CITY OF MISSOULA

CONSERVATION & CLIMATE ACTION PLAN

CONTENTS

LETTER FROM THE MAYOR'S CLIMATE ACTION PLAN TASK FORCE

Dear Friends,

What makes the City of Missoula such a wonderful place to live, work, play and engage with family, friends and neighbors?

Some say it's the easy access to rivers, mountains, and open space. Others talk about the mix of vibrant local businesses, sporting events, outdoor concerts, farmer's markets, and family-friendly gatherings that make our city so unique. Some just say it's something intangible – the quality of life in Missoula that's pretty darned exceptional.

We, the members of Missoula's Climate Action Plan Task Force, believe that Missoula is a wonderful place – and keeps getting better – in large part because of its people. Business leaders, teachers, government employees, students, and citizens routinely work hand-in-hand with elected leaders to protect our public resources, support the local economy, and help care for this community.

We also understand that when challenges come up, community members must rise to meet them. And because we believe our city is unique, we want to help craft good decisions that will protect it for the long term. We can't predict the future, but we do know that our city will keep growing and changing — and that we'll need to find new, efficient ways to power our buildings and provide goods and services to citizens. And, with climate change already causing drought, declining snowpack, and shifts in our native plant and animal species, it is ever more critical to protect the clean air and clean water that are the lifeblood of our economy and our community.

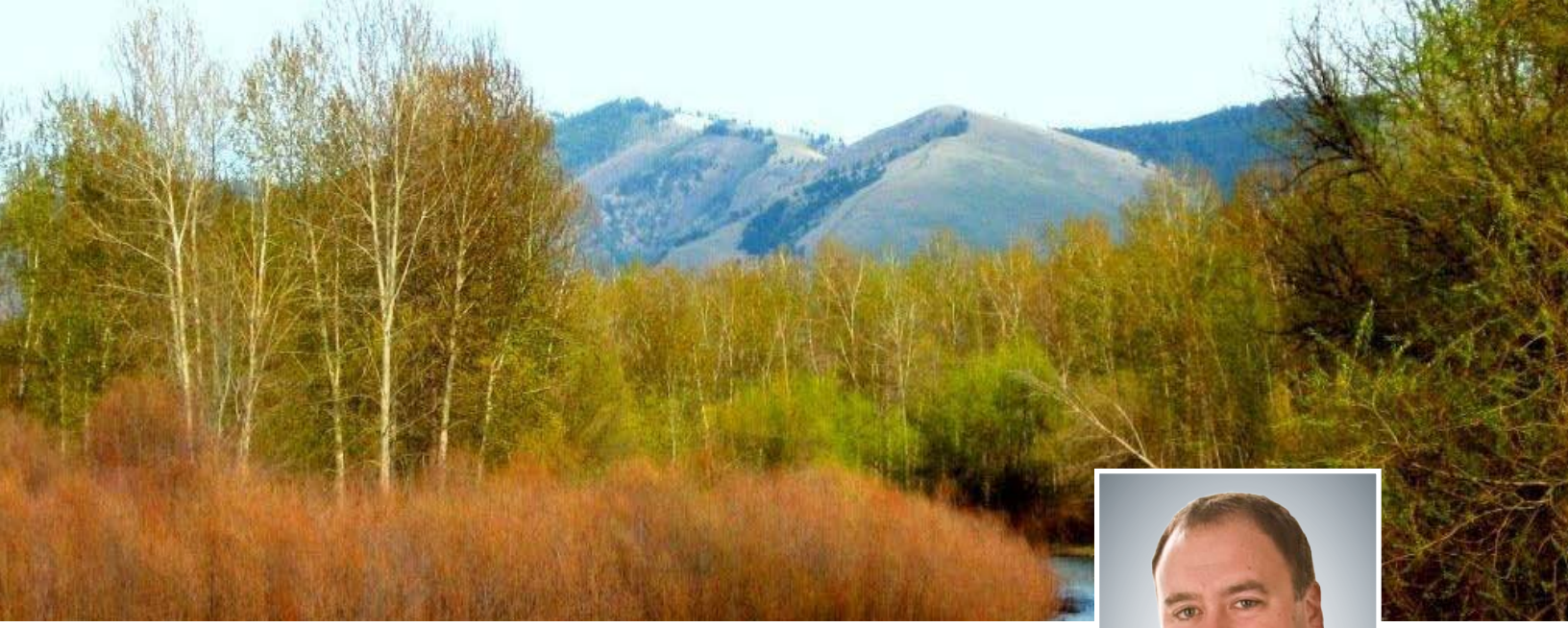
In 2009, the City of Missoula took an inventory of its municipal energy use and carbon footprint, and Mayor John Engen convened this Task Force to move from research to action. We, the members, include small business owners, City employees, conservation professionals, University representatives, and more. Over the course of a year, we consulted with an even wider, more diverse group of individuals to develop conservation actions that will streamline our city-wide operations, reduce costs, decrease consumption, and build a safer future for the City of Missoula. We feel that this plan—although ambitious—is absolutely necessary. We also recognize that as we move forward, the plan will likely evolve and improve thanks to the ingenuity and dedication of Missoula's City government.

Many thanks are due to the City employees, local citizens, business leaders, and groups who contributed to this plan. In particular, Chase Jones and Andrew Valainis deserve special recognition for all their hard work and for keeping the rest of us on track. And most importantly, we thank Mayor Engen for convening this group and trusting us to create a plan this community deserves.

Please take a look at what our City can do, and then help support our local leaders as they implement these actions. A more efficient and sustainable Missoula won't happen overnight, and it won't happen without you. Together, we can create common-sense solutions that protect our valued way of life in the face of a changing climate. Together, we can set an example worthy of Missoula.

Thank you.

The Mayor's Climate Action Plan
Task Force, Missoula



LETTER FROM THE MAYOR

November 5, 2012

Greetings and welcome to our Conservation & Climate Action Plan.

Good work takes time, even when it's urgent.

There's no question that the City of Missoula feels a sense of urgency around climate change and our responsibility to do our part to temper it. We made a commitment years ago to our citizens and fellow municipalities to join in the effort to use less energy and generate fewer greenhouse emissions.

The work has been detailed and challenging. First, we had to commit. Then we had to understand what our carbon footprint looks like. Then we had to acknowledge that we have to balance our responsibilities to deliver services to our citizens with our responsibility to protect our environment for generations to come. Finally, we had to have a plan.

The plan in your hands is the product of the work of an extraordinary group of committed citizen volunteers with various areas of expertise who have created a practical way for the City of Missoula to become carbon neutral over time. It's smart, it's understandable and we've committed resources to ensuring it's put to work.

This is a good thing, a long time in the making, that will have consequences for many years to come. With this plan, we further commit to doing the right thing.

Sincerely,

John Engen
Mayor

ACKNOWLEDGMENTS

Prepared by

Chase Jones, *LEED Green Associate, Missoula Office of Planning and Grants*

Andrew Valainis, *Energy Corps Member, Missoula Office of Planning and Grants*

"Missoula "We picked carbon neutrality as a goal, because we believed that Missoula can get it done. Let's put our city on the map as having a dedicated and comprehensive program for mitigating our impacts to the climate."

- ROSS KEOGH

Task Force Members

Amy Cilimburg, *Montana Audubon (Task Force Co-Chair)*

Ross Keogh, *Sagebrush Energy (Task Force Co-Chair)*

Jill Alban, *Clark Fork Coalition*

Dan Daly, *Roseburg Forest Products Co.*

Chase Jones, *LEED Green Associate, Missoula Office of Planning and Grants*

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Bryan von Lossberg, *Alternative Energy Resources Organization*

Ginny Merriam, *City of Missoula*

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Robin Saha, Ph.D., *University of Montana*

Beth Schenk, *St. Patrick Hospital and Health Sciences Center*

Ben Schmidt, *Missoula City-County Health Department*

Jack Stucky, *City of Missoula*

Andrew Valainis, *Energy Corps, Missoula Office of Planning and Grants*

Krisztian Varsa, *University of Montana (Previous Energy Corps Member)*

Executive Summary

The City of Missoula has been engaged and involved in conservation and climate action-related commitments, projects, work and planning for many years as part of Municipal Operations. Each step has been an important block to a solid foundation of reducing energy consumption, saving money and contributing to a healthy, clean environment. This Municipal Conservation & Climate Action Plan (MCCAP) is the synergy of these activities and will serve as the formal roadmap and latest iteration of City actions to achieve and maintain commitments, resolutions and goals. Milestones include: joining the Cities for Climate Protection Campaign (1996), signing the U.S. Conference of Mayors' Climate Protection Agreement (1996), and conducting Missoula's first Greenhouse Gas Inventory (2009).

The City of Missoula believes that it is uniquely positioned to act as a leader and catalyst for positive action in the community through conservation and climate action planning. Operating efficiently and saving money is a high priority for the City. Conservation and climate action planning is an effective way to identify strategies that reduce energy and fuel consumption, lean operations, save money and free up funds to allow for long-term stability and viability. Climate change is a present and growing risk to Missoula's environment, economy, quality of life, and community. The City of Missoula is committed to taking action to mitigate greenhouse gas emissions, acting as a steward to sustain natural resources and our environment for future generations through conservation.

Emissions Inventory

In 2008, Missoula Mayor John Engen requested the assistance of University of Montana (UM) Environmental Studies professor Robin Saha and UM students in conducting a detailed municipal greenhouse gas (GHG) emissions inventory for Missoula. This inventory examines changes in emissions from fiscal years 2003 to 2008 to determine sectors and sources within sectors for which emissions are increasing, decreasing and remaining stable over time. 2008 was chosen as the "target year" because it was the most recent year for which an entire year's data could be obtained when the inventory began. Included in the inventory was a list of recommended actions that the City should take. One of them, and a logical next step, was to set a reduction target and develop a climate action plan. Municipal emissions for 2008 totaled 11,540 metric tons of Carbon Dioxide equivalents (mtCO2e). This value served as basis for the emissions targets and interim goals described in this document.

> "This plan, ambitious as it is, provides a solid foundation for a broader community climate action plan. It will no doubt catalyze Missoulians to craft a broader plan that sets us on the path to a sustainable and prosperous future, one that is fitting for this wonderful landscape and our children who will call it home."
>
> - AMY CILIMBURG

Emissions Reduction Targets and Goals

The greenhouse gas emissions target for the City of Missoula is to be carbon neutral by 2025. Carbon neutrality means that through conservation and reduction measures, along with the purchase of Carbon Offsets, the City's net greenhouse gas emissions will be zero. Achieving carbon neutrality requires the purchase of some form of Carbon Offsets[1] to account for emissions that remain after conservation and other forms of reduction have been fully explored. Short-term, interim goals were established to encourage beginning reduction activities as soon as possible and to help measure and track progress towards the overall carbon neutrality target. Those goals are:

Target:
Carbon Neutral by 2025

Interim Goal #1:
10% Reduction from 2008 baseline by 2015

Interim Goal #2:
30% reduction from 2008 baseline by 2017

Interim Goal #3:
50% reduction by 2020

Task Force and Working Groups

In 2011, Mayor Engen appointed members from his Mayor's Advisory Group on Climate Change and Sustainability, the Greenhouse Gas Energy Conservation Team, and other key community members to form a task force charged with drafting a Conservation & Climate Action Plan. The Task Force developed plan objectives and outlined emissions reduction goals. They then identified three areas of focus to craft the MCCAP: Fleet and Facilities, Internal Policies and Practices, and Renewable Energy and Offsets. These were created with focus areas that would be complementary parts of a holistic approach to emissions reductions. Each area of focus became a formal subcommittee or Working Group, with Task Force members self-assigning themselves based on expertise and interest. Next, Task Force members suggested additional working group members from the community for recruitment. From there, strategy creation was executed at the Working Group level while the Task Force served as the overall vetting and advisory body, as well as Plan and Process architect. Overlap and collaboration among strategies was intended and will increase the positive effects of each.

Strategies

The conservation and climate action strategies are the roadmap to reducing City energy consumption, costs, and emissions, and are steps to achieving conservation and climate action goals. In the Action Plan document, strategies include projected implementation costs, annual energy and dollar savings, and avoided emissions where possible. Estimates and projections are based on published research, case studies and best practices from established agencies, organizations and other municipalities, and are referenced in each strategy. Exact costs, savings, and avoided emissions will be tracked and reported after implementation where possible and will be evaluated on a case-by-case basis. Strategies included in this plan are intended to be the first in a series of Plan updates as we continually adjust to the changing realities of economics, technology, government policies, and our ecosystems. Table 0-1 below lists the strategies included in the Action Plan. They are organized alphabetically within each working group and subcategory.

