# Missoula Greenhouse Gas Energy Conservation Plan

Passed May 10, 2004
RESOLUTION NUMBER __5890__

Amended 9/14/2009

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# Missoula Greenhouse Gas-Energy Efficiency Plan

## Introduction

Conservation of resources and protection of the environment in the Missoula Valley is important to us as individual citizens, as well as important to us in our public roles as community members, civic and business leaders, employers and employees alike. The following Plan is adopted as a guidance document that provides suggestions for both public and private sectors. The Plan encourages efforts and positive results in maximizing energy efficiency and minimizing the formation of Greenhouse Gases. This Plan: does not set mandatory limits or implementation criteria in any manner, is not intended to be used as a platform for current or future regulation, and is solely intended to provide a valuable community resource for energy efficiency and greenhouse gas minimization.

## Energy Efficiency and Greenhouse Gases

Missoula has enjoyed and been challenged by dynamic growth in the past 20 years. This growth has brought a rich blend of cultural and economic diversity that makes Missoula a fantastic place to live and raise families. However, it has also served to challenge our ability to provide services and infrastructure in a manner that maintains a pristine environment for us to live in without spoiling the essence of what it is to live in Montana.

Energy efficiency is an important element in the management of our environmental resources in Missoula. By focusing on efficient utilization of finite energy resources, i.e. fossil fuels (gas, diesel, fuel oil, natural gas, etc.) and electricity in heating, lighting, manufacturing, transportation, communications, and recreation, to name a few, we can minimize our "footprint" on our environment while maximizing our quality of life as citizens.

A very important effect of energy efficiency is the beneficial reduction of $CO_2$ greenhouse gas emissions. The Plan as outlined below capitalizes on the complimentary relationship between energy efficiency and greenhouse gas emissions. A brief introduction to "greenhouse gasses" follows.

## Greenhouse Gas

Many chemical compounds found in the Earth's atmosphere act as "greenhouse gases (ghg)." These gases allow sunlight, which is radiated in the visible and ultraviolet spectra, to enter the atmosphere unimpeded. When it strikes the Earth's surface, some of the sunlight is reflected as infrared radiation (heat). Greenhouse gases absorb this infrared radiation as it is reflected back towards space, trapping the heat in the atmosphere.

Many gases, including naturally occurring gases and manmade gases, exhibit "greenhouse" properties. Common gases in this group include water vapor, carbon dioxide ($CO_2$), methane, and nitrous oxide. Because $CO_2$ is the most abundantly

produced greenhouse gas, all greenhouse gas emissions are usually expressed as $CO_2$ or equivalent $CO_2$ ($eCO_2$).

Atmospheric concentrations of several greenhouse gases, including carbon dioxide, methane, nitrous oxide, and other man-made gases have increased since large-scale industrialization began in the 1800's. It is commonly understood that two of the largest constituents of greenhouse gases, $CO_2$ and methane, are important compounds in the natural growth and degradation of plants and bio-fuels. $CO_2$ has been held in a general balance for millennia through the generation of $CO_2$ via the natural burning of trees, forest, and grasslands, and the natural use of $CO_2$ in plant photosynthesis. Whether it is wood, paper, plastic or fossil fuels, $CO_2$ is generated in the burning process. If $CO_2$ is not consumed by natural processes such as photosynthesis in relative balance with its generation, higher concentrations of greenhouse gases can trap heat in the atmosphere.

The trapping of heat in the atmosphere due to greenhouse gases is another fine balance of nature. With too much trapped heat (i.e. Global Warming), global changes occur such as the melting of the glaciers 15,000 years ago. There are indications that higher levels of greenhouse gases since the Industrial Age are influencing the natural balance of Global Warming.

Scientists are split on the effects of greenhouse gas generation and global warming. Some argue that global warming is predominantly caused by human activity, presents a "grave threat to humanity," and greenhouse gas emissions should be cut by up to 60%. Other knowledgeable scientists say that the one-degree rise in average global temperature noted to-date is a natural phenomenon caused by the earth's natural cycles.

What is not contested is the fact that fossil fuel burning generates $CO_2$, similar to forest fires and other naturally occurring combustion processes. Less burning and combustion equals less $CO_2$. Less $CO_2$ potentially lowers the impact of greenhouse gases on Global Warming. Hence, a focus on energy efficiency has a compounding benefit of lowering the increase in global warming.

## Missoula's Greenhouse Gas - Energy Efficiency Plan

The Missoula Community includes a large number of individuals that are concerned with the consumption of fossil fuel resources on a local, state, national and worldwide basis. Alternative energy sources such as solar cells and hydrogen fuel are receiving support and funding on a national level, and have little-to-no negative effect on greenhouse gas emissions and Global Warming. However, many Missoulians encourage a more proactive stance, on the local level, for lowering our dependence on fossil fuels as our primary energy source. In addition, they support initiatives that guide and encourage energy efficiency, up to and including lowering our overall energy requirement, thereby reducing our fossil fuel use and its ensuing effect on greenhouse gas generation.

Recognizing that business, industry, and our fellow citizens benefit through the efficient management and use of energy resources, a Greenhouse Gas – Energy Efficiency Plan has been generated to provide a road map for Missoulians to utilize

energy more effectively and efficiently; thereby exemplifying leadership as a city that takes initiative on a national and global issue. For history on the Greenhouse Gas-Energy Efficiency plan development, see Appendix A.

## Greenhouse Gas/Energy Conservation Team

A Greenhouse Gas/Energy Conservation Team (Team) will be appointed by the City Council to aid in the community-wide education and communication of energy efficiency opportunities and renewable energy measures that minimize greenhouse gas generation. The team will be comprised of up to seven (7) members from each of the following sectors:

1) the city and county Government
2) the builder's sector
3) the transportation sector (preferably locally owned and operated commercial trucking)
4) the conservation sector
5) the commercial/business sector
6) the institution sector ,
7) the industry sector

The Council shall also appoint up to two alternates who participate on the team and who may vote absence of a regular member. The City Council shall designate the alternate members as "1st alternate" and "2nd alternate." The 1st alternate shall vote in the absence of a regular member of the team. The 2nd alternate shall vote when there is more than one member absent or when the 1st alternate is absent and is eligible to vote.

This representative cross-section of the community will meet at the scheduled direction of the Conservation Committee. Team meetings will be facilitated by the Missoula Area Chamber of Commerce and the Missoula Area Sustainable Business Council. Team members will elect the chair of the team from within the team membership.

The team should meet on a regularly scheduled basis(at least quarterly) to monitor and lead efficiency initiatives throughout the area. Team members will be volunteers and will be initially challenged with establishing a charter that is approved by the City Council's Conservation Committee. The team will report to and receive direction from the City Council's Conservation Committee.

## Plan Overview

The Plan is divided into six chapters listed below and the overall strategy is to reduce fossil fuel use, reuse material when possible and encourage all aspects of recycling. Recycling has its own chapter because each of the categories below are involved with recycling to some degree and a separate recycling chapter was needed to address this issue in a concise fashion. The other chapters or categories were chosen based on natural splits. For example, transportation emissions and energy usage is easily split from household energy use.

