long life-expectancy rates and are composed of 100% recyclable aluminum frames, which can be disassembled, reconfigured, and expanded as needs dictate. In addition, the insulation and other materials in the buildings provide higher R-values than conventional construction applications, thereby reducing heating and cooling related energy consumption.

While initial steps have been taken toward these goals of energy efficiency, Spirit Mountain intends to continually examine and improve operations to reflect this commitment. Goals for reduced energy usage include utilization of alternative energy sources. Wind and solar power each have potential applications throughout the facility. Green credit offsetting, where electric power is necessary, also helps to reduce fossil fuel consumption. Spirit Mountain recognizes the importance of education and involvement of both guests and staff, as any program will suffer without support. In turn, Spirit Mountain is committed to support the global system, and as such, is dedicated to seeking out products and services derived from businesses and organizations likewise committed to a sustainable future. Wherever possible, the intent is to utilize goods which are produced locally of recycled and post-consumer products, can be recycled or composted with nominal waste, and those which are manufactured through ethical and minimally invasive practices. Through these steps toward energy and resource efficiency, and many others, Spirit Mountain pledges to make a positive difference for future generations.

Appendix 5 – Glossary of Terms & Related Links

Decorative street lighting – Street lighting of a decorative nature that is typically located in business districts, that has a non-standard fixture per Duluth standards.

Environmentally preferable purchasing (EPP) - EPP is the procurement of goods and services that have a reduced impact on human health and the environment as compared to other goods and services serving the same purpose In simple terms, EPP means "Buying Green."

Home page for EPA's EPP **Program** web site Environmentally Preferable Purchasing (EPP) | US EPA

Fossil fuels - Energy sources formed by the decay of plants, dinosaurs, and other animals over millions of years; coal, oil, and natural gas are fossil fuels. These energy reserves form so slowly in comparison to our rate of energy use that they are regarded as a finite resource.

Kilowatt (kW) – 1000 watts (see *Watt*)

Photovoltaic – A technology for using semiconductors to directly convert light into electricity.

Recycled content materials – Materials that have a minimum percentage of recycled materials, such as 20% recycled content steel. Pre-consumer content means that the manufacturer used waste material that never made it into the marketplace, such as paper scraps at a paper mill. Post-consumer content is used material; this is the preferred type of recycled content.

Buying products made out of recycled materials
Increased demand for recycled-content products will help develop stable, long-term markets for recycled material. Look for and purchase products with labels that say they contain post-consumer material. More and more packaging is made of recycled content. Common items that may have post-consumer recycled content (look for labels on each of these products):

Toilet tissue	Garden hoses	3-ring binders
Paper towels	Poly-fill for coats	Computer paper
Cereal boxes	Trash bags	Sandpaper
Insulation	Carpeting	Video cassettes

- Purchase paper and other products that contain the largest amount of post-consumer recycled content.
- Purchase recycled stationery, note pads, computer and copy paper and other such items.

Minnesota's Recycled Products Directory lists quality, locally produced products made from recycled materials. The database is searchable and continually updated.

Renewable energy – Sources of energy that are either continuously resupplied by the sun or tap inexhaustible resources, such as wind, solar, *biomass*, *hydropower*, and *geothermal energy*.

Therm – A therm is an energy unit with approximately the energy equivalent of burning 100 cubic (often referred to as 1 Ccf) of natural gas.

Sustainability – Sustainability is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It considers a larger approach to decision-making by determining ahead of time how policies and actions impact people, the environment, and the economy.

Grand Rapids Michigan Sustainability Plan: http://www.ci.grand-rapids.mi.us/index.pl?page_id=10563

Waste generated from operations – the amount of materials that is taken out of service or that are used one-time and disposed of by recycling, reuse or land filled.

Watt – Watts are used to measure the total quantity of electricity. One watt is the power developed by an electric current of 1 ampere across a potential of 1 volt.

1 kilowatt (kW) = 1000 watts
1 megawatt (MW) = 1000 kilowatts = 1 million watts

Both kW and MW are used to describe the maximum output of an electric generator at a particular moment. The amount of electricity generated or used during a period of time is typically expressed in *kilowatt hours* (kWh).