[1] A Carbon Offset is one metric ton of carbon dioxide equivalent (CO_2e) that is taken out of the atmosphere, or one metric ton of CO_2e that is not emitted to the atmosphere. Carbon Offsets are generated by carbon sequestration or emissions reduction activities that are quantified, reported, verified, validated, and certified via the regulatory or voluntary market. ClearSky Climate Solutions: www.clearskyclimatesolutions.com

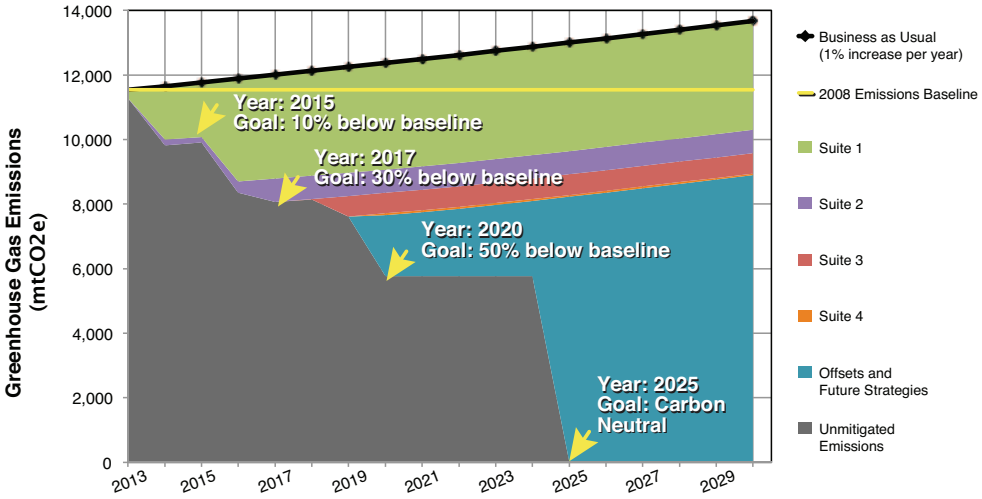


Figure 0-1: Impact of Implementing Strategy Suites on City of Missoula Greenhouse Gas Emissions, Showing Interim Goals

Implementation

Using the tentative timeline established by the Task Force for implementation of each strategy, the City will achieve all of the interim goals and carbon neutrality target described in this Plan. However, in order to achieve them, progress must begin immediately. Below are crucial steps that should be taken as soon as possible to facilitate implementation.

Establish a Full-time, Dedicated Staff

A dedicated, full-time staff member to oversee this Plan is needed to successfully implement recommended strategies across all departments and staff and produce the desired results and expected benefits. This staff person would take responsibility for the coordination of the City's conservation and climate action efforts. This would include strategy implementation and establishing timelines for review and updates to the City's Greenhouse Gas Emissions Inventory and Conservation & Climate Action Plan.

The importance of establishing a full-time, dedicated staff to oversee the City of Missoula's Conservation & Climate Action Plan and associated activities was recognized and approved in the budget for Fiscal year 2013 with an FTE. Specific job description, details and hiring will occur in Fiscal year 2013. Once hired, the FTE will interact and collaborate where appropriate with all levels of City government including the Mayor/Administration, Staff, City Council, Mayor's Advisory Group on Climate Change and Sustainability, Greenhouse Gas Energy Conservation Team and stakeholders to ensure success.

Establish a Data Monitoring and Reporting System

Collecting data and reporting on the impacts of each strategy is essential to the Climate Action Planning process. Tracking and monitoring provides evidence of energy, fuel, water, and cost savings, feedback on project success, and progress toward goals. In addition, it provides sound reasoning and results to justify continued internal and external investment and funding.

Establish a Budget and Financing Strategy

This plan presents a wide variety of strategies, and thus requires a robust mix of funding mechanisms. Many recommendations will require both financial and human investment. Below is a list of commonly used mechanisms to be included and used as appropriate and available.

- Integration and Inclusion in annual City Budget
- Grants
- Energy Savings Performance Contracts
- Bonds
- Revolving Loan Funds
- Utility Rebates and Incentives
- Reinvestment of Rebates, Incentives, and/or Energy Savings
- Public/Private Partnerships

Table 0-1: Conservation and Climate Action Strategies

FLEET AND FACILITIES

- **Fleet**
  - Bike Fleet Infrastructure
  - Eco Drivers Manual
  - Efficient Fleet Vehicle Purchasing (Fuel economy)
  - Expand Route Optimization Software/GPS
  - Hybrid/Electric Vehicle Purchasing
  - Sustainable Commute Infrastructure (Bike, etc.)
  - Utilize Cleaner Fuels
- **Facilities**
  - Continuous Building Retro and Re-commissioning for Existing Buildings
  - Groundwater Cooling Systems
  - LEED for Existing Buildings: Operations and Maintenance Policy (EBOM)
  - Real-time Energy Monitoring Systems
  - Shut Off/ Remove Water Fountain Cooling
  - Water Wise Bathroom Features
  - Water Wise Park Areas

INTERNAL POLICIES AND PRACTICES

- **Employee Commute**
  - Employee Commuting Incentive Program
  - Flexible Work Scheduling
  - Rideshare Scheduling plan for Employees
- **Employee Culture**
  - Conservation and Sustainability in Work Plans and Annual Review
  - Fostering Sustainable Workplace
  - Include Conservation and Sustainability in Job Descriptions
  - Include Sustainability in Employee Orientation
- **Products, Procurement, & Facilities**
  - Green Purchasing Policy
  - LEED for New Construction and Major Renovations Policy
  - Paper and Printing Policies
  - Reduce Electronics Energy Use
  - Waste Stream Reduction Policy

RENEWABLE ENERGY AND OFFSETS

- **Renewable Energy**
  - Enhance Methane Utilization at Wastewater Treatment Plant (WWTP)
  - Micro-hydropower Electricity Generation at WWTP
  - Solar PV Installations on Municipal Buildings
  - Solar Thermal Heating System and Thermal Pool Blanket at Splash Montana and Similar Energy Efficiency Improvements at Currents
- **Offsets**
  - Carbon Offset Development
  - Carbon Offset Purchasing
- **Carbon Sequestration**
  - Missoula Open Space Portfolio
  - Poplar Plantation near WWTP
  - Urban Tree Planting and Maintenance

RECOMMENDED ACTIONS

- **Fleet and Facilities**
  - Aeration blower retrofit
  - Building De-Construction Policy
  - Review Operation-and-Maintenance (O&M) Program for MCCAP Integration
- **Internal Policies and Practices**
  - Incentives and Department Competitions
- **Renewable Energy and Offsets**
  - Expansion of Solar Thermal at Fire Stations

CONSERVATION DEMONSTRATION PROJECTS

- **Fleet and Facilities**
  - Compost
  - Gray Water Systems (Purple Pipe)
  - Green Roof
  - Hydrogen Fleet Retrofits
  - Native and Water Wise Garden around City Hall
  - Permeable Surfaces
- **Renewable Energy and Offsets**
  - AlgEvolve Pilot Project

COMMUNITY CCAP PROJECTS

- **Fleet and Facilities**
  - Street Light Efficiency Retrofit
  - Traffic Light Efficiency Retrofit
- **Internal Policies and Practices**
  - Ride share on community level
- **Renewable Energy and Offsets**
  - Community Solar PV Project
  - Wetland Development and Riparian Enhancement

INTRODUCTION

The Case for the Plan

Operating Efficiently and Saving Money

The City of Missoula is committed to maintaining the high levels of service to the community that make Missoula a wonderful place to live and do business. As a result, the City is always looking for ways to reduce operations costs and to do more with less. Conservation & Climate Action Planning is an effective way to identify strategies that reduce energy and fuel consumption, lean operations, save money and free up funds to allow for long-term stability and viability. Implementing the strategies and activities in this plan emphasizes resourcefulness, efficiency and fiscal responsibility.

Energy and Natural Resource Conservation

The City of Missoula should operate as a steward to sustain natural resources and our environment for future generations through energy and resource conservation. The City of Missoula recognizes that fossil fuels and other natural resources are finite and that we need to take action to reduce their consumption. This plan identifies strategies and practices that enable City operations to optimize efficiency, work wisely and responsibly, and utilize technology and innovation to consume less, reduce costs, and build resiliency for the future.

Maintaining a Healthy Environment and Community

Climate change is a present and growing risk to Missoula's environment, economy, quality of life and community. Therefore, the City of Missoula is committed to taking action to mitigate greenhouse gas emissions. Decreasing greenhouse gas emissions, especially by reducing dependence on fossil fuels, will help mitigate the associated negative impacts to human health, including asthma and respiratory diseases, heart disease, and mercury-related neurological damage. At the same time, reducing fossil fuel use decreases harm to the environment by reducing air pollution, acid rain, and drought.[2,3] Actions outlined in this plan will reduce the City's operational emissions and will contribute to local clean air, clean water, community health and long-term prosperity.

Government Leading by Example

The City of Missoula believes that it is uniquely positioned to act as a leader and catalyst for positive action in the community through Conservation & Climate Action Planning. The plan creation process has been an exercise in broad collaboration with diverse organizations and individuals and represents the Task Force's collective experience and expertise. Plan implementation, tracking and reporting will be an opportunity for local government to provide best practices, lessons learned, case studies, helpful resources and replicable strategies that will hopefully empower other organizations, businesses, agencies and individuals to engage in energy conservation and climate action activities.

City of Missoula Conservation & Climate Change Milestones

The City of Missoula has been engaged and involved in conservation and climate action related commitments, projects, work and planning for many years. Each step has been an important block to a solid foundation of reducing energy consumption, saving money and contributing to a healthy, clean environment. This Municipal Conservation & Climate Action Plan (MCCAP) is the synergy of these activities and will serve as the formal roadmap and latest iteration of City actions to achieve and maintain commitments, resolutions and goals. Milestones include:

1996 – U.S. Conference of Mayors' Climate Protection Agreement Signed

1996 – Cities for Climate Protection Campaign

2004 – Missoula Greenhouse Gas – Energy Efficiency Plan

2004 – Greenhouse Gas and Energy Conservation Team Established

2007 – City Council Resolution #7241 – Energy Efficiency and Greenhouse Gas reduction policy for municipal building

2007 – Mayor's Advisory Group on Climate Change and Sustainability Established

[2] Union of Concerned Scientists. "The Hidden Cost of Fossil Fuels." 2002. http://www.ucsusa.org/clean_energy/our-energy-choices/coal-and-other-fossil-fuels/the-hidden-cost-of-fossil.html
[3] Physicians for Social Responsibility. "Coal Fired Power Plants: Understanding the Health Costs of a Dirty Energy Source". http://www.psr.org/assets/pdfs/coal-fired-power-plants.pdf

2008 – City Council Resolution #7375 – Fuel and energy reduction policy

2008 – First City "Green Team" forms with staff from 18 Departments

2009 – Mayor's Memorandum on new employee Green Policy based upon City Green Team recommendations for ways to reduce energy, fuel and product use.

2009 – Missoula Greenhouse Gas Emissions Inventory & Analysis

2009 – Energy Efficiency & Conservation Block Grant (EECBG) successful application

City of Missoula Greenhouse Gas Inventory

In 2008, Missoula Mayor John Engen requested the assistance of University of Montana (UM) Environmental Studies professor Robin Saha and UM students in conducting a detailed municipal greenhouse gas emissions inventory for Missoula. In addition to identifying and quantifying various direct and indirect emissions from municipal operations, this inventory examines changes in emissions from fiscal years 2003 to 2008 to determine sectors and sources within sectors for which emissions are increasing, decreasing and remaining stable over time. The year 2003 was chosen as the baseline for the inventory because it was the earliest year for which hard-copy records of purchased energy existed for most sectors. 2008 was chosen as the "target year" because it was the most recent year for which an entire year's data could be obtained when the inventory began. Included in the inventory was a list of recommended actions that the City should take. One of them, and a logical next step, was to set a reduction target and develop a climate action plan. This document represents that effort.

Municipal emissions for 2008 totaled 11,540 metric tons of Carbon Dioxide equivalents (mtCO2e). This value served as a basis for the emissions targets and interim goals described in this document. As seen in Figure 1-1 below, the largest contributing sectors to the City's carbon footprint were wastewater treatment, municipal buildings, and municipal vehicles. This information helped the Task Force identify key areas in which to focus conservation efforts.

The 2008 inventory needs to be updated. City operations are dynamic and constantly changing, and concerted efforts have been made to reduce the City's emissions since the inventory was published. Continually updating the inventory as new data and methods become available will help track and show progress and allow for analysis of the effectiveness of each strategy. It will help identify areas for improvement and continue to guide the timing and implementation of new and documented strategies.

The Task Force recommends that the greenhouse gas emissions inventory for municipal operations be regularly updated every two years, starting in 2013.

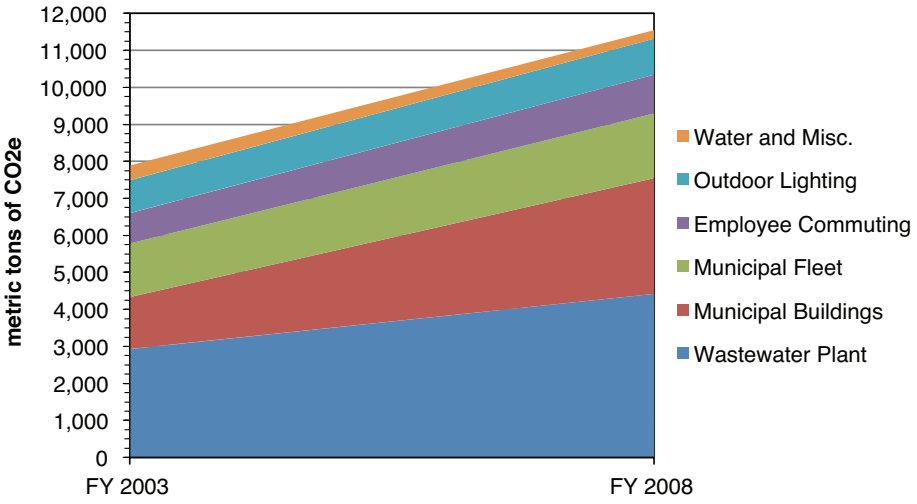


Figure 1-1: Growth in City of Missoula Greenhouse Gas Emission in Metric Tons of CO2e by Sector in FY2003 and FY2008 (Saha et al, 2010)

Conservation & Climate Action Plan

Scope

This Conservation & Climate Action Plan focuses wholly on municipal operations. This was identified by the Task Force as the logical first step and foundation to community-wide or larger efforts. There was much Task Force enthusiasm and interest in larger-scale planning, but it was decided that the current City staff and budget capacity was in line with a Municipal scope. In addition, the Task Force agreed that the "City's house must be in order first" to successfully lead or collaborate on broader conservation and climate action planning activities.