Chapter 1: Recycling

This chapter involves an important niche that cuts across the remaining five chapters; it is tracked and measured community-wide.

Chapter 2: Municipal Government

The government sector has the opportunity to set an exemplary benchmark for citizens, business and industry in the area of energy efficiency and independence from fossil fuels.

Chapter 3: Household

There is a large opportunity for energy efficiency in the education and awareness of citizens.

Chapter 4: Transportation

Private, public, and commercial transportation initiatives including voluntary carpooling, greater access to public transportation, and improved traffic control provide significant benefits to lower energy consumption.

Chapter 5: Commercial/Institutional

Missoula's growing commercial and institutional sector can establish important benchmarks for energy efficiency through voluntary implementation that has a cost benefit payback.

Chapter 6: Industrial

The industrial sector is well versed on implementing energy reduction initiatives that improve their profitability. This chapter acknowledges current and future efforts to improve their competitive position through energy management.

The guidelines and recommendations in these chapters provide a range of opportunities for the Missoula community to consider and implement where practical. The benefits derived from the implementation of improvement initiatives include: direct cost savings, improved air quality, lower dependence on fossil fuels, and lower greenhouse gas emissions.

## Chapter 1 – Recycling

Reduce, Reuse, and Recycle is a three-pronged strategy to reduce $eCO_2$ emissions from the use of "goods". Most material or "goods" take energy to produce. Managing consumption patterns can significantly save energy. After consumption has been reduced, focusing on materials that can be reused and recycled increases efficiency significantly. Reusable canvas bags, cold water for clothes and dish washing, and greater use of walking and bicycle riding for short trips are examples of energy-conscious items that can reduce $eCO_2$ emissions. Also, manufacturing products in ways and out of materials that are easily recyclable can encourage recycling.

Recycling reduces emissions and energy use in Missoula and other locations by keeping material out of the landfill and by reducing the need for raw material to manufacture other products. The $eCO_2$ emission reductions listed in Appendix E are based on the life-cycle emission reductions for the given material. This accounts for all emission reductions for recycling, not just the reductions in the Missoula area. Material that can be recycled includes cardboard, newspaper, magazines, office paper, plastics, metal, batteries, organic material for composting and other material. By composting organic matter, material is kept out of the landfill and the greenhouse gas methane produced at landfills is reduced.

In 1991, the typical Montana resident produced 5 pounds of waste per day. By 2001 the typical Montana resident produced 6.1 pounds of waste per day and the typical United States resident produced 4.5 pounds of waste per day. In 2002, about 15% of all solid waste in Montana was recycled. This recycling rate includes composting measures (Brian Spangler, Montana DEQ Pollution Prevention Division, phone conversation 3/26/04). The national average for recycling is 30% and about 20% of material is recycled in Missoula. All this indicates that there is room for increased recycling in Missoula and throughout Montana.

The best way to increase recycling is to concentrate efforts at the largest sources of solid waste. Overall, the commercial/industrial sector produces more land filled waste than the other sectors and only a small minority of the businesses in Missoula are involved with the site pick-up recycling program for cardboard and other material (BFI, 3/26/04). The residential sector is probably the major source of newspaper, aluminum cans and vegetation that gets sent to the landfill. The transportation sector produces a huge amount of waste as junk vehicles. But because of Montana's junk vehicle recycling program, which is one of the best in the nation, most Missoula vehicles are already crushed and recycled. Appendix E describes the junk vehicle recycling tonnage for Missoula County.

### Methods to Increase Recycling

- Promote residential curbside recycling programs
- Actively support convenient recycling drop boxes throughout the community
- Actively promote residential and business community composting
- Encourage and provide incentives for the business community to increase recycling and participate in on-site recycling pick up

§ Work with the Montana state government to achieve state wide recycling goals
§ Promote and investigate electronics recycling and reuse potential
§ Promote and investigate practical methods to recycle tires

Based on 2002 waste generation tonnage, if Missoula recycling was increased from 20% to 30%, $eCO_2$ emissions would be reduced 5442 tons per year (Appendix E).

## Chapter 2 - City Government Operations

The City of Missoula's Mission is to facilitate the health, safety and well being of the community. In the spirit of this mission, Missoula has adopted and will participate in the Greenhouse Gas-Energy Efficiency Plan. By participating in the Plan the city will take a leadership role on an important national issue, save money through reduced energy cost, reduce greenhouse gas and air pollution emissions, and provide examples that individuals, businesses and organizations can use to reduce their greenhouse gas emissions and conserve energy. Wherever practical, the city will reduce its use of fossil fuels, reuse resources in its operations and participate in recycling programs.

To help determine where municipal government can reduce greenhouse gas emissions and energy use, city operations are divided into five categories: green fleets, employee actions, city buildings, new technology, and green power. Greenhouse gas-energy use reduction strategies for each category are discussed below.

### Green Fleet (by Green we mean increase efficiency and increase use of renewable energy)

New technologies are continually developed to increase efficiency and reduce vehicle emissions. Missoula will continue to explore how new technology can improve the city fleet. Gasoline and diesel have been the primary fuels used in the City's vehicles. By switching from gasoline to ethanol (corn based, renewable) and from diesel to biodiesel fuel, the City can significantly reduce $eCO_2$ emissions. In addition, new vehicles are being developed that are powered by alternate sources of energy. The City's long-term plan should include the replacement of conventional vehicles in the fleet to alternately fueled vehicles as appropriate and practical.

### Employee Actions

There are two ways the City Administration can encourage its employees to help reduce greenhouse gases and improve energy conservation:

§ City Administration will continue to oversee the Recycling Program in City offices. The primary goal for this program will be to increase as much as possible the amount and types of material that is recycled. The Recycling Program will be kept current with available programs in the community and employees will be trained on correct recycling practices.

§ Through community programs and in-house incentive programs, employees will be encouraged to use alternate modes of transportation to commute to work.

These include walking, biking, carpooling, commuter vans and the Mountain Line bus system.

City Buildings

Where appropriate, City buildings should be audited and the recommendations from that audit should be implemented. All new construction or remodeling should look at ways to maximize natural interior lighting and passive solar heating for the winter months. Before construction begins on any project, all aspects of the project that affect energy efficiency should be analyzed with the idea of maximizing energy efficiency. Some aspects to consider for any building project include site orientation, lighting, landscaping, insulation, high efficiency windows, building design, possible solar panel locations, space heating-cooling methods and use of passive solar energy where possible.

New Technology

City Departments are encouraged to investigate the newest technologies available that might help reduce greenhouse gas emissions and conserve energy. Requests for purchases of equipment should include a description of how it might improve efficiency and/or conserve energy. Any cost/benefit analysis should include the ecological impacts as well as financial impacts. The City Council will take all impacts into consideration when considering approval of such purchases.