Many activities that reduce fuel and energy consumption, reduce operations costs, and address climate change have occurred continually and for years in City operations. However, they have occurred departmentally and have not necessarily been comprehensively documented or planned. This plan is an effort to document past and current activities and provide an overall road map for future City conservation and climate action activities.

Mitigation

According to the Intergovernmental Panel on Climate Change's Fourth Assessment Report, "mitigation means implementing policies to reduce GHG emission and enhance sinks." Adaptation is defined as "initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects."[4] In essence, mitigation focuses on reducing the amount of emissions produced to lessen the severity of the effects of climate change, while adaptation focuses on adjusting habits, processes, and ways of life in response to the changes produced. Both are important and necessary as communities discuss the implications and effects of climate change on their ways of life.

This plan emphasizes mitigation as a natural first step. The document presents a mix of climate action strategies and conservation activities. Both are vital to mitigating the effects of climate change. Adaptation and other methods will likely be included in future updates to the plan. The Clark Fork Coalition has recently published a report discussing adaptation strategies for the Missoula community.[5] The report is a synthesis of a two-day Climatewise Community Workshop hosted by the Clark Fork Coalition in 2011. The workshop focused on educating attendees about the impacts of climate change on the local economy and community and developing and discussing strategies designed to address risks and impacts. The City should continue to collaborate with the Clark Fork Coalition as its Climatewise work continues and develops.

Foundation for a Community Wide Conservation & Climate Action Plan

The Municipal Conservation & Climate Action Plan (MCCAP) is to serve as a learning process and foundation for the final goal of developing and implementing a community-wide effort. The City hopes to lead by example and use this plan as a catalyst for positive action in the community. A well developed and supported community-wide Action Plan is necessary to maximize the positive effects on Missoula's environment, economy, and community. The successful completion and implementation of a Municipal Conservation & Climate Action Plan will allow the City to provide case studies, best practices, and methodology to the community-wide planning process.

Municipal Conservation & Climate Action Plan Objectives

To define what the MCCAP intends to attain or accomplish, Task Force members identified the following plan and process objectives:

- Document Past and Current Conservation & Climate Action Activities
- Set Emissions Reduction Target
- Identify Potential Conservation & Climate Action Strategies
- Evaluate Potential Actions' Feasibility
- Recommend Implementation Strategy
- Establish Plan for Monitoring and Reporting

[4] IPCC Fourth Assessment Report: Climate Change 2007: Working Group III: Mitigation of Climate Change - Glossary
[5] Clark Fork Coalition. "Missoula County Climate Change Primer: Strategies To Care For Our Community, Land & Water." 2011.

Working Groups

To achieve plan objectives and outline emissions reduction goals, the Task Force identified three areas of focus to craft the Action Plan: Fleet and Facilities, Internal Policies and Practices, and Renewable Energy and Offsets. Each area of focus became a formal subcommittee or Working Group, with Task Force members self-assigning themselves based on expertise and interest. Next, Task Force members suggested additional Working Group members from the community for recruitment. From there, strategy creation was executed at the Working Group level while the Task Force served as the overall vetting and advisory body, as well as Plan and Process architect.

In deciding on Working Group areas of focus, the Task Force recognized the incredible opportunity as well as the complexity of City Operations. To achieve desired results, Working Groups had to be chosen with a holistic approach that encompassed the built environment, human interaction, and emerging technology and innovation.

The focus areas for each working group were created as complementary parts of a whole that will meet the challenge of emissions reductions. Strategies developed by the Fleet and Facilities working group include infrastructure, building energy use, vehicles and equipment, fuel use, and staff commuting. Strategies developed by the Internal Policies and Practices working group include operations policies, workplace culture, purchasing, and employee health and wellbeing. Strategies developed by the Renewable Energy and Offsets working group include renewable energy generation, carbon sequestration projects, and carbon offsets. Overlap and collaboration among strategies was intended and will increase the positive effects of each.

We are lucky in Missoula to have community members who volunteered many hours on the Task Force and Working Groups and who possessed the professional, diverse knowledge and professional skill set to provide the needed ideas, input and technical knowledge to develop robust strategies in each focus area.

Greenhouse Gas Emissions Targets

The greenhouse gas emissions target for the City of Missoula is to be carbon neutral by 2025. Carbon neutrality means that through conservation and reduction measures, along with the purchase of Carbon Offsets, the City's net greenhouse gas emissions will be zero. Achieving carbon neutrality requires the purchase of some form of Carbon Offsets[6] to account for emissions that remain after conservation and other forms of reduction have been fully explored.

Missoula's baseline amount of annual greenhouse gas emissions is 11,540 mtCO2e.[7] Short-term, interim goals were established to encourage beginning reduction activities as soon as possible, and to help measure and track progress towards the overall carbon neutrality target. These goals are:

Target:
Carbon Neutral by 2025

Interim Goal #1:
10% reduction from 2008 baseline by 2015

Interim Goal #2:
30% reduction from 2008 baseline by 2017

Interim Goal #3:
50% reduction from 2008 baseline by 2020

Discussion on how these were established is included in the Methodology section below.

[6] A Carbon Offset is one metric ton of carbon dioxide equivalent (CO2e) that is taken out of the atmosphere, or one metric ton of CO2e that is not emitted to the atmosphere. Carbon Offsets are generated by carbon sequestration or emissions reduction activities that are quantified, reported, verified, validated, and certified via the regulatory or voluntary market.
ClearSky Climate Solutions: www.clearskyclimatesolutions.com

[7] Missoula Greenhouse Gas Emissions Inventory and Analysis, 2003-2008: Toward a Blueprint for Municipal Sustainability, September 2010.

METHODOLOGY

Emissions Factor for Electricity Produced in the State of Montana

The calculations for greenhouse gas emissions in this document used widely accepted CO2e conversion factors. A list of conversion factors and common variables used throughout the calculations can be found in the Appendix. The amount of emissions generated from the production of electricity depends on what sources of fuel are being used to generate the electricity. After much debate, the Task Force decided to use an emissions factor of 0.432 mtCO2e/MWh, as provided by ICLEI's Climate and Air Pollution Planning Assistant (CAPPA) software tool. "[G]reenhouse gas emissions factors for electricity generation are the most recent available from [EPA's Emissions & Generation Resource Integrated Database (eGRID)], calendar year 2007",[8] which is a credible, reliable, and regularly updated database of emissions factor values. Using this factor would ensure consistency between values from proprietary calculations and those calculated using the CAPPA software itself. Most importantly, using this factor would ensure consistency with the Missoula Greenhouse Gas Emissions Inventory and Analysis, 2003/2008, which also used eGRID 2007 values.

However, this Task Force suggests that greenhouse gas emissions from electricity use presented in this document are underestimates, based on information regarding fuel resource mix from both EPA's eGRID[9] and Northwestern Energy.[10] Values in eGRID are regional, and thus by nature are less accurate than using values provided by local utilities. As seen in Table 2-1, the NWPP Subregion, which includes Montana, has a less coal-intensive resource mix than the reported NorthWestern Energy mix and overestimates the amount of hydro-sourced electricity. This suggests the NWPP value underestimates the associated greenhouse gas emissions. It was beyond the capacity of this Task Force to produce an emissions factor based on the NorthWestern Energy values at this time, though it is highly recommended that this value be pursued for use in future inventories and planning documents.

Use of the Climate and Air Pollution Planning Assistant

"The Climate and Air Pollution Planning Assistant (CAPPA) is designed to help U.S. local governments explore, identify and analyze potential climate and air pollution emissions reduction opportunities… CAPPA includes a customizable and expandable library of more than 110 distinct emissions reduction strategies for local governments. Its calculation functions are based on real-world data from other U.S. communities and a variety of expert sources."[11] Many of the calculations for energy savings, dollar savings, and avoided emissions for the strategies included in this document were

Fuel Source	NWE Reported Resource Mix	eGRID NWPP Subregion Resource Mix	NWWP over(+) & under(-) estimates
Coal	53.0%	32.0%	-21.0%
Oil	7.0%	0.2%	-6.8%
Gas	5.0%	12.8%	7.8%
Other fossil	0.0%	0.3%	0.3%
Biomass	0.0%	1.1%	1.1%
Hydro	21.0%	48.4%	27.4%
Nuclear	0.0%	3.0%	3.0%
Wind	12.0%	1.9%	-10.1%
Solar	0.0%	0.0%	0.0%
Geothermal	0.0%	0.3%	0.3%
Other unknown/purchased fuel	1.0%	0.1%	-0.9%

Table 2-1: Comparison of NorthWestern Energy Reported Fuel Mix Percentages versus Regional NWPP Fuel Mix Percentages

[8] ICLEI – Local Governments for Sustainability USA. "CAPPA User Guide." For CAPPA v1.5. © 2010.
[9] From eGRID2010 Version 1.1 Year 2007 Summary Tables (created May 2011).
[10] "Northwestern Energy Docket D2011.5.41 Spion Kop Wind Project. Montana Public Service Commission (PSC) Set 1 (001-007). Regarding: Portfolio Diversity."June 2011.
[11] ICLEI – Local Governments for Sustainability USA. "CAPPA User Guide." For CAPPA v1.5. © 2010.

conducted in proprietary spreadsheets with researched and available data. CAPPA was used to assist with calculations that would have otherwise been very difficult and time-consuming due to complexity or lack of available data. Proprietary calculations were often cross-referenced with CAPPA calculations and showed consistency.

Explanation of the Suites of Strategies and Relation to Interim Goals

No one strategy will be the best solution to reducing the City's emissions. In order to have a significant impact, it is necessary to implement multiple strategies to allow them to complement each other. The strategies were therefore grouped into suites, to be implemented together.

The Task Force determined that 2025 will be the target year for the City to achieve carbon neutrality. The years between 2013 (the year after drafting of this document) and 2025 were split into segments of 3, 2, 3, and 5 years. The strategies were placed in one of those groupings to be implemented within that time frame, acknowledging that availability of funding and staff time will influence the actual timing of implementation.

The placement into the different suites was based on both quantitative and qualitative factors. The quantitative factors were primarily annual emissions reduction and simple payback. The qualitative factors included simplicity of implementation, pre-existence of groundwork related to the strategy, ability to be a "quick win," and time required for full-scale implementation. Once the suites were established, interim emission reductions goals were created based on the reduction potential from the suites. The suites with their associated interim goals are:

Suite 1 2013-2015: Achieve 10% reduction from 2008 baseline

Suite 2 2016-2017: Achieve 30% reduction from 2008 baseline

Suite 3 2018-2020: Achieve 50% reduction from 2008 baseline

Suite 4 2020-2025: Achieve carbon neutrality

Figure 0-1 (on page 6) shows the impact of the suites on the City's total baseline emissions. The gray area represents the unmitigated emissions after strategies have been implemented. The graph includes a 1% annual growth in emissions to account for intangible or unforeseen contributions to the total emissions (e.g. population growth, new buildings, etc.). The Task Force decided on a 1% emissions growth rate to serve as a placeholder and to simply acknowledge that there will be an increase in emissions over time. Because the City has conducted only one Emissions Inventory, there are not enough data to accurately predict trends in emissions growth. Emissions growth will undoubtedly vary from year to year. Some years the City will experience large spikes due to new buildings, services, annexations or utility enhancements and expansion while others will stay level or grow slowly. The variable nature of emissions growth emphasizes the need for regular Emissions Inventory updates and monitoring over time as called for in the Implementation section in this report. With emissions data over time, growth will be more accurately accounted for and projections will become clearer. Updated data will be reflected in future versions of this graph .With the current set of strategies, the City will need to begin purchasing Carbon Offsets in 2020 to meet its third interim goal. Though the unmitigated emissions levels out in 2020, the 1% increase in emissions still exists. To remain carbon neutral the City would need to increase the amount of Offsets it purchases every year to account for any increase in emissions.

Advances and changes in technology, pricing, and incentives will affect the impacts and cost effectiveness of the strategies included in this plan, as well as present new opportunities and strategies that will contribute to achieving the interim and carbon neutrality goals. These newly identified strategies will be included and implemented as the plan and these suites are continually updated.

> "Collecting data and establishing a baseline allows you to set achievable goals and, more importantly, to know when you need to step up your efforts and when you should be celebrating your successes."
>
> - ANDREW VALAINIS

CONSERVATION AND CLIMATE ACTION STRATEGIES

This chapter details the strategies identified by the Conservation & Climate Action Plan Task Force and Working Groups, which include City Staff. The strategies are the roadmap to reducing City energy consumption, costs, and emissions, and are steps to achieving conservation and climate action goals. Strategies include projected implementation costs, annual energy and dollar savings, and avoided emissions where possible. Estimates and projections are based on published research, case studies and best practices from established agencies, organizations and other municipalities, and are referenced in each strategy. Exact costs, savings, and avoided emissions will be tracked and reported after implementation where possible and will be evaluated on a case-by-case basis. Strategies included in this plan are intended to be the first in a series of Plan updates as we continually adjust to the changing realities of economics, technology, government policies, and our ecosystems.

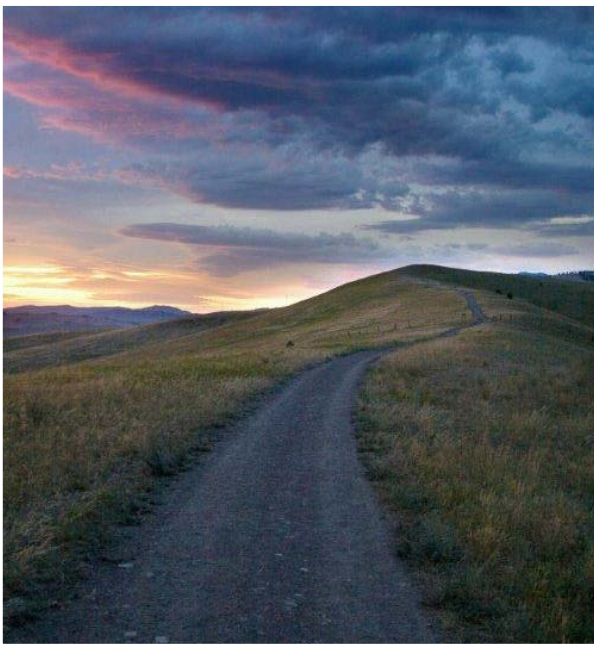


Table 3-1 below lists the strategies included in the MCCAP. They are organized alphabetically within each working group and subcategory.

Figure 3-1 below provides a snap shot of the strategies included in this plan, each represented by a bar on the graph. The benefit of the graph is that it provides a visual comparison of all of the strategies. The vertical axis shows savings or cost per metric ton of CO2e reduced, and the horizontal axis shows the total annual emissions reduction in mtCO2e. The width of each bar is relative to the amount of emissions avoided annually.

The height of each bar above or below the horizontal axis is relative to the savings (positive) or cost (negative) per metric ton of emissions avoided. The savings/cost value is a way to take three important metrics from each strategy (implementation cost, annual savings, and annual emissions reduction) and combine them into one value that can be used to compare all of the strategies at once. Information on how this value was calculated can be found in the Appendix.

The strategies are organized from left to right in order of greatest savings to greatest cost. Note that some of the bars are hard to see since the relative emissions reduction (width) is so small. Some of the bars extend off the graph. The current view is presented to provide the best visual representation of the entire list of strategies. Several strategies are not shown on this graph, due to lack of available data. For example, the projected emissions reductions for many of the employee culture strategies are indeterminable at this time, and so those were not included.

Table 3-1: Conservation and Climate Action Strategies

FLEET AND FACILITIES

- **Fleet**
  - Bike Fleet Infrastructure
  - Eco Drivers Manual
  - Efficient Fleet Vehicle Purchasing (Fuel economy)
  - Expand Route Optimization Software/GPS
  - Hybrid/Electric Vehicle Purchasing
  - Sustainable Commute Infrastructure (Bike, etc.)
  - Utilize Cleaner Fuels
- **Facilities**
  - Continuous Building Retro and Re-commissioning for Existing Buildings
  - Groundwater Cooling Systems
  - LEED for Existing Buildings: Operations and Maintenance Policy (EBOM)
  - Real-time Energy Monitoring Systems
  - Shut Off/ Remove Water Fountain Cooling
  - Water Wise Bathroom Features
  - Water Wise Park Areas

INTERNAL POLICIES AND PRACTICES

- **Employee Commute**
  - Employee Commuting Incentive Program
  - Flexible Work Scheduling
  - Rideshare Scheduling plan for employees
- **Employee Culture**
  - Conservation and Sustainability in Work Plans and Annual Review
  - Fostering Sustainable Workplace
  - Include Conservation and Sustainability in Job Descriptions
  - Include Sustainability in Employee Orientation
- **Products, Procurement, & Facilities**
  - Green Purchasing Policy
  - LEED for New Construction and Major Renovations Policy
  - Paper and Printing Policies
  - Reduce Electronics Energy Use
  - Waste Stream Reduction Policy

RENEWABLE ENERGY AND OFFSETS

- **Renewable Energy**
  - Enhance Methane Utilization at WWTP
  - Micro-hydropower Electricity Generation at WWTP
  - Solar PV Installations on Municipal Buildings
  - Solar Thermal Heating System and Thermal Pool Blanket at Splash Montana and Similar Energy Efficiency Improvements at Currents
- **Offsets**
  - Carbon Offset Development
  - Carbon Offset Purchasing
- **Carbon Sequestration**
  - Missoula Open Space Portfolio
  - Poplar Plantation near WWTP
  - Urban Tree Planting and Maintenance

RECOMMENDED ACTIONS

- **Fleet and Facilities**
  - Aeration Blower Retrofit
  - Building De-Construction Policy
  - Review Operation-and-Maintenance (O&M) Program for MCCAP Integration
- **Internal Policies and Practices**
  - Incentives and Department Competitions
- **Renewable Energy and Offsets**
  - Expansion of Solar Thermal at Fire Stations

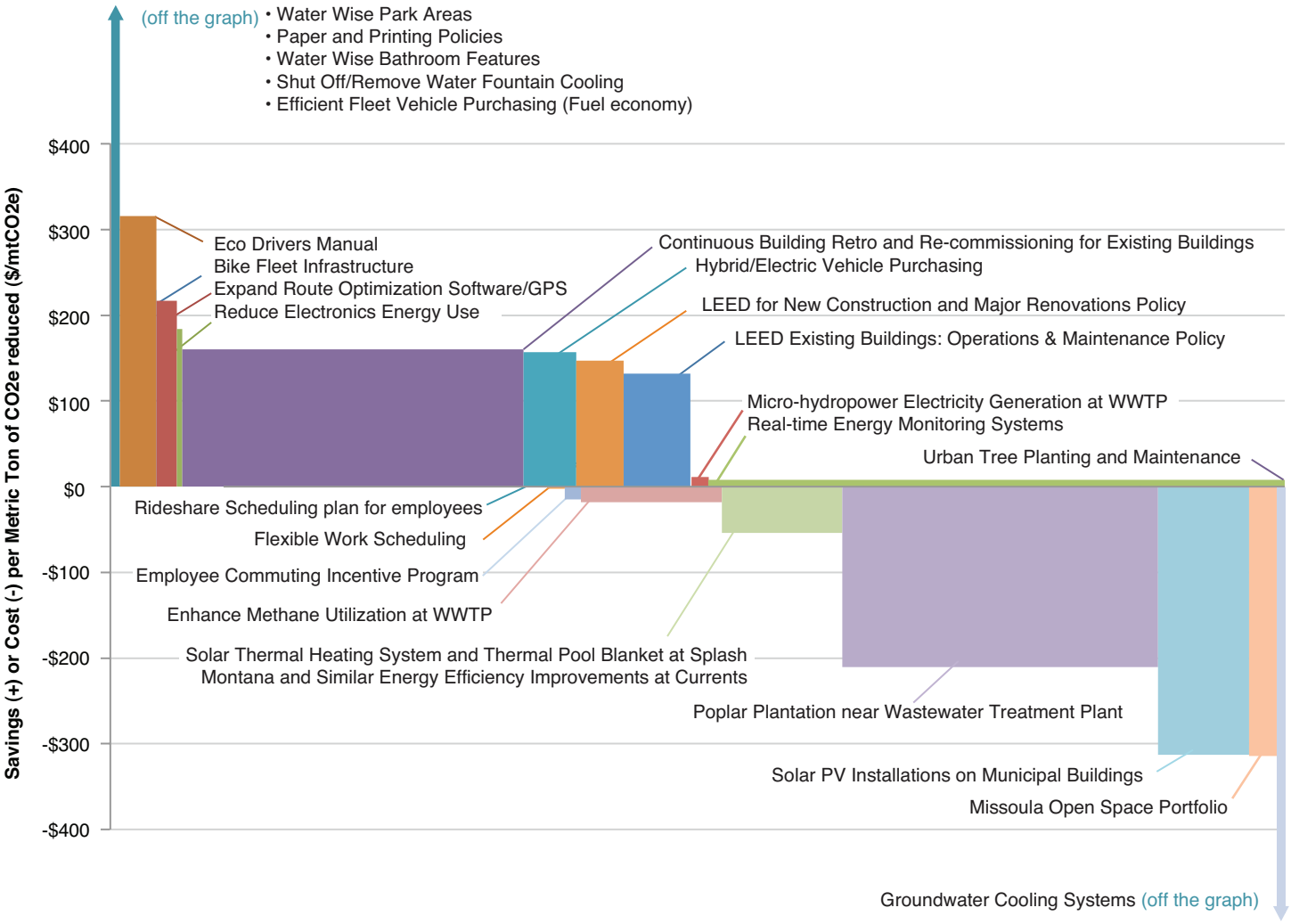
CONSERVATION DEMONSTRATION PROJECTS

- **Fleet and Facilities**
  - Compost
  - Gray Water Systems (Purple Pipe)
  - Green Roof
  - Hydrogen Fleet Retrofits
  - Native and Water Wise Garden around City Hall
  - Permeable Surfaces
- **Renewable Energy and Offsets**
  - AlgEvolve Pilot Project

COMMUNITY CCAP PROJECTS

- **Fleet and Facilities**
  - Street Light Efficiency Retrofit
  - Traffic Light Efficiency Retrofit
- **Internal Policies and Practices**
  - Ride share on community level
- **Renewable Energy and Offsets**
  - Community Solar PV Project
  - Wetland Development and Riparian Enhancement

Figure 3-1: Comparison of Conservation and Climate Action Strategies



Visual Comparison of Strategies

This graph is a visual comparison of strategies based on annual emissions reduction and cost. The benefit of having this graph is the ability to quickly compare strategies to see which have larger emissions reductions and best cost benefits.

The width of each bar is relative to the amount of emissions reduced annually. The wider the bar, the more emissions are avoided every year. The height of each bar above or below the horizontal axis is relative to the savings (positive) or cost (negative) per metric ton of emissions avoided. The savings/cost value is a way to take three important metrics from each strategy (implementation cost, annual savings, and annual emissions reduction) and combine them into one value that can be used to compare all of the strategies at once. Bars extending above the axis generate a net savings. Bars extending below the axis generate a net cost.

The strategies are listed in order of greatest savings (left) to greatest cost (right).

FLEET AND FACILITIES WORKING GROUP

WORKING GROUP MEMBERS

Cherie Peacock, *University of Montana (Working Group Chair)*
Heath Carey, *Terra Mater Solutions, Bioroot Energy*
Dan Daly, *Roseburg Forest Products*
John Freer, *Riverworks Inc.*
Dale Horton, *National Center for Appropriate Technology*
Steve Loken, *Loken Builders*
Heather McMillin, *Homeword*
Hannah Motl, *spectrUM Discovery Area*
Jack Stucky, *City of Missoula*
Starr Sullivan, *City of Missoula*

Nationally, building energy use and transportation are the two largest sectors of municipal emissions. As presented in the 2008 Greenhouse Gas Inventory, Missoula is no exception. The following Fleet and Facilities (FF) strategies include high-efficiency and updated equipment and will produce large decreases in maintenance costs. Often, upgrades and efficiency measures are limited or prohibited by the cost of equipment and available conditions. It is important to continually monitor existing equipment and new products to identify the most cost-effective opportunities.

The way equipment is used is just as important as the efficiency of the machine, as improper use can negate any benefits of mechanical efficiency. This highlights the importance of the relationship between these strategies and those described in the Internal Policies and Practices section.

Fleet and Facilities Completed Actions

Table 3-2 below lists actions already taken by the City within the scope of the Fleet and Facilities working group categories. It is important to recognize these projects and programs and that they be kept in place as we pursue greater reductions in operational costs, energy use, and emissions.

Table 3-2: Fleet and Facilities Completed Actions

Action	Year Implemented
Purchased Hybrid Vehicles	2004
Resolution 7241: Energy Efficiency and Greenhouse Gas Reduction Policy for Municipal Buildings	2007
Resolution 7375: Fuel Energy Reduction Plan	2007
Conducted Lighting Upgrade and Other Energy Efficiency Measures at Central Maintenance Facility	2009
Purchased Plug-In Electric Vehicle	2010
Energy Savings Performance Contract with Johnson Controls	2010
GPS Route Optimization Technology Installed in Select Fleet Vehicles	2011

Fleet and Facilities Strategies

Table 3-3 summarizes the Fleet and Facilities Working Group strategies. Further details are described in the narratives below.