Green Power (power that is renewable and has little to no ghg emissions)

Sometime in the future, the City of Missoula will be able to choose the source of electric power it buys for government operations. From a greenhouse gas reduction standpoint it would be most desirable to have the city buy all green (renewable such as hydro, wind, solar) power. It is not clear how much extra the taxpayers will be willing to pay for green power. Too many variables exist to predict what savings may be realized from the eventual purchase of green power. The city should purchase some % of green power when the option becomes available and the price is with in 5% of the regular power rate. Actual tons of $eCO_2$ reduction cannot be calculated until we know the source and percentage of green power purchased. The city will also develop a Capital Improvement Program for alternative energy.

Plausible $eCO_2$ reductions: 606 tons $eCO_2$ per year, of which 247 tons has already been done with biodiesel and red Light Emitting Diode (LED) traffic lights.

Energy Advisory Team

City Administration will appoint an energy advisory team that will meet regularly to discuss new technology and analyze how the City can improve its energy conservation efforts. The team will include representatives of the following: Information Services, Vehicle Maintenance, Administrative Support Team, Bicycle and Pedestrian Program, Mayor's Office, Health Department and City Council Conservation Committee. This Team will advise Administration and City Council on technologies and conservation strategies that will allow the City to continue to serve as a model for the Missoula community in its effort to reduce Greenhouse gases and improve energy efficiency.

## CHAPTER 3 - Household Opportunities

Many household activities affect the generation of greenhouse gases, primarily through the use of electricity in home heating, cooling, lighting and appliance use. Projections indicate that approximately 15% of the total $eCO_2$ generated in the community will be related to household energy use by the year 2010. Personal energy conservation in the home environment can significantly reduce $eCO_2$ generation in the community. A combination of recycling, energy-efficient appliances, seasonal home temperature control, and conservation measures can reduce the $eCO_2$ emissions in Missoula. In the following sections, a number of steps are outlined that can be taken to reduce energy use in the home.

### Reduce, Reuse, Recycle

Managing household consumption patterns can significantly save on energy. Most of the materials in our lives take energy to produce. By focusing on the use of materials that can be reused and recycled, significant efficiencies can be realized. The use of reusable canvas shopping bags, cold water for clothes and dish washing, and greater use of walking and bicycle riding for short trips are examples of energy-conscious items that can reduce $eCO_2$ emissions.

Recycling, covered in Chapter 1, is an important component of home energy conservation. In 2002, as much as 20% of material that was economically recyclable in Missoula was recycled. This is below the national average and represents significant potential for savings.

It is plausible to increase recycling in Missoula by as much as 10% through an economically feasible curbside recycling program and greater consumer awareness of recycling benefits to a sustainable environment. For more information on $eCO_2$ reductions from increased recycling, refer to Chapter 1.

### Build energy efficient homes

Higher standards of new home construction have significantly improved the average home energy efficiency in the past 10 years. In addition, higher energy prices have provided economic incentives for new homeowners to invest in construction methods, insulation, and appliances that conserve energy. However, room remains for greater energy efficiency in most new homes. The Energy Star designation from the US Department of Energy, a new home energy standard that is up to 30% more efficient than “built-to-code” homes in Missoula, is a plausible model for new home construction. A Missoula program that would encourage new homeowners to build to higher standards, such as Energy Star, through community recognition, would encourage homeowner awareness, training, and investment in energy-efficient home construction.

By focusing community awareness on the benefits of new home energy efficiency, including lower monthly energy bills, and better resale value of the home, home energy efficiency can be consumer-driven. Appendix F outlines potential savings referenced against various energy cost scenarios (i.e. $/kilowatt-hour, $/gallon of fuel, etc.). In addition to opportunities that individual citizens and builders can implement, local government may play a supportive role, such as the following:

§ City government should support Energy Star (or equivalent) energy standards programs. The waiver of certain fees that are currently assessed on new home construction is one method of supporting these standards.

§ City government will enforce current new home construction energy codes and ensure that the energy efficiency label is completed and affixed to each new home interior breaker panel.

§ Government should support the establishment of a Greenhouse Gas/Energy Conservation Team comprised of local citizens. The Team would develop and implement educational programs on homeowner energy efficiency.

Make existing homes more energy efficient

According to the 2000 Census, approximately 72% of Missoula homes were constructed before 1990. In addition, 17% of Missoula housing units were built before 1939, when energy efficiency was not a focal point. Therefore, it is safe to assume that there are significant potential savings in energy efficiency measures for older homes. In addition to opportunities that individual homeowners and landlords can implement, local government may play a supportive role, such as the following:

§ City government can encourage State legislators to support the continuation and increased funding of the Universal System Benefit Program that helps the District IX Human Resource Council weatherize the homes of low and moderate-income households.

§ The City of Missoula will encourage home energy audits and increased awareness of older home energy efficiency. Through the Greenhouse Gas/Energy Conservation Team, ongoing education programs focused on home energy efficiency will be supported.

Buy energy efficient appliances

Local government, business, and the conservation community should promote the distribution of information to consumers on promotions and incentives to buy Energy Star appliances. The Energy Star designation is more than a standard for home energy efficiency. It also provides standards for appliances, including heating, ventilation, and cooling systems, washers and driers, refrigerators, stoves and a number of home-related energy consuming items.

Invest in renewable energy

There are a number of ways to invest in renewable energy options, including individual solar electric (photovoltaic) generators for home power sources, solar hot water, and/or other independent renewable systems. In addition, individuals will soon have the ability to purchase electric power generated from various sources including wind, hydroelectric, natural gas, or coal generated. By selecting a renewable electrical energy source like wind or hydroelectric, consumers will be reducing greenhouse gas emissions.

The City of Missoula should promote the distribution of information to consumers on renewable energy options.

Conserve existing resources

Conservation measures available to all consumers include turning off all electronic items when not in use, such as lights, TVs, stereos and home office equipment. In addition, set climate control temperatures to minimal levels of comfort to conserve energy.

Support climate friendly products and services

As outlined earlier in this chapter, ways to significantly save on energy use and the generation of greenhouse gases include general concepts of *Reduce, Reuse, and Recycle*. Examples abound. Many citizens have access to two or more vehicles when the need to travel exists. If possible, use the vehicle that is most energy efficient for the trip. When practical, save boxes, packaging, and bags for reuse at the first available opportunity instead of purchasing new items. When shopping, prioritize the purchase of items that have higher levels of recycled content, focus on reusable packaging, and recycle discarded packaging.

Support local agriculture

Take advantage of farmers' markets, community-supported agriculture and other ways of buying from local farmers. Food purchased close to the farm where it's grown can provide the opportunity for energy savings. In addition, by buying locally produced items, you support the local economy.