Table 3-3: Fleet and Facilities Strategies

Strategy	Implementation Cost	Est. Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback (yrs)
FLEET				
FF-1 Bike Fleet Infrastructure	$180-$653	$140	0.36	1-4
FF-2 Eco Drivers Manual	< $1,000	$35,000	90.5	< 0.1
FF-3 Efficient Fleet Vehicle Purchasing (fuel economy)	-$121,290	$8,723	22.5	0
FF-4 Expand Route Optimization Software/GPS	$65,313	$19,800	51.6	3.3
FF-5 Hybrid/Electric Vehicle Purchasing	$221,058	$50,572	134	4
FF-6 Sustainable Commute Infrastructure	Unknown	Indeterminable	Indeterminable	Indeterminable
FF-7 Utilize Cleaner Fuels	Unknown	-$14,131/$104,574	165-565	N/A
FACILITIES				
FF-8 Continuous Building Retro and Re-commissioning for Existing Buildings	$89,224	$176,975	862.1	0.5
FF-9 Geothermal/Groundwater Cooling/Heating	$174,000	$2,230	9.63	78
FF-10 LEED EBOM Policy	$88,000	$35,500	169.1	2.5
FF-11 Real-time Energy Monitoring Systems	$105,000	$23,532	1,452	4.5
FF-12 Shut Off/ Remove Water Fountain Cooling	$160	$11,123	4.8	0.16
FF-13 Water Wise Bathroom Features	$27,624	$72,025	1.2	0.41
FF-14 Water Wise Park Areas	$9,583 / acre	$42,560 / acre	0.3 / acre	0.5

"We strive to care wisely for our resources, our people, and our earth. It reminds us that we are responsible, as a large organization, not only for being careful with our financial resources and treating people well, we also need to be good stewards of the environment. Working with the City and other groups to help keep our natural environment clean and healthful is a win-win for us. It keeps the people we treat healthier, helps bring high-quality practitioners to Missoula, and saves energy and resources."

- BETH SCHENK

FF-1 Bike Fleet Infrastructure

RECOMMENDATION

Establish a bike fleet to be used by City staff to attend meetings and other local, work related events.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
FF-1	$180-$653[8]	--	--	40	$140[9]	0.36[9]	1–4 yrs

BACKGROUND

The City of Missoula has a history of encouraging employees' use of sustainable transportation and employee wellness as well as being a model for other businesses. Currently, the City offers covered bike parking for employees and informally encourages the use of bikes (and buses) to attend work-related meetings. The creation of a fleet of bicycles that could be "checked out" (similar to a motor pool) would allow employees who do not bike to work to use a bicycle to attend meetings as opposed to checking out a vehicle from the motor pool.

The City is considered by many to be a progressive city and state-wide leader in both livability and sustainability. Initiating a bike-fleet program reflects the organizational culture and helps the City set an example that is relevant to the concept of an active, livable community.

Benefits of a Bike Fleet:

- Help reduce traffic congestion and emissions, conserve resources and reduce travel costs during the workday.
- Increased employee productivity as it is easy to access many parts of town efficiently by bike due to central location downtown and proximity to Missoula's major bike trails. This allows efficient access to University, North/Westside, as well as the Southside/Mall area.
- Easy access to Mountain Line transfer center making bike/bus trips feasible. An employee could expand the range of the bicycle by combining bus and bike for more distant trips thereby increase the potential use of bikes for work-related travel.
- Improved employee wellness as a bike fleet offers employees a means of getting physical activity during the work day, whether they use it to travel to offsite meetings or run errands during lunch (subject to bike fleet policy).
- Most trips Americans make are short: 49% are less than 3 miles, 39% are less than 2 miles, and 24% are less than 1 mile.[3]
- Bicycling reduces road congestion and air pollution. Traffic congestion wastes nearly 3.9 billion gallons of gas per year in the U.S.

Department
> Bike/Ped Office
> "Motor pool"
> Human Resources/benefits/ wellness

Strategy Target
> Reduce emissions associated with motor pool

Related Strategies
> Fuel & Fleet

Timeline
> Six weeks

Potential Partners
> MIST – FreeCycles Community Bike Shop
> Other local bike shops

Potential Funding Sources
> None identified at this time

FF-1 Bike Fleet Infrastructure Continued

- For every 1 mile pedaled rather than driven, nearly 1 pound of CO2 (0.88 lbs) is saved.[5]
- Bicycling is less expensive than driving a car. The average American household spends $7,179 per year on owning and driving their cars.[6]
- Using data from the Office of Planning and Grants for June-September 2011, taking round trips 4 miles or less by bicycle would have avoided 44.85 VMT (16 of 86 trips)[9]. This would equate to a savings of $10.35 on gasoline and 0.03 mtCO2e.

Similar to the University of Montana bike fleet, the City should "brand" their bikes to make them more recognizable and thus increase the public awareness of the program. This could include painting the bikes the same color, including stickers or labels, etc. This will also help distinguish City-owned bikes from other bikes in the area.

References

1. BiketoWorkInfo.org http://www.biketoworkinfo.org/resources/pdf/Bicycle_Stats_One_Pager.pdf
2. 2-mile map (created by Lewis Kelley, OPG/Transportation)
3. Bikes Belong.org
4. Texas Transportation Institute, 2010. http://www.bikesbelong.org/resources/stats-and-research/statistics/in-2009-congestion-caused-48-billion-hours-of-travel-delay-and-39-billion-gallons-of-wasted-fuel
5. US Environmental Protection Agency, 2009 http://www.epa.gov/OMSWWW/fetrends.htm#summary
6. Bureau of Transportation Statistics, 2010. http://www.epa.gov/OMSWWW/fetrends.htm#summary
7. Equipment Statistics Summary Reports, cerca December 2011
8. Cost Estimates (based on name brand models)

High end: $653

- Bike $550
- Helmet $7 (St Patrick Hospital)
- Paniers $40
- Lock $30
- Headlight $13
- Taillight $13

Low end: $180

- Potential partnership program with Missoula Free Cycles. Monthly rental would include bike, lock, light, helmet, and maintenance (as needed).

9 Office of Planning and Grants Gas Log for Jeep Support Vehicle, June - September 2011. Annual estimates in the included table were extrapolated using monthly averages. These are likely low estimates, since the data is for the months most likely to have the lowest vehicle use for local travel due to better weather conditions. Also, OPG already has a bike in use for local meetings.

FF-2 EcoDriver's Manual

RECOMMENDATION

That City staff use more fuel efficient, "Smart Driving" techniques while operating City fleet vehicles, using recommendations found in a distributed EcoDriver's Manual.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
FF-2	< $1000	--	--	10,200	$35,000	90.5	< 1 mo.

BACKGROUND

The *EcoDriver's Manual* is a manual of "Smart Driving" techniques, which are tips and tricks to improve overall vehicle gas mileage.[1] The manual is endorsed by several car manufacturers and produced by the U.S. Forest Service. Each vehicle in the City's fleet should have an EcoDriver's Manual accessible to the driver. Additionally, all City employees should be given an EcoDriver's Manual during their orientation period. Smart Driving techniques can improve vehicle gas mileage as much as 33%.[1,2] Smart Driving could save up to approximately 10,200 gallons of fuel.[3] This could produce dollar savings of over $35,000 annually,[4] and avoid emitting approximately 90.5 mtCO2e.[5]

EcoDriver's training could be included into defensive driver training that already exists within the City operations. For example, the Parks and Recreation Department requires defensive driver training every three years.

Department

> Human Resources

> Vehicle Maintenance & Facilities

Strategy Target

> Reduce fuel consumption by improving City employees' driving habits with the fleet

Related Strategies

> "Fostering Sustainable Behavior" Book

> Fleet Emissions

> Vehicle Maintenance

> Drive Smoothly

> Maximum Speeds

Timeline

> Implement changes to employee orientation and required vehicle operations documents within one year

Potential Partners

> Automobile Manufacturer's Association

> Missoula County

Potential Funding Sources

> Unknown

References

1. U.S. Forest Service. "EcoDriver's Manual." http://www.fs.fed.us/sustainableoperations/documents/TheEcoDriversManual.pdf
2. Energy and Environmental Analysis, Inc., "Owner Related Fuel Economy Improvements", Arlington, Virginia, 2001.
3. Equipment Statistics Summary Reports, cerca December 2011. Cost and fuel savings are estimated using "practical" fleet vehicles only, i.e. those that could participate in the manual's recommendations without sacrificing efficiency of their duties.
4. Energy Information Association, November 2011. http://www.eia.gov/oog/info/gdu/gasdiesel.asp $3.45/gal unleaded, $4.09/gal diesel. A trending increase in gas prices will increase the dollar savings realized annually.
5. http://www.epa.gov/otaq/climate/420f05001.htm

FF-3 Efficient Fleet Vehicle Purchasing

RECOMMENDATION

Continually analyze and update Missoula's fuel efficiency standards to meet and exceed the most current vehicle efficiency technologies and fuel efficiency standards.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
FF-3	- $121,290	--	--	2,532	$8,723	22.5	0
Per Vehicle	- $10,107[5]	--	--	211[3]	$727[3]	1.9[3]	0[6]

BACKGROUND

As technologies continue to advance and the average fuel economies of modern vehicles increases, so should government policies be updated with higher standards for fleet vehicles.

The City of Missoula already adheres to the purchasing policy set forth by the State of Montana stating that all state vehicle fleets must meet the average fuel economy of 30 MPG.[1,2] Resolution 7375 set forth by the City Council in 2008 addresses the issue at a more local level. This resolution requires that the City:

- Upgrade older diesel vehicles in the fleet to more efficient vehicles
- Rate vehicle per fuel efficiency (on scale of 1-5) and give replacement priority to vehicles with poor fuel efficiency ratings.
- Assess life cycle costs and fuel efficiency when purchasing new fleet vehicles
- "Right sizing" of equipment
- Sell lightly used vehicles to decrease fleet size
- Examine fuel efficiency of "on call" vehicles

The city should also continue to replace low-fuel-efficient vehicles, including vehicles in a different class. These decisions should account for the use of the vehicle, as, for example, certain vehicle classes are necessary for off-road driving. Typically, fuel efficiency in compact cars has been higher than in jeeps, SUVs, and trucks. However, car manufacturers have made significant improvements in the fuel economy of these types of vehicles, and replacing them with a more fuel efficient version in the same class may be just as beneficial as replacing them with a smaller compact car. For the example calculations in this strategy, calculations were based on replacing jeeps and SUV's with compact cars. The example assumes replacing 12 vehicles – the number of vehicles in the City fleet's Jeep/SUV category.[4]

MSRP comparison:[5]
Compact car: $14,592 • Jeep/SUV/Truck: $24,700
Difference: $10,107 in savings (represented as a negative value in the table above)

Department
> Bike/Ped Office
> "motor pool"
> Human Resources/benefits/ wellness

Strategy Target
> Reduce emissions associated with motor pool

Related Strategies
> Fuel & Fleet

Timeline
> 6 weeks

References

1. http://data.opi.mt.gov/bills/mca/2/17/2-17-416.htm
2. http://www.montanaclimatechange.com/gov_activities.php
3. Annual cost savings and avoided emissions will depend on the vehicle(s) being replaced and the vehicle(s) purchased. This example demonstrates savings based on the average fuel economy and fuel usage of current fleet vehicles[4], showing the annual savings per Jeep/SUV replaced with a midsize sedan.
4. City of Missoula - Equipment Statistics Summary Report by Class. Generated 12/1/2011 by Jack Stucky
5. FuelEconomy.gov. MSRP values were used to compare relative implementation costs. Mean values for two 2011 name brand vehicles were used for a "Compact Car", both of which have estimated fuel economies over 30 mpg. Mean values for two 2011 name brand jeep and SUV vehicles were used for a "Jeep/SUV/Truck". The payback value is zero since relative MSRP produces savings not costs.

FF-4 Expand Fleet Route Optimization Software/GPS

RECOMMENDATION

Expand the use of current Fleet Route Optimization Software and installation of associated GPS units in all remaining applicable fleet vehicles and pieces of equipment.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
FF-4	$65,313[2,3,4]	--	--	5,807[2]	$19,800[3]	51.6	3.3 yrs

BACKGROUND

In November 2011, the City purchased and installed GPS units on 52 fleet vehicles and pieces of equipment as well as associated Fleet Route Optimization Software. This action reduces fuel consumption and fleet related greenhouse gas emissions by:

- Reducing excessive idling where the engine is running and the vehicle is not moving. Parameters can be set on proposed units to electronically alert a fleet manager when excessive idling is occurring. They can then call each operator to have them turn off the engine and conserve fuel.
- Allowing utilization of the closest vehicle to a service call as well as providing driving directions to help staff arrive via the most efficient route from their location.
- Maintaining compliance with strategic route management plans to ensure fuel efficiency and cost savings.
- Maintaining efficient fleet vehicle speeds. According to the U.S. Department of Energy, maintaining efficient vehicle speed provides a fuel economy benefit of 7-23%. Proposed units track and display driving speeds, which can be analyzed by fleet managers to achieve desired speeds.[1]
- Allowing detailed analysis of vehicle use to ensure fuel log accuracy and identify fleet reduction possibilities.

According to the City of Missoula's Fleet manager, Jack Stucky, GPS units can reduce fuel consumption by 3%-10% annually. For averaging purposes, the numbers in the table above reflect a projected 7% reduction, and show an annual savings of almost $20,000 and approximately 5,800 gallons of fuel.

Department
> Vehicle Maintenance (lead)
> All departments as necessary

Strategy Target
> Reduce excessive idling
> Optimize fleet route efficiency
> Reduce fleet fuel consumption
> Reduce fleet fuel cost
> Reduce fleet-related emissions

Related Strategies
> "Eco Drivers" Manual
> Efficient Fleet Vehicle Purchasing

Timeline
> Implementation could be completed in 3 months with full funding
> Implementation could be accomplished with a phased approach. If this approach is adopted then fleet could be prioritized and units could be installed as funds permit.

Potential Partners
> N/A

Potential Funding Sources
> General Fund (CIP)
> EPA/DOE/DEQ Grants
> Phased reinvestment of all or partial fuel savings until all applicable fleet vehicle/ equipment are equipped

References

1. U.S. Department of Energy. http://www.fueleconomy.gov/feg/drivehabits.shtml
2. Equipment Statistics Summary Reports, cerca December 2011. Estimates for implementation costs and annual fuel savings are made using data for the entire fleet of vehicles, excluding equipment. Equipment was excluded from these calculations because fuel use data are measured in hours used and not gallons used, making emissions calculations inconsistent. However, there are many potential applications for equipment, and savings from such applications could prove significant. It will ultimately be the decision of Fleet manager Jack Stucky and the department heads to make the decision on which vehicles will receive GPS units.
3. A trending increase in gas prices will increase the dollar savings realized annually. In addition, these calculations used unleaded prices only. For heavy equipment, using diesel fuel, cost savings will be greater
4. Parks Rolling Stock (GPS) Cost Benefit Analysis 2011, prepared for the City of Missoula. Cost estimates include price of the unit and installation. Annual service fees were included in the annual dollar savings values

FF-5 Hybrid and Electric Vehicle Purchasing

Recommendation

Purchase all-electric or hybrid vehicles, where appropriate, when replacing fleet vehicles.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
FF-5[6]	$221,058	-	-54,233	16,254	$50,572	134	4
Electric Car	$18,188	-	-2,328	276	$718	1.4	25
Extended	$527,438	-	-67,498	8,004	$20,825	42	25
Hybrid Car	$7,528	-	-	139	$479	1.2	16
Extended	$218,298	-	-	4,034	$13,897	36	16
Electric Truck	- $3,995	-	-539	269	$874	2.5	0[7]
Extended	- $151,058	-	-20,485	10,235	$33,212	95.3	0

Background

Currently the City owns and operates over 400 vehicles and pieces of equipment, including police cars, fire trucks, snow removal equipment, and maintenance vehicles. The City fleet used roughly 170,000 gallons of gasoline and diesel fuel in fiscal year 2010. There are options to replace some of these vehicles with hybrid vehicles, all-electric vehicles (EV), or all-electric trucks (EV truck). The University of Montana has one all-electric truck in operation, and it works well for smaller loads moving slowly around campus.

The electric vehicle used in these calculations has a range of 100 miles on average, and the electric truck approximately 63.32 miles per charge, though cold weather and driving conditions significantly affect the range of electric vehicles. Other limitations, such as maximum speed on the electric truck, should be considered before replacing vehicles.

Estimated annual dollar savings are based on annual fuel cost compared to the vehicle it is replacing. Equivalent fuel costs for electric vehicles were estimated using kWh per vehicle mile traveled[1,2] and the price of electricity in Montana. Energy use is shown in the table above as negative savings. Dollar savings and emissions for the electric vehicles are net values that include negative energy use and savings from electricity use. Extended savings are based on a full replacement of eligible vehicles for each vehicle type. There were 29 vehicles identified for potential replacement with either an all-electric or a hybrid car and 38 vehicles identified for potential replacement with an electric truck.[4]

Department

> Fleet

> Vehicle Maintenance

Strategy Target

> Reduce consumption of gasoline and diesel fuel and related carbon footprint

Related Strategies

> EcoDriver's Manual

> Vehicle Replacement Policy

Timeline

> Ongoing annually, as fleet vehicles require replacement

Potential Partners

> Local car dealerships

Potential Funding Sources

> Federal Income Tax credit

FF-5 Hybrid and Electric Vehicle Purchasing Continued

MSRP compared to fleet vehicle:

Hybrid: $7,527 vs. compact car[1] in additional costs

Electric Car: $18,187 vs. compact car[1] in additional costs

Electric Truck: $3,995 vs. truck[1] in savings (shown as a negative value in the table above)

With fuel prices trending upwards[5], the annual dollars saved will steadily increase, potentially decreasing the simple payback time and increasing the cost-benefit of electric vehicles.

> "Missoula has consistently risen to the challenges and opportunities that communities inevitably meet when planning for the long haul. Missoula is simply a wonderful place to live, and this plan represents some of the best thinking in energy conservation and renewable energy implementation that will help ensure Missoula continues to be a responsible, thoughtful, and innovative community for generations."
>
> - BRYAN VON LOSSBERG

References

1. FuelEconomy.gov. MSRPs for 2011 name brand hybrid, all-electric, compact, and truck type vehicles. MSRP for the "compact car" is the mean MSRP price for two name brand compact cars with high fuel efficiency. The energy required to fully charge the EV car is estimated at 34 kWh/100 miles. http://www.fueleconomy.gov/feg/findacar.htm
2. NEVAMERICA U.S. Department of Energy Advanced Vehicle Testing Activity. The energy required to fully charge the electric truck is estimated at 15 kWh/100 miles.
3. Phone conversations with representatives at electric truck manufacturer. November 2011
4. City of Missoula - Equipment Statistics Summary Report by Class. Generated 12/1/2011 by Jack Stucky.
5. Eligible vehicles for hybrid/electric included: compact cars, midsize sedans, passenger vans, 4-wheel-drive vans/cars, and jeeps/SUVs.
6. Eligible vehicles for the electric truck included: small pickups, ½ ton 2-wheel-drive pickups, ¾ ton 2-wheel drive-pickups
7. Energy Information Administration. Monthly Energy Review. Motor Gasoline Retail Prices, U.S. city average, monthly from 1973–Current U.S. City Average›. Release date: November 23, 2011. http://www.eia.gov/totalenergy/data/monthly/pdf/sec9_6.pdf
8. The final estimates for this strategy demonstrate full implementation of this strategy. They were calculated assuming the following: 100% truck replacement with an electric truck; 50% compact car replacement with hybrids; 50% compact car replacement with EV cars.
9. The payback value is zero since relative MSRP produces savings not costs.

FF-6 Sustainable Commute Infrastructure

RECOMMENDATION

Increase efforts to facilitate employees' use of sustainable commuting modes, including creation of key infrastructure items.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
FF-6	Unknown	--	--	Indeterminable	Indeterminable	Indeterminable	Indeterminable

BACKGROUND

The City of Missoula wants to continue its tradition of encouraging employees to commute to work in a sustainable manner. Inconvenience is a large impediment to engaging in sustainable behaviors.[1] Simple improvements can be made that will support employees' use of such sustainable transportation choices such as walking, biking, and riding the bus. Where lacking, the following items should be installed, developed, and/or provided to support and encourage sustainable commuting:

- Secured, covered bike parking
- Electric vehicle charging stations
- Bike repair station
- On-site bike repair expertise
- Workshops on bike repair, safe cycling, exercise conditioning, dressing for cold-weather commuting, navigating the bus system
- Maps of trails/paths for walking and cycling
- Customized bike/walk routes from home to work
- Customized bus route mapping from home to work
- Bus schedules
- "check-out" items, including: umbrellas, rain gear, helmet, panniers, locks
- First aid kit (bandaids, moleskin, antiseptic wipes)
- Convenient location to shower/change clothes

After the infrastructure is created and ready for use, employees should receive explanation and training, potentially in a workshop, on the new facilities and discuss how to use any new or unfamiliar equipment.

Department

> Bike/Ped Office

Strategy Target

> Reduce greenhouse gas emissions associated with employee commute

Related Strategies

> Bike Fleet Infrastructure
> Preferred Parking
> Incentives

Timeline

> 2-6 weeks

Potential Partners

> Willard School Chain Links
> Free Cycles
> Other local bike shops
> ASUM Transportation
> Mountain Line
> Missoula In Motion

Potential Funding Sources

References

1. McKenzie-Mohr, Doug. 2011. "Fostering Sustainable Behavior: An Introduction to Community Based Social Marketing." Pp.121-128, discussing "Convenience: Making it Easy to Act."

FF-7 Utilize Cleaner Fuels

RECOMMENDATION

Replace conventional fuels with cleaner burning fuels.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
BioDiesel	Unknown	--	--	70,658	- $14,131	564.6	--
CNG	Unknown	--	--	70,658	$104,574	165.4	Unknown

BACKGROUND

In 2010, the City of Missoula used 70,6583 gallons of diesel fuel, which accounted for 41% of total fuel purchased, and has a carbon footprint of approximately 720 mtCO2e. While there is a clear need for diesel reduction, this has proven difficult since diesel-fueled vehicles are mostly functional specific, and reduction in use will cause a reduction in essential services. Therefore reducing emissions instead through cleaner fuels is a good option. Montana State Code 90-4-1011 states, "The state of Montana encourages the use of alternative fuels and fuel blends to the extent that doing so produces environmental and economic benefits to the citizens of Montana." It continues, "State and local governments should be encouraged to set an example with their vehicle fleets in the use of alternative fuels and fuel blends."[1] Two options for Missoula are BioDiesel and Compressed Natural Gas (CNG).

BioDiesel. According to the U.S Department of Energy, the production and use of biodiesel results in a 78.5%2a reduction in CO2 emissions, when compared to petroleum diesel. A blend of B20 biodiesel has also been shown to greatly reduce emission levels of particulate matter, sulfates, unburned hydrocarbons, and carbon monoxide.

The City previously used biodiesel, and the fleet is bio-fuel ready; however, a lack of a reliable supplier is the main issue.[4] Options include contracting with local producers to grow biofuel crops, buying from new commercial biofuel plant coming soon to Havre[5] and then storing and pumping biofuel at City facilities, or contracting with someone to collect and produce biofuel from local restaurants' waste oil.

The cost of biodiesel depends on the market price for vegetable oil. In general, biodiesel blended at a 20 percent level with petroleum diesel costs approximately 20 cents per gallon more than diesel alone. Given the other advantages of biodiesel, though, an emission management system with biodiesel is a least-cost alternative. A study by Booz-Allen & Hamilton, Inc., found fleets using a 20 percent biodiesel blend would experience lower total annual costs than other alternative fuels. Similarly, results reported by the University of Georgia indicate biodiesel-powered buses are competitive with other alternatively fueled buses with biodiesel prices as high as $3 per gallon.[2b]

Department

> Vehicle Maintenance

Strategy Target

> Reduce emissions associated with diesel vehicles

Related Strategies

> Improve overall fleet fuel efficiency
> Fleet emissions reduction
> Efficient fleet purchasing policy

Timeline

> Implemented can begin almost immediately once a reliable source is found

Potential Partners

> Bio Energy Testing Center[6]
> Bioroot Energy (Envirolene)[7]
> Sign a contract to create a reliable source

Potential Funding Sources

> Federal tax credits to incentivize suppliers

FF-7 Utilize Cleaner Fuels Continued

Estimated annual dollar savings in the table above are based on fuel costs only. At approximately $0.20 more per gallon, annual fuel savings for a 100% changeover to biodiesel would increase annual fuel costs from $289,202 to $303,334.

Compressed Natural Gas (CNG). Though also a fossil fuel, natural gas is a domestically available, inherently clean-burning fuel. Using compressed natural gas (CNG) and liquefied natural gas (LNG) as vehicle fuels increases energy security, paves the way for fuel cell vehicles, and improves public health and the environment. Compared with vehicles fueled by conventional diesel and gasoline, natural gas vehicles can produce significantly lower amounts of harmful emissions such as nitrogen oxides, particulate matter, and toxic and carcinogenic pollutants as well as carbon dioxide.[8c] Due to the cleaner burning characteristics of natural gas, CNG vehicle engines can run more efficiently than a gasoline-powered vehicle, thereby extending the life of the vehicle.[9]

According to the Department of Energy, relative to gasoline and diesel counterparts, CNG reduces emissions between 21% and 26%.[8b] The numbers in this table used an estimate of 23% reduction. On average, CNG costs approximately $1.24 less than gasoline on a per-gasoline-gallon equivalent basis and approximately $1.48 less than diesel on a per-diesel-gallon equivalent basis.[8a]

With prices for gas steadily rising, CNG could prove to be a very cost effective option. Unlike biodiesel, however, vehicles may need to be converted to a CNG or LNG system before the fuel can be used. This will increase initial implementation costs.