## Chapter 4 - Transportation Sector

The transportation sector includes anything with an internal combustion engine involved with transportation. The transportation sector is projected to account for approximately 18% of the Missoula area $eCO_2$ emissions by 2010, an increase from about 12% in 1990. Emissions from the transportation sector are predicted to increase faster than emissions from the other sectors because the population in the Missoula area is growing and on average, individuals are driving more miles each year (i.e. per capita vehicle miles traveled is increasing.)

Methods for reducing transportation greenhouse gas emissions:

- Ø Reduce fossil fuel use.
- Ø Encourage alternative-fuel and high efficiency vehicles.
- Ø Improve transportation efficiency for all system users.

Transportation measures to reduce fossil fuel use

A. Support continued investment in Missoula's Bicycle, Pedestrian and Transit System

- § Investigate the feasibility of East/West bicycle Commuter Ways
- § Investigate "Safe Routes to School Program" for local implementation so children can walk/bike to school safely (see Appendix G)
- § Encourage urban development in a manner that provides close access to services, is bicycle and pedestrian friendly, provides for mixed uses, and offers a range of mobility choices
- § Improve the quality, convenience, affordability and awareness of walking, bicycling and public transit
- § Explore the possibility of train service in Missoula

B. Promote options to reduce the number of single occupancy vehicles

- § Improve the quality, convenience, affordability and awareness of teleworking, ride sharing and vehicle sharing.
- § Create a car share network
- § Increase vanpooling, carpooling, bicycle and pedestrian travel, public transit, teleworking, and employer and neighborhood based transportation demand programs

C. Support Transportation Demand Management programs and projects

- § Encourage City employees to reduce automobile travel for commuting and City business

D. Actively support programs that educate the public about the benefits of non-motorized transportation options.

Improve access to alternative-fuel and high fuel-efficient vehicles

A. Support a program for lowering $eCO_2$ emissions

- § Encourage the use of alternative-fuel vehicles by the city fleet
- § Implement use of clean fuels on all public mass transit vehicles

- § Maximize the efficient use of alternative fuels, such as biodiesel, by the City fleet
- § Encourage use of alternative-fuel vehicles throughout community
- § Continue to evaluate new transportation ideas and technologies

B. Support the purchase of high-efficiency vehicles
- § Purchase high-efficiency vehicles for the city fleet
- § Consider developing a rebate program for residents or businesses who purchase hybrid or other high-efficiency vehicles

C. National Programs
- § Support federal initiatives to increase vehicle average fuel economy
- § Support the development of alternative fuel vehicles (i.e. hydrogen)
- § Support the development of renewable fuels for vehicles

<u>Improve transportation efficiency for all system users</u>

A. Implement roundabouts where feasible and practical.
B. Continue optimization of the City's traffic signals
C. Encourage separation between bike/walk facilities and motor vehicles
D. Encourage and support route optimization throughout the transit system

In Appendix G is a summary of existing transportation programs that reduce $eCO_2$ emissions. Transportation programs in place in 2003 accounted for 537 tons $eCO_2$ emission reductions. If several of the programs mentioned above were implemented, plausible $eCO_2$ reductions would be 36,500 tons per year.

## Chapter 5: Commercial/Institutional Opportunities

The commercial sector in the Missoula Valley accounted for approximately 16.2% of the total greenhouse gases generated in 1990, and this number is projected to grow to 16.7% by 2010. The commercial sector includes office, retail, merchant, and educational facilities.

The 1999 Commercial Building Energy Consumption Survey (CBECS) published by the Federal Energy Information Administration, reports the following, which highlights vast opportunities for increased energy efficiency in this sector:

- Approximately 14% of commercial floor space nationwide is heated or cooled with efficient heat pumps.
- Less than a third of space heating and cooling use three fundamental conservation practices (economizers, variable air volume and management/control systems).
- Only half the floor space uses multi-pane windows and only half use reflective/shading windows.
- Only a quarter of floor space uses natural lighting and 57% uses inefficient incandescent lights.
- While 90% of the floor space uses standard fluorescent bulbs, only 62% has the more efficient electronic ballasts on those bulbs.
- During off-hours, only 76% of floor space lighting is decreased, 59% of space heating and 58% of space cooling floor space is reduced, and as little as 13% of office equipment is turned off.

There is a natural progression to achieve energy-efficiency. First, low or no-cost opportunities are identified and implemented (including practices, not just equipment). Second, opportunities for upgrading equipment and systems, with an emphasis on cost effectiveness and energy efficiency, is implemented. Third, energy efficient opportunities are identified that pay the organization back over many years. Opportunities for energy efficiency can be identified through intensive energy audits. Savings can be calculated and capital investment and/or expensed repair and replacement investment can be budgeted.

Generally, retail operations place customer comfort first. However, comfort can be provided with energy efficient equipment and systems. Comfort and energy efficiency do not have to be in conflict with each other. In fact, retail operations, as well as other commercial/institutional operations, provide a unique opportunity to educate the recipients of their goods and services about energy efficiency, if they promote and publicize their energy efficiency efforts.

In commercial sectors, competition engenders efficiency and cost cutting. In many cases, energy is second only to labor as a cost of production, with labor accounting

for approximately 40% of GDP and energy about 20%. Increases in productivity are well known as the only free lunch in economics (e.g. it allows growth and employment without any inflation). Therefore, energy productivity (total energy costs divided by GDP) is at least half as important as labor productivity; yet, energy productivity is scarcely mentioned. Therefore, it is critical that energy efficiency be linked with competitiveness and profitability in the minds of commercial managers.

Institutional managers are often under equal cost-cutting pressure, though not always from competition, and they tend to have longer time frames for investment decisions.

Detailed, ongoing scrutiny, through energy audits and perpetual energy management programs, are obligatory to realize large opportunities for reduced energy use and expenditures. These opportunities are seldom obvious and may require commercial and institutional businesses to consult with energy management firms for opportunity identification.

Finally, it is important to remember that energy efficiency savings are potentially greater than straight forward return-on-investments calculated to the full-payback period. This is due to the huge economic externalities in the energy sector of the economy --i.e. costs to society and to the environment--that are not calculated and incorporated into the market price for energy. These externalities can be very large. For example, estimates have placed the "externalized" cost of gasoline $10/gallon. Some of these externalized costs include the effects of climate change, impacts on the public's health from pollution, and government subsidies for fossil fuels.

Organizations can choose on their own to adopt improvements that have a one to ten year pay back (the shorter the more attractive). Government can provide incentives that can help by shortening the pay-back period through investment tax credits and supportive fee structures.

Strategies to promote energy efficiency in commercial and industrial sectors include:

<u>Existing Buildings: Thermal Efficiency</u>

Buildings with walls having open cavities -- either open framing studs or concrete block with open cores -- are candidates for retrofit using blown-in foam insulation..
Retrofitting traditional commercial roof structures with improved insulation.
Improving air sealing around windows, doors, elevator shafts and other openings in the building envelope.
Potential savings for these envelope measures—insulation, air sealing, and shading—could represent a decrease of 12% in sector energy use.