Like all fuels, safety and proper storage and handling are always a concern. Natural-gas-powered vehicles are designed and built to be safe both in normal operation and in accidents. New OEM natural gas vehicles are subjected to the same federal government crash tests as other vehicles. Natural gas cylinders are much thicker and stronger than gasoline or diesel tanks. Industry standards test them far beyond normal environmental and service damage risks, including bonfire tests and penetration tests. The cylinders are designed for a specific lifetime from 15 up to 25 years and are required to be inspected every 3 years or 36,000 miles.[9] Leaks are a concern, especially indoors. However, CNG disperses rapidly, minimizing ignition risk relative to gasoline. Natural gas is lighter than air and will not pool as a liquid or vapor on the ground.[10]

To be more effective in raising public awareness about the City's use of cleaner fuels a logo, brand, or decal should be painted onto those vehicles. This should include simple text highlighting the fact that the vehicle uses a cleaner type of fuel and that it is a City vehicle. Other text on the vehicle could act as an education piece; for example, highlighting the average number of gallons of gasoline avoided every year, and even avoided emissions.

References

1. Montana Code Annotated 90-4-1011. http://data.opi.mt.gov/bills/mca/90/4/90-4-1011.htm
2. Biodiesel.org
3. Benefits of Biodiesel. http://www.biodiesel.org/docs/ffs-basics/benefits-of-biodiesel.pdf?sfvrsn=4
4. Fleets: Market Segments. http://www.biodiesel.org/using-biodiesel/market-segments/fleets
5. Fuel, Gas, Electricity Emm Report FY2010 by Jack Stucky
6. Montana Associated Technology Roundtables. "Missoula based Sustainable Systems fails to pay farmers. Missoula's biodiesel bus system loses its fuel supplier of 10 years." April 22, 2009. http://www.matr.net/article-33970.html
7. Leeds, Tim, "New Biofuels Plant headed for Havre." Havre Daily News. May 9, 2011. http://www.havredailynews.com/news/story-234980.html
8. Montana State University – Northern. Bioenergy Testing Center. http://bioenergytestingcenter.com/
9. Bioroot Energy. http://biorootenergy.com
10. U.S. Department of Energy - Energy Efficiency and Renewable Energy – Alternative Fuels and Alternative Vehicles Data Center.
11. Clean Cities – "Alternative Fuel Price Report January 2012".
12. Natural Gas Emissions. http://www.afdc.energy.gov/afdc/vehicles/emissions_natural_gas.html?print
13. Natural Gas Benefits. http://www.afdc.energy.gov/afdc/fuels/natural_gas_benefits.html
14. Clean Vehicle Education Foundation. "How Safe are Natural Gas Vehicles?" Technology Committee Bulletin. September 1999, revised September 2010. http://www.cleanvehicle.org/committee/technical/PDFs/Web-TC-TechBul2-Safety.pdf

15 U.S. Environmental Protection Agency. "Clean Alternative Fuels: Compressed Natural Gas." EPA420-F-00-033. March 2002. http://www.afdc.energy.gov/afdc/pdfs/epa_cng.pdf

FF-8 Continuous Building Retro and Re Commissioning

RECOMMENDATION

Ensure that all applicable City buildings are Retro or Re-commissioned. Establish a minimum 5-year recommissioning cycle for applicable City buildings.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
FF-8	$89,224	48,940	1,354,506	--	$176,975	862.1	0.5 yrs

BACKGROUND

Commissioning ensures that facilities are built as planned and operate in the safest and most energy-efficient manner possible. With today's complex mechanical and control systems, this is an important component of any energy conservation effort. In new design and construction processes, commissioning begins at the beginning of the design process, to ensure the functions of the systems being designed meet the performance requirements. Commissioning during construction ensures that the equipment installed during construction is the equipment specified and is installed appropriately. Commissioning at the completion of the construction ensures the systems operate as intended in the design, and that they meet the performance requirements of the building occupant.

Retro-commissioning is defined by the EPA as commissioning of a building that has never been or was not fully commissioned at its completion.

Recommissioning is the process through which buildings are commissioned again at some time after their initial completion, occupancy, and commissioning. Recommissioning is a check to ensure that building systems are still functioning as originally planned, constructed, and delivered, and to identify where periodic operating procedure changes or drifts in control calibrations have affected building mechanical system performance in a previously commissioned building.[1]

Research conducted by E.O. Lawrence Berkeley National Laboratory found median retro-commissioning costs for existing buildings to be $0.30 per square foot with resulting energy savings of 16%. Using this data, retro-commissioning all Missoula City buildings listed in the Greenhouse Gas Inventory would cost approximately $89,000. Potential energy savings, based on 2008 usage figures from the Inventory, was calculated to be approximately 49,000 TH of natural gas and 1,300,000 kWh of purchased electricity.[2,3] This would result in over 850 metric tons of avoided CO2e emissions.

Department

> Building Operations and Maintenance

Strategy Target

> Reduce energy consumed by building systems, associated costs and Greenhouse Gas emissions

Related Strategies

> LEED EBOM
> LEED NC & MR
> Energy Monitoring
> Sustainable Operations Measures in O&M Manual
> Energy Use & Goals Reporting
> Energy Performance Targets

Timeline

> Recommendation adopted by FY'13. Commissioning to begin in FY'13 based on building status and cycle.

Potential Partners

> N/A

Potential Funding Sources

> General Fund (CIP)
> Energy Savings Performance Contracts
> Revolving Energy Loan Fund

References

1. U.S. Environmental Protection agency. http://www.epa.gov/oaintrnt/energy/commissioning.htm.

- E.O. Lawrence Berkeley National Laboratory. http://cx.lbl.gov/2009-assessment.html.
- *Building Commissioning, A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions*, Evan Mills, Ph.D., Lawrence Berkeley National Laboratory. Report Prepared for: California Energy Commission Public Interest Energy Research (PIER). July 21, 2009. http://cx.lbl.gov/documents/2009-assessment/LBNL-Cx-Cost-Benefit.pdf.

FF-9 Groundwater Cooling Systems

RECOMMENDATION

Install groundwater cooling systems in City buildings to replace conventional air conditioning systems.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
FF-9	$174,000	-	22,300	-	$2,230	9.63	78 yrs

BACKGROUND

Groundwater Cooling systems typically consist of one or more groundwater extraction (or supply) wells, submersible pumps, piping, interior heat exchangers, and groundwater reinjection wells. Groundwater is withdrawn from an aquifer at the supply well(s), and then passes through a heat exchanger prior to reentering the subsurface at the injection well(s).

In the Missoula area, the average groundwater temperature (approximately 50°F) is similar to the average annual air temperature. During the summer months, the groundwater mass can serve as a heat sink. Therefore, facilities may benefit from the stable groundwater temperature, which boosts efficiency and reduces operational costs.

The systems can be installed at both new and existing facilities, and the necessary above-ground hardware may require less space than conventional HVAC systems. Groundwater cooling systems also have relatively few moving parts, which increases system durability and decreases maintenance costs. Often, the submersible pump in the groundwater extraction well is the only significant mechanical/ electrical component.

Potential applications for the City of Missoula would include City Hall and the five fire stations.

To estimate the energy and dollar savings, the square footages of the building in the case study[1] and City Hall were compared to determine the percentage of energy savings that could be realized at City Hall as related to the case study (65%). The cost estimate is taken directly from the case study. Site conditions such as shallower aquifer depth and more reliable groundwater production and injection rates could greatly reduce costs.

Department
> Facilities

Strategy Target
> Reduce emissions from energy use in City buildings

Related Strategies
> Renewable Energy

Timeline
> Less than 1 year

Potential Partners
> City Engineering Division
> Montana DEQ
> Federal Agencies
> National Center for Appropriate
> Technology
> NorthWestern Energy
> Local Drilling Contractors and Engineering Firms
> Water Rights Specialists and Hydrogeologists

Potential Funding Sources
> Montana Department of Environmental Quality
> Alternative energy revolving loan fund (up to $40,000 for local governments)
> U.S. Dept. of Treasury Renewable Energy Grants
> U.S. Dept. of Agriculture Rural Energy for America
> Other grants, low-interest loans, and/or tax incentives

References

1. Fact Sheet and Case Study – Groundwater Cooling Systems. Adam Johnson, Hydrogeologist, AMEC. 2011.

FF-10 LEED Existing Buildings: Operations & Maintenance Policy

RECOMMENDATION

Create and adopt a policy that all applicable existing City of Missoula buildings attain Leadership in Energy and Environmental Design (LEED) Existing Building: Operations and Maintenance (LEED-EBOM) certification. The policy should include criteria for building inclusion and LEED-EBOM designation maintenance.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
FF-10	$88,000[3]	7,860	290,000	--	$35,500	169.1	2.5

BACKGROUND

The LEED for Existing Buildings Rating System helps building owners and operators measure operations, improvements and maintenance on a consistent scale, with the goal of maximizing operational efficiency while minimizing environmental impacts. LEED for Existing Buildings addresses whole-building cleaning and maintenance issues (including chemical use), recycling programs, exterior maintenance programs, and systems upgrades. It can be applied both to existing buildings seeking LEED certification for the first time and to projects previously certified under LEED for New Construction, Schools, or Core & Shell.[1]

In 2000, the U.S. Green Building Council (USGBC) established the LEED® green building rating system as a way to define and measure green buildings. LEED is an internationally recognized green building certification system, providing third-party verification that measures how well a building or community performs across established metrics.[2a]

Green facilities save taxpayer dollars, reduce resource consumption and greenhouse gases, and create demand for local green products and services. Green Buildings use 26% less energy in comparison to the average commercial building.[2b]

The cost and savings estimates in the table above were generated for City Hall, which has approximately 55,000 sq.ft. of space and in FY2009 used approximately 30,000 TH of natural gas and 1,100 MWh of electricity.[4]

Department
> Facilities Maintenance
> Finance
> Administrative Leadership Team
> All departments and staff as necessary

Strategy Target
> Increase energy efficiency
> Conserve water
> Reduce waste
> Use environmentally responsible products
> Contribute to building occupant and visitor health
> Create demand for local green products and services
> Reduce Greenhouse Gas Emissions
> Reduce Operations and Maintenance Costs

Related Strategies
> LEED New Construction and Major Renovation Policy
> Numerous MCCAP strategies across all working groups

Timeline
> 6 months

Potential Partners
> U.S. Green Building Council

Potential Funding Sources
> No funding need for policy creation

References

1. U.S. Green Building Council, Inc. http://www.usgbc.org/DisplayPage.aspx?CMSPageID=221.
2. U.S. Green Building Council, Inc. (USGBC). *Roadmap to Green Government Buildings.* http://www.usgbc.org/ShowFile.aspx?DocumentID=5486
   a. Page 3-4.
   b. Page 2.
3. Leonardo Academy Inc. "The Economics of LEED for Existing Buildings, For Individual Buildings. 2008 Edition. A White Paper." April 21, 2008. Revised May 29, 2009. Page 7. Case studies have shown an average of $1.60/sq.ft. to receive LEED-EBOM certification
4. Missoula Greenhouse Gas Inventory. Energy use data for Fiscal Year 2009

FF-11 Real-time Energy Monitoring Systems

RECOMMENDATION

Install real-time electricity energy monitoring systems at high use and/or high visibility municipal sites.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
FF-11	$105,000	--	235,315	--	$23,532	1,452	4.5 yrs

BACKGROUND

Studies and evidence from existing installations indicate that the energy consumption in municipal buildings could be reduced an average of 5-10% of the baseline usage,[1b,1c] or more in certain situations, by installing real-time energy monitoring systems in City buildings and effectively communicating energy use to the building occupants. Real-time or near-real-time energy monitoring raises awareness about energy consumption and facilitates energy conservation and efficiency improvements. Real-time energy monitoring systems have declined in cost sufficiently to enable small-scale or residential-scale installations for approximately $1,000-$10,000 per building.[1] The City should install real-time electricity energy monitoring systems at high use and/or high visibility municipal sites, e.g. Mayor's office, City Council chambers, solar installations at fire stations. The associated monitoring systems would then be used to track and report consumption of individual facilities, as well as aggregated consumption for review by the building occupants, as well as the Mayor, City Council, and Conservation & Climate Action Plan Task Force.

To increase participation, and thereby energy and cost savings, implementation should include establishing energy savings incentives for building occupants and competitions among buildings.

Based on energy use data presented in Missoula's latest Greenhouse Gas Inventory, municipal buildings (including Splash and Currents) used approximately 3.3 million kWh in FY2008. If a conservative estimate of 7% savings from this strategy was achieved, it would result in a reduction of approximately 235,315 kWh annually, amounting to $23,532 in annual energy savings and an avoided 1,452 mtCO2e in emissions.

Department

> Building Operation and Maintenance

Strategy Target

> Reduce energy consumed by building systems, associated costs and Greenhouse Gas emissions

Related Strategies

> Incentives and Department Competitions
> Fostering Sustainable Workplace
> Reduce Electronics Energy Use

Timeline

> Installation in less than one month

Potential Partners

> AERO (outreach)

Potential Funding Sources

> Fund installations through building maintenance budgets.

References

1. Possible monitoring systems:
   a. eGauge: http://www.egauge.net
   b. TED: http://www.theenergydetective.com
   c. Lucid Design Group: http://www.luciddesigngroup.com
2. Implementation cost of $105,000 assumes $5,000 average installation per building.

FF-12 Shut Off/Remove Water Fountain Cooling

RECOMMENDATION

Turn off the coolers to drinking water fountains mounted in City buildings.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
FF-12	$160[3]	-	11,123	-	$1,112	4.8	2 mo

BACKGROUND

Typical wall-mounted drinking fountains have a reservoir that keeps water cooled to 40-50°F.[1] If this cooling system were turned off, energy could be saved. A fact sheet developed by the North Carolina Energy Office estimated the energy consumed by one drinking fountain to be between 7.8-10.8 kWh per 40-hour work week.[1] This consumption varies widely however, and depends on usage, supply water temperature, air temperature, etc.