<u>Existing Buildings: Lighting Efficiency</u>

Replace existing incandescent and halogen lighting with energy efficient fluorescent lighting.
Replace standard fluorescent with energy efficient fluorescent (T-8 lamps and electronic ballasts) lighting.
Install lighting control equipment to reduce the amount of lighting in vacant spaces where not needed. In addition to the savings on lighting energy, more efficient

lighting will reduce space cooling needs, as well as the operating time of central blowers.
Increase the use of controlled natural lighting.
Potential savings from lighting efficiency measures could be a 16% reduction in energy consumption.

Existing Buildings: HVAC (Heating, Ventilation and Cooling) Efficiency

New standard heating and cooling equipment can be 20% more efficient than HVAC units 15 years and older. Higher efficiency units may double the savings.
Energy Management Systems (EMS) automatically control the heating and cooling system of a building, along with other components, such as lighting. EMS systems will also monitor energy use and help reduce bills by reducing the peak use of electricity.
Increase duct and pipe insulation and repair all leaks – either air or liquid.
Optimize the performance of economizers or air handling systems that bring in outdoor air for "free cooling" during mild weather.
Potential energy savings from all of the HVAC measures could be a 14% decrease in energy use.

Existing Buildings: Hot Water System and Equipment Efficiency

Hot water systems in commercial buildings may use circulating systems which provide heated water at any time to any faucet, or other outlet in the building. There are several efficiency measures that can be applied including water-saving fixtures and appliances, increased insulation on water heating equipment and piping, reducing unintended circulation of hot water, and replacing equipment with more efficient units.
Appliances and electronic equipment range from grocery store freezers to highly sophisticated, computer controlled systems. An increasing array of equipment is available with the EnergyStar label. Whenever existing buildings upgrade, selecting more efficient models is usually cost effective.

New Commercial Buildings: Thermal Efficiency, HVAC Efficiency, Alternative Energy Options, and Hot Water Efficiency

New commercial building construction offers numerous opportunities to institute energy savings. Nearly all of these strategies are listed above, however, implementing them during new construction offers greater efficiencies at less cost than attempting to retrofit existing buildings.

Greening Fleets

Large businesses and institutions frequently have their own fleet of vehicles, including diesel-fueled large equipment and vehicles. Refer to the chapter on Transportation to review a number of efficiency initiatives for vehicle fleets.

## Chapter 6: Industrial Opportunities

### Business Benefits

Industry creates the products that drive our economy and industry supports the lifestyle that Americans demand. In the creation of these products, vast amounts of energy are required, and in many cases, energy is the largest cost component in the creation of products. According to estimates derived from local power producers, industrial energy use accounts for approximately 47% of the total energy consumed in the Missoula metropolitan area, with a resultant impact on greenhouse gas generation. Due to the significant effect of energy use on the cost of industrial products, cost control measures receive routine focus; however additional cost cutting measures can be identified. It is important to recognize the need for all consumers of industrial products to focus on three core concepts that have been pervasive throughout this plan: reduce, reuse, and recycle! Without reducing core consumption, industrial capacity will continue to increase in order to meet consumer demand. Increasing controls on industrial emissions could further aggravate global environmental challenges by exporting our industrial capacity to foreign countries with little-to-no environmental consciousness.

Increasing the energy efficiency of process equipment, lighting, steam systems and building shells are among the most cost-effective actions that industrial companies can undertake. Across a broad range of industries, these types of improvements are saving industries millions of dollars each year.

Along with reductions in costs, the benefits of climate-protecting resource management strategies can include:

- Enhanced labor and equipment productivity (examples include improved lighting for better process control and improved comfort)
- Positive publicity, community relations, and recognition of the company's efforts to protect the environment
- Positive impact on employee morale due to the contribution to a noble effort
- Reduced business risk associated with energy price volatility, environmental regulation and carbon-based taxes

In light of these benefits, it is no surprise that companies are increasingly connecting environmental responsibility with overall financial performance. Directly and indirectly, an investment in energy efficiency and climate protection can bring improved operating margins, greater market visibility and, ultimately, higher market valuation for the company.

### Energy Efficient Actions and Opportunities to Consider

Increased energy efficiency can provide cost-effective emissions reductions and bring significant savings to a company. Cost-effective efficiency measures can take many different forms, depending on the size and age of the facility and the financial position of the company.

In Appendix H, documentation and potential savings cataloged by various industrial energy conservation constituencies are outlined. The measures documented are not necessarily representative of the industries in the Missoula area. Due to very strict competitive pressures on forest products industries, which account for the largest percentage of industrial capacity in the Missoula Valley, energy efficiency measures have been focused on to-date and brought to the bottom line of their financial statements. However, additional opportunities abound.

## Appendix A

### History and Background Information

Missoula's Involvement in Energy Efficiency and Reducing Greenhouse Gas Emissions

The Missoula City Council formed the Subcommittee on Greenhouse Gas (ghg) Reduction and Energy Conservation in June 2001 to develop a local action plan to reduce our local contribution to global warming and to increase our energy efficiency locally. This document represents the results of that work.

Throughout the process that developed this action plan, energy saving opportunities were emphasized. We also tried to be pragmatic. Since there is a great deal of information available on both energy efficiency and greenhouse gas reduction, and we felt no need to "reinvent the wheel," we made use of models from other communities to develop our initial drafts for each section. But to "reality test" it, we conducted a series of roundtables with representatives from the various sectors to better understand what Missoula was already doing (a great deal) and what proposed steps were possible or too difficult, or not really relevant. A Roundtable on Housing was held March 26, 2002; Transportation on Dec. 11, 2002; and Commercial/Institutional on April 22, 2003. The committee then revised and finalized the plan reflecting the comments submitted by those participants. We benefited greatly from this feedback. Plausible $eCO_2$ reductions were calculated based on the information collected.

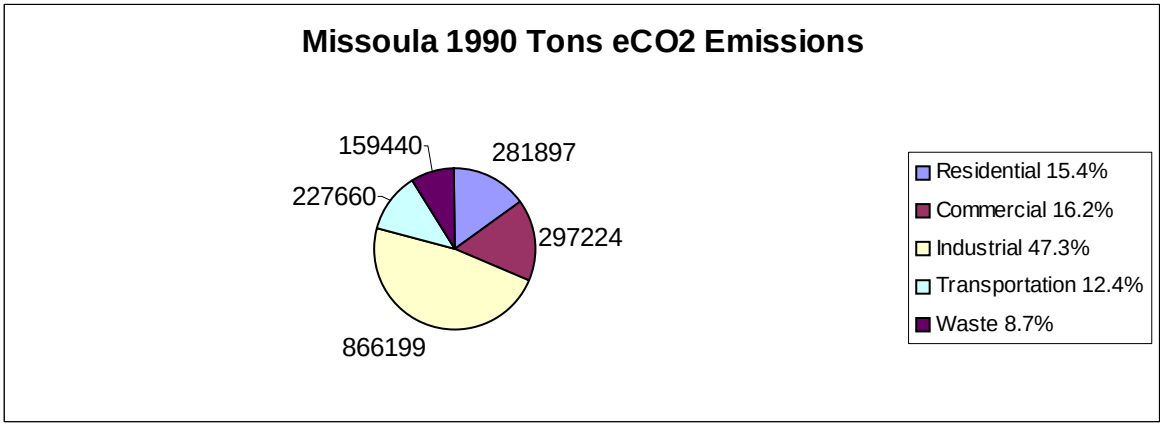
We learned, for example, that the University of Montana has been experimenting with geothermal heating (among many other things). Many efforts in the transportation sector are known, such as Biodiesel conversions and non-motorized transportation projects. Creative residential developments are being built, such as HomeWORD's Gold Dust project which includes photovoltaics on the roof, providing 30-50% of the building's electric power needs; efficient radiant floor heat; and is made of sustainable, recycled materials such as wheatboard and low-maintenance, reusable materials such as metal siding.

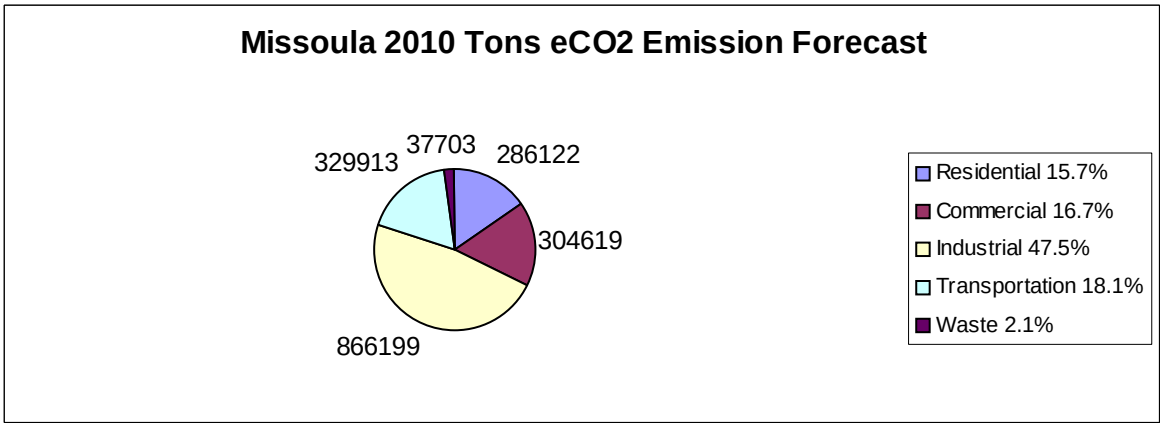
Our pragmatism leads to another emphasis. As often as possible we strove for recommendations that were incentive-based and stressed education and technology transfer. That's because most actions taken in Missoula to reduce GHG emissions and save energy will be done by individual citizens, businesses, schools and institutions and not by regulations.

Cities For Climate Protection

On June 17th 1996, mayor Dan Kemmis signed a resolution passed by the Missoula City Council "Expressing support and agreement in joining the Cities for Climate Protection Campaign." (Appendix B) Within that resolution the city of Missoula pledged to "join with cities from all over the world in the Cities for Climate Protection Campaign" and to "take a leadership role in increasing the energy efficiency of and reducing the ghg from its own local government operations" and to "develop a local action plan to increase energy efficiency and reduce ghg throughout the community."

With the help of the Health Department, Missoula has completed the first of five steps in the Cities for Climate Protection five-milestone framework (Appendix D). We have a Missoula Greenhouse Gas Emission Inventory and a Greenhouse Gas Emission Forecast, see charts below. This forecast does not take into account new mandated regulatory requirements or business's continuous improvement processes.




In the mid 1990's, a methane flare was completed at the Missoula landfill (waste section). By flaring methane (CH4) into $CO_2$, the landfill greenhouse gas emissions were reduced for 2010. A molecule of methane has about 24.5 times more global warming potential than a molecule of $CO_2$. Methane is produced by the decomposition of organic materials under anaerobic conditions. Sometime in the future, the landfill methane may be used to generate electricity.

The inventory found the industrial sector to be the largest at 47.3% of emissions, and its share is projected to grow to 47.5%. The commercial sector accounted for 16.2% in 1990 and will grow to 16.7% in 2010. The residential sector was 15.4% and will be 15.7%. Transportation contributed 12.4% of the share of emissions in 1990 but will increase to 18.1% by 2010. On the other hand, the landfill produced 8.7% of the emissions in 1990 but is projected to drop to a mere 2.1% in 2010 because the methane at the landfill is now burned in a flare.

The inventory also calculated the projected emissions by sector in tons of $eCO_2$ and millions of BTUs of energy consumption in the year 2010 (see table below).

Community $eCO_2$ Emissions and Energy use in 2010, Summary Report

| Sector | Tons eCO2 | Sector % of eCO2 | Energy (million Btu) |
|---|---|---|---|
| Residential | 286,122 | 15.7 | 2,832,142 |
| Commercial | 304,619 | 16.7 | 2,384,609 |
| Industrial | 866,199 | 47.5 | 8,532,568 |
| Transportation | 329,913 | 18.1 | 4,189,287 |
| Waste | 37,703 | 2.1 | Not Applicable |

Community-wide, the total emissions for 2010 are projected to be 1,824,555 tons of $eCO_2$ and 17,938,606 million BTUs energy used.

Could Local Actions Alone Resolve the Global Warming and Energy Crisis?

While a single local government cannot resolve the global warming crisis, and while national and international leadership is crucial, local actions can have a dramatic influence on national and global issues. For instance, throughout 2003 local and state governments in the United States have been pressuring our federal government with petitions and legal tools to take action on global climate change. Also, local governments like Missoula that are members of Cities for Climate Protection represent 18% of all U.S. ghg emissions. If all Cities for Climate Protection members reduced their jurisdiction emissions by 10%, the impact on ghg emissions would be significant.

Retooling the entire energy infrastructure of the planet must ultimately be a coordinated international effort. Implementing local and state greenhouse reduction plans is one step towards encouraging dramatic federal and international action on global climate change and energy efficiency.

Benefits of Adopting a Greenhouse Gas Reduction Plan

In addition to fighting global warming, adopting the above steps produce other benefits:

1) Increased energy efficiency and decreasing fossil fuel use lowers the cost of operating a home, a business, or a government facility.

2) Increased efficiency, reducing demand for goods and services, or switching to renewable energy reduces emissions of other air pollutants in addition to carbon dioxide. This leads to cleaner air, reduced demand for health services and lower economic losses from lost work time.

3) Energy efficiency services and renewable energy are both vibrant, rapidly expanding economic sectors that provide jobs, economic development and tax receipts. A prominent local example of this is Missoula-based Montana

Biodiesel which provides fuel for a University of Montana bus and other customers.

4) National security is increased by a diverse, local, and renewable energy source. Relying on volatile countries in the Middle East and elsewhere for energy puts the United States economy at risk.

5) Fossil fuels are a very finite resource. Current predictions are that the demand for oil will exceed supply around 2009 (*The Myth of Spare Capacity*, Oil and Gas Journal, March 20, 2000). This will cause prices to increase. By constructing infrastructure and increasing use of renewable energy supplies now, adverse economic impacts can be reduced when fossil fuel supplies start to decrease.

**Appendix B**
**City Council Climate Protection Campaign Support**

RESOLUTION NUMBER __5890__

A RESOLUTION OF THE MISSOULA CITY COUNCIL EXPRESSING SUPPORT AND AGREEMENT IN JOINING THE CITIES FOR CLIMATE PROTECTION CAMPAIGN.

WHEREAS, at the 1992 Earth Summit in Rio de Janeiro, the United States signed the United Nations Framework Convention on Climate Change, which calls for reducing greenhouse gas emissions to 1990 levels by the end of the decade; and

WHEREAS, actions taken to reduce greenhouse gas emissions and increase energy efficiency can provide multiple local benefits to the City government and the community by decreasing air pollution, creating jobs, reducing energy expenditures, and saving money for the City and its citizens; and

WHEREAS, the City of Missoula has already developed numerous energy conservation and energy efficiency programs and policies, including placing heavy emphasis on Transportation Demand Management (TDM) strategies in the update of Missoula's Long-Range Transportation Plan; "Try A Better Way Day," the 20% Club, and Bike/Walk Week; the addition of bicycle racks to buses; membership in the United States Department of Energy's Clean Cities program to encourage and promote the use of alternative fuels; Mountain Line's Clean Air Express; Mountain Line's major employer pass program; the Downtown Circulator Bus; the Public Works Department's pilot traffic calming project, sponsored and funded by the Montana Department of Environmental Quality; membership in, and support of, the Missoula-Ravalli Transportation Management Association (MR TMA); adoption and implementation of Missoula's Non-Motorized Transportation Plan; and

WHEREAS, the Cities for Climate Protection Campaign, sponsored by the International Council for Local Environmental Initiatives, Public Technology, Inc. and the U.S. Environmental Protection Agency has invited the City of Missoula to become a partner in the Campaign; and

WHEREAS, the Cities for Climate Protection will provide participating cities with:

* a framework for determining the sources of local greenhouse gas emissions;

* information and assistance on developing a local action plan which outlines the actions and measures that will be pursued to achieve greenhouse gas emissions reduction;

* publications such as the *Climate Action Tool Kit for Municipal Managers, and Profiting from Energy Efficiency;*

NOW THEREFORE, BE IT RESOLVED that the City of Missoula pledges to join with cities from all over the world in the Cities for Climate Protection Campaign; and

BE IT FURTHER RESOLVED that as a participant in the Cities for Climate Protection Campaign, the City of Missoula pledges to:

1. Take a leadership role in increasing the energy efficiency of and reducing the greenhouse gas emissions from its own local government operations.

2. Develop a local action plan to increase energy efficiency and reduce greenhouse gas emissions throughout the community. The plan will include a baseline emissions analysis, a greenhouse gas (ghg) emission forecast, an inventory of existing energy conservation and ghg emission reduction programs and a strategy for meeting the ghg reduction target.

PASSED AND ADOPTED this __17th__ day of June, 1996.

ATTEST: APPROVED:

_____ _____

Martha L. Rehbein Daniel Kemmis

City Clerk Mayor

(SEAL)

**Appendix C**
**Round Table Participants**

**Roundtable on Housing, March 26, 2002**
Jim McGrath, City Council
Lou Ann Crowley, City Council
Jerry Ballas, City Council
Ed Childers, City Council
Sue Von Tersch, Gillespie Realty
Scott Hansen
Jim Morton, Human Resource Coucil
Tony Tweedale, Citizen
Don Garramone, Missoula Building Industry Association President
Deb Harris, City Clerk
Lori Davidson, Missoula Housing Authority
Benjamin Schmidt, Health Department
Erich Zimmerman, Citizen

**Roundtable on Transportation, December 11, 2002**
**Committee members present:** Jim McGrath (Chair), Lou Ann Crowley
**Others present:** David Harmon, Ron Mueller, Bob Giordano, Nancy McKiddy, Jim Greene, Erich Zimmerman, Jan Hoem, Rich Boberg, Dave Levinson, Mike Kress, Randy Vztin, Beth Wright, Jan Scher, Jeo Gottlieb, Jerry Taylor Walf, Leif Griffin, Laura Howe, Phil Smith, Nora Knell, Melissa Wangler, Ken Willett, Jennifer Sutton, Jim Habeck, Jim Leiter (BFI), David Max, Dennis Foy, John Couch, David Merrill, Jeff Renz, Diane Benjamin, Tracy Mumma, David Sturman, Ben Schmidt

**Commercial/Institutional Roundtable, April 22, 2003**
**Committee members present:** Jim McGrath, Chair; Lou Ann Crowley.
**Others present:** Laura Howe, Hugh Jesse, David Merrill, Ben Schmidt, Jane Latimer, Ronald Mueller, Claudia S. Brown, Tony Tweedale, Deb Harris.

**Appendix D**
**International Council for Local Environmental Initiatives**
**Cities for Climate Protection**

Their home web page is at: http://www.iclei.org/co2/

The international Cities for Climate Protection jurisdictions represent 8% of global greenhouse gas emissions.

**Appendix E**
**Recycling**

In 2002, the Missoula area recycled 6252 tons of cardboard, 365 tons of aluminum, 2464 tons of newspaper, 200 tons of magazines, 1370 tons of non-ferrous metal, 75 tons of plastic, 454 tons of paper and 9500 tons of scrap metal. Based on an average weight of 1800 pounds per vehicle, the Missoula County junk vehicle program recycled 777.6 tons of steel in 2002. Approximately 20% of material that can be recycled in Missoula is recycled. This is compared to a national average of 30%. An increase in total recycling to 30% of waste through increased services and education by 2012 is plausible. Since it will be difficult to increase the recycling rate for materials such as iron that already have a high recycling rate, other materials such as cardboard and plastic would need to increase recycling rates more to achieve an overall 30% recycling rate.

The table below shows the new $eCO_2$ reductions if recycling increased to 30%. The non-ferrous metal category was not calculated at this time because the $eCO_2$ reductions from recycling this category are unknown. Due to lack of information, battery recycling was not included.

Plausible Sector $eCO_2$ Emission Reductions if Recycling Rates Increased to 30%

| Category | Increased Recycling in Tons | $eCO_2$ Reduction in Tons |
|---|---|---|
| Cardboard | 625.2 | 1988 |
| Aluminum | 36.5 | 605 |
| Newspaper | 246.4 | 732 |
| Magazines | 20 | 50 |
| Plastic | 7.5 | 14 |
| Paper | 45.4 | 182 |
| Scrap Metal | 950 | 1,871 |

*$eCO_2$ reductions calculated with Torrie Smith & Associates Software.

Total $eCO_2$ reductions if recycling increased from 20% to 30% in the Missoula area: 5442 tons $eCO_2$ per year.

**Appendix F**
**Residential Building Energy Efficiency Resource List**
**and**
**Potential Money Savings**

**The Consumer Guide to Home Energy Savings** (Wilson and Morrill), 5th edition, 1996, available from the American Council for an Energy Efficient Economy at 510-549-9914.

**Homemade Money** (Heede and the staff of RMI), 1995, available from the Rocky Mountain Institute at 970-927-3851.

**Fact sheets on Increased Insulation, Air Sealing, High Performance Windows, and Right-Sized Air Conditions** available from the U.S. EPA toll free Energy Star Hotline at 1-888-STAR-YES (1-888-782-7937).

**Heat Pumps** and other **energy efficiency fact sheets** available from the Energy Efficiency and Renewable Energy Clearinghouse (EREC), P.O. box 3048, Merrifield, MA 22116, 1-800-DOE-EREC (1-800-363-3732)

Consumer energy efficiency **fact sheet and resource list** (recommended) at www.eren.doe.gov/erec/factsheets/eehouse.html

**International Ground Source Heat Pump Association**, 499 Cordell South, Oklahoma State University, Stillwater, Oklahoma 74078-8018 (1-800-626-4747). Web site www.igshpa.okstate.edu/

**Building America**, U.S. Department of Energy, Office of Building Systems, EE-41, 100 Independence Ave., SW Washington, D.C. 20585-0121

Energy Star Web Site: www.energystar.gov

Minnesota Web Site: www.me3.org/issues/efficiency

GeoExchange Web Site: www.geoexchange.org/home.htm

Montana has a $250.00 tax credit for ground source heat pump systems that can be used for 4 years ($1000.00 total state tax credit). Montana Tax Form ENRG-B.

Montana State tax credits available for insulation and other winterization expenses for existing homes.

Free home energy audits by Xenergy (1-800-823-5995).

**Potential Money Savings**

RESIDENTIAL: Replace incandescent w/ compact fluorescent bulbs in a family home.

1) At $0.08/kwh electric cost, replace 75W incandescent with 25W fluorescent:

75W - 25W = 50W/bulb average saving
50W x 10 bulbs x 10 hr/d x $0.00008/W = $0.40 per day saved (over 10-yr life: $1,460)
$1,460 - [( $10/bulb x 10 bulb) - ($0.5/bulb x 10 incand. bulbs/year x 10 yrs)] = $1,410

2) At $0.14/kwh cost, a total of $2,505 would be saved (over 10 yr life of compact fluorescent bulbs).

**Appendix G**
**Transportation Programs in Place**

Missoula in Motion started a Way to Go! Club on May 1, 2002. People who join the club commit to non-single occupancy motor vehicle commuting at least once per week and participants track their mode of commuting each day. The Missoula in Motion web site is http://www.waytogoclub.com/. As of November 12, 2003, 2242 people have joined the club and over 514 tons of $eCO_2$ have not been released to the air because of member's alternative commuting choices. One of the benefits of the club is that members who log their commuting choices are entered into a monthly prize drawing.

The Missoula-Ravalli Transportation Management Association (MR TMA) coordinates another commuter program. Since March, 1997, MR TMA has coordinated carpools and vanpools for Missoula commuters that live outside of Missoula. Approximately 15 tons of CO2 emissions are reduced each year by this program.

Free Cycles Missoula is a citizen organization that collects and restores old bicycles for those in need. From 1996 to 2003, 3,200 bicycles were collected and 1,600 rebuilt. See http://strans.org/freecycles.html for more information. The Safe Routes to School Program website is http://www.saferoutestoschools.org/.

Mountain Line, the local bus system, has offered a summer youth ride free program since 1997. In the first summer of the program youth ridership increased over 800%, which reduces $eCO_2$ missions by over 8 tons per year. Because the summer youth ride free program is so successful, Mountain Line plans to continue this program into the future.

On the vehicle and fuel front, Missoula County now owns and operates 3 high efficiency hybrid gas-electric vehicles and all Missoula uses 10% ethanol, a renewable fuel, in its gasoline from November 1 through the end of February each year.

Missoula also has a Bicycle/Pedestrian Coordinator who works to improve conditions for bicyclist and pedestrians. Several bike/pedestrian bridges have been constructed around town to improve the transportation network for these groups and most new construction includes bike and pedestrian infrastructure. With safer and more convenient access, more people will chose to bike and walk as a choice in transportation.

**Appendix H**
**Industrial Energy Efficiency**

The following table shows typically recommended energy efficiency measures and their associated economics. It is based on Climate Wise documentation of 4,300 manufacturing companies audited from January 1990 through July 1997.[1]

| Recommended Energy Efficiency Measures and Associated Economics | | | | | |
|---|---|---|---|---|---|
| **End Use** | **Recommendation Rate** | **Avg. Annual** | **Average** | **Average** | |
| **Average** | | **Energy** | **Project Cost** | **Annual Cost** | **Simple** |
| | (percent of audited | **Savings** | | **Savings** | **Payback** |
| | facilities) | (MMBtu) | ($) | ($) | (months) |
| | | | | | |
| Boilers | 20 percent | 2,600 | $5,300 | $7,200 | 9 |
| Steam Systems | 13 percent | 2,400 | $3,300 | $7,100 | 6 |
| Furnaces & Ovens | 4 percent | 2,500 | $5,500 | $8,100 | 8 |
| Process Heating | 1 percent | 3,600 | $7,500 | $12,200 | 7 |
| Heat Containment | 22 percent | 1,100 | $1,100 | $5,1 00 | 9 |
| Heat Recovery | 26 percent | 3,700 | $16,500 | $12,500 | 16 |
| Cogeneration | 3 percent | 31,000 | $667,500 | $233,600 | 34 |
| Air Compressors | 68 percent | 300 | $1,600 | $4,300 | 5 |
| Process Cooling | 6 percent | 1,000 | $18,900 | $11,200 | 20 |

Other measures analyzed under the Climate Wise program are water conservation, recycling, pollution prevention and educational outreach. As this table shows, the profitability of recommended measures is outstanding-so much so that payback can be measured in months rather than years.

To help firms identify their own efficiency and climate protection projects, the Climate Wise program has developed a toolkit, *Wise Rules for Industrial Energy Efficiency.* The kit has simple rules for estimating energy savings and greenhouse gas emissions in six major categories: boilers, steam systems, process heating, waste heat recovery and cogeneration, compressed air systems and process cooling.

A 10 % reduction on the forecasted 2010 energy use would reduce eCO2 emissions by 87,000 tons per year and save 850,000 million BTU per year.

**Footnotes**

1. "The Climate Action Plan" by Burlington Climate Protection Task Force, Burlington, Vermont, April 2000: Industry Section, pg 9.