By turning off the coolers, there is potential to save approximately 11,100 kWh[2] of energy and reduce emissions by roughly 5 metric tons annually.

Water use patterns (water in a reservoir of a low-use fountain could become distasteful if not chilled) and employee reaction should be considered before turning off coolers to drinking fountains.

Including signage next to these coolers will increase awareness of the City's energy saving efforts, provide education about energy savings techniques, and could also be an opportunity to address concerns or misconceptions about the fountain working properly (since the cooler is now off).

Department

> Building Operations and Maintenance

Strategy Target

> Reduce energy consumption

Related Strategies

> None identified at this time.

Timeline

> One week, depending on intricacy of wiring

Potential Partners

> None identified at this time.

Potential Funding Sources

> The cost to disconnect electricity to drinking fountains is estimated to be minimal. Depending on the model of the fountain, it could be as easy as pulling a plug. Other models require the work of an electrician.

References

1. Waste Reduction Partners. "Drinking Fountains and Water Coolers: Energy Saving Fact Sheet. http://wastereductionpartners.org/phocadownload/userupload/Resources/Energy_Saving_Fact_Sheet_Drinking_Fountains__Water_Coolers.pdf
2. Calculations based on median energy use per fountain (9.3 kWh/40 hour work week) for the 23 drinking fountains mounted in City buildings.
3. Estimated 8 hours total staff time at $20/hr.

FF-13 Water Wise Bathroom Features

RECOMMENDATION

Install "water wise" and energy efficient bathroom features in City-owned and operated bathrooms.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
FF-13	$27,624[2]	90	1,557	-	$72,025	1.2	5 mo

BACKGROUND

The City of Missoula's buildings serve employees as well as citizens. The City could save hundreds of thousands of gallons annually by converting to touch-less, water-wise, and low-flow features.[1a,b] For example, compared to older toilets, high efficiency toilets can save up to almost 3 gallons of water per flush.[1] High efficiency and touch-less faucets can reduce hot water use, thus saving energy on water heating in addition to lowering water consumption.[1b,3] The estimated savings in this strategy are for toilets and faucets alone, but other features that could increase savings significantly should be considered (i.e. waterless urinals).[3]

In addition to the water and energy reductions, "water wise" features that include automatic controls are more hygienic and can reduce the spreading of germs.[3,4]

Department
> Building Maintenance

Strategy Target
> Reduce water consumption and maintenance costs

Related Strategies
> Water Wise Park Areas
> Fostering Sustainable Behavior

Timeline
> One week for installation of new features after procurement.

Potential Partners
> Missoula County
> Mountain Water
> Clark Fork Coalition
> Wastewater Treatment Plant

Potential Funding Sources
> Mountain Water
> US EPA

References

1. ICLEI - CAPPA v1.5 ©2010.
   a. "High Efficiency Toilets."
   b. "Faucets."
2. Assumptions include: annual water savings, percent hot water use, daily water use, etc. Costs of water and electricity were customized.
3. Cost per faucet/toilet[1a,b] plus an additional estimated $120/bathroom for installation (6 hr staff time x $20/hr)
4. Government of Manitoba, Canada. "Fact Sheet – Water Conservation." http://www.gov.mb.ca/ia/climate/toolkit/water_conservation.pdf
5. Lewis, Mark. "Benefits of restroom automation: touchless technology keeps germs in their place." July, 2004. http://findarticles.com/p/articles/mi_m3830/is_7_54/ai_n14920746/

FF-14 Water Wise Park Areas

RECOMMENDATION

Formally adopt a xeriscaping policy and replace water intensive plants and grasses with those that require less water and/or can be sourced locally.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
FF-14	$9,583/acre[5]	-	571/acre[4,5]	3.5/acre[4]	$42,560/acre[6]	0.3/acre	< 6 mo

BACKGROUND

Xeriscaping is "the wise use of water through water-efficient landscaping."[1] The City of Missoula Parks and Recreation Department already uses low water-intensive shrubs and plants for developed parks and open space, but there is no formal policy in place. To institutionalize the policy, it would be advisable that the City of Missoula also update the recommended tree and planting list[3] where appropriate.

The largest potential savings would come from converting turf areas, the average acre of which uses roughly 652,000 gallons of water annually.[4] Xeriscape areas have shown reductions in water consumption from 30% up to 80%, as well as savings on fuel and fertilizer costs.[1] A conservative estimate (25%) of water savings shows a potential reduction of 163,000 gallons of water per acre annually, saving over $42,000 per year. This would reduce annual emission by 0.3 mtonsCO2e per acre. Alternative forms of turf grass could provide potentially large savings of water, energy, and cost. There are commercially available turf grasses, including a Fescue Blend from Bitterroot Turf Farm in Corvallis, MT, that are more drought-tolerant and less water-intensive than the commonly used Kentucky Bluegrass, and can handle high foot traffic.[5]

The policy should identify where xeriscaping is appropriate and where traditional turf is the preference for activity, users or ease of maintenance. Efficiencies and water conservation should still be explored and implemented in traditional turf areas with application of more efficient irrigation systems and practices, and improving soil types and depth to increase water retention.

Department
> Parks and Recreation
> Building Maintenance

Strategy Target
> Reduce carbon emissions and costs associated with water use

Related Strategies
> Compost
> Water use reduction strategies

Timeline
> Within two years; Update recommended plant species during next review of document.

Potential Partners
> Montana Native Plant Society
> Montana Natural History Center
> Missoula County Extension Service
> Native plant nurseries
> Montana Natural Resources Conservation Service
> Clark Fork Coalition
> Five Valleys Land Trust
> Mountain Water
> Missoula County Public Schools
> Bitterroot Turf Farm

Potential Funding Sources
> National Fish & Wildlife Foundation
> US EPA
> NOAA
> Montana FWP
> Montana Native Plant Society
> Missoula County Extension Service

References

1. Colorado State University Extension service. http://www.ext.colostate.edu/pubs/garden/07228.html
2. USDA Natural Resource Conservation Service. http://www.mt.nrcs.usda.gov/technical/ecs/plants/xeriscp/intro.html
3. City of Missoula Parks and Recreation Department. Appendix to Missoula Municipal Code, Ch. 12.32.
4. ICLEI - CAPPA v1.5 ©2010. "Landscaping."
5. Bitterroot Turf Farm. Cost estimates are approximates. http://www.turfmontana.com/products.asp
6. Water and fuel savings only. Based on Mountain Water metered rate, last updated October 2011 (as of January 2012). It is uncertain as to whether or not energy costs are embedded in the tariff, so energy cost savings were excluded.

INTERNAL POLICIES AND PRACTICES WORKING GROUP

WORKING GROUP MEMBERS

Amy Cilimburg, *Montana Audubon Society (Working Group Chair)*

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Beth Schenk, *St. Patrick Hospital and Health Sciences Center*

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A tremendous amount of energy conservation and emissions reduction potential exists in the way the nearly 450 City employees go about their work every day. The following Internal Practices & Policy (IPP) strategies intend to further integrate green practices into City operations so that reducing energy and material consumption, reducing the cost of doing business, and healthy, happy employees are the workplace norm. Internal Policies and Practices strategies are a cost effective foundation for emissions reduction and can be implemented rather quickly. Savings tend to decrease over time without centralized support and consistent follow up, training and feedback. Therefore, staff assigned to champion and oversee efforts is essential to long-term success.

Internal Policies and Practices Completed Actions

Table 3-4 below lists actions already taken by the City within the scope of the Internal Policies and Practices working group categories. It is important to recognize these projects and programs and they be kept in place as we pursue greater reductions in operational costs, energy use, and emissions.

Table 3-4: Internal Policies and Practices Completed Actions

Action	Year Implemented
Formation of City Green Team	2008
Green Team Initiatives and Green Policy	2009
Administrative Rule 11: City Fleet Vehicle Use	2010

Internal Policies and Practices Strategies

Table 3-5 below summarizes the Internal Policies and Practices working group strategies. Further details are described in the narratives below.

Table 3-5: Internal Policies and Practices Strategies

Strategy	Implementation Cost	Est. Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback (yrs)
EMPLOYEE COMMUTE				
IPP-1 Employee Commuting Incentive Program	Unknown	$0	31	--
IPP-2 Flexible Work Scheduling	< $1000	Indeterminable	31	Unknown
IPP-3 Rideshare Scheduling plan for employees	< $1000	$0	62	--
EMPLOYEE CULTURE				
IPP-4 Conservation and Sustainability in Work Plans and Annual Review	Unknown	Indeterminable	Indeterminable	--
IPP-5 Fostering Sustainable Workplace	Unknown	Indeterminable	Indeterminable	--
IPP-6 Include Conservation and Sustainability in Job Descriptions	Unknown	Indeterminable	Indeterminable	--
IPP-7 Include Sustainability in Employee Orientation	Unknown	Indeterminable	Indeterminable	--
PRODUCTS, PROCUREMENT, & FACILITIES				
IPP-8 Green Purchasing Policy	Unknown	Indeterminable	Indeterminable	--
IPP-9 LEED for New Construction and Major Renovations Policy	$43,500	$25,438	119	< 2
IPP-10 Paper and Printing Policies	< $1000 - $9,500	$58,000 - >$170,000	0.5 -1.4	< 2 months
IPP-11 Reduce Electronics Energy Use	< $1000	$3,350	14.5	0.3
IPP-12 Waste Stream Reduction Policy	< $1000	Indeterminable	Indeterminable	--

> "The City now owns and manages approximately 3,800 acres of open space that provides many ecological benefits, including floodwater storage, contributing to clean water and air, wildlife and bird habitat, carbon storage, and the cooling influence of trees during the summer months, as well as providing scenic beauty and many health and recreation benefits to our citizens."
>
> - JACKIE CORDAY, Open Space Program Manager

IPP-1 Employee Commuting Incentive Program

RECOMMENDATION

Provide incentives to City employees who find alternatives to single-occupancy vehicle commuting. Formalize easy enrollment in Missoula in Motion's Way to Go! Club.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
IPP-1	Unknown	--	--	0	$0	31	--

BACKGROUND

Currently, all City employees receive a Mountain Line bus pass and have the opportunity to enroll in Missoula In Motion's Way to Go! Club (WTG!C). The WTG!C is an incentive program for commuters that employees can opt into.[1] By formalizing enrollment for City employees during orientation (as part of the sustainability portion) participation becomes more the norm. Additionally, the City should conduct a survey of employee commuting behavior to have baseline data to help determine the effectiveness of incentives. Insight into the commuting habits and preferences of employees can inform the City's implementation of measures that will simultaneously meet employee needs and reduce the overall contribution to transportation-related emissions. Incentives could come directly from Missoula in Motion or could include other department prizes and/or cash. These incentives should be City-specific (i.e. different from the current WTG!C prizes) and should be developed with employee input. Interest in and desire for different types of incentives could be included in the survey mentioned above to most effectively motivate employees to participate.

Realizing a conservative 5% increase in sustainable commuting (29 employees) from this strategy would result in approximately 300 vehicle miles avoided every work day. This equates to 3,470 gallons of fuel[2] and, collectively, $12,000 in savings for those employees. This would avoid 31 mtCO2e in commuting-related emissions for the City. Since the cost and fuel savings are realized by City employees, they are not included in the table below. The associated emissions do fall under the scope of the City and are therefore included.

This project would reinvigorate the City's' relationship with Missoula in Motion, which will lead to future synergy and collaboration on other transportation-related projects.

Department

> Human Resources
> Planning and Grants
> Bike/Ped Office

Strategy Target

> Reduce emissions associated with employee transportation
> Better tracking of employee commute mode

Related Strategies

> Fostering Sustainable Workplace
> Incorporate Sustainability in Employee Orientation
> Employee Commuting Incentive Program

Timeline

> First year: conduct commute survey; enroll in WTG!C as part of orientation (strategy concurrent with implementation of sustainability training during orientation).

Potential Partners

> Missoula In Motion
> Mountain Line
> MRTMA
> Missoula Parking Commission

Potential Funding Sources

> None identified.

References

1. Missoula In Motion: http://missoulainmotion.com
2. Assuming 21.3 mpg. FuelEconomy.gov - average combined fuel economy of 2008 name brand midsize, wagon, and truck vehicles.

IPP-2 Flexible Work Scheduling

RECOMMENDATION

Adopt a formal policy for flexible work scheduling for employees to allow for sustainable commuting.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
IPP-2	< $1000	Indeterminable[4]	Indeterminable[4]	--[4]	Indeterminable[4]	31	Unknown[4]

BACKGROUND

Current City of Missoula Personnel Policy[1] allows for departments to adopt flexible scheduling plans subject to approval by the Mayor's Office and ensuring citizen access required by state law. Adopting a formal policy on alternative scheduling (including telework and flex time for sustainable commuting) could lead to increased savings in personnel expenses from increased productivity and retention of employees and potential reduction in greenhouse gas pollutants from employee transportation and facility heating/cooling/lighting.

The recently passed Telework Enhancement Act (2010) established the following guidelines for federal employees:

- Designate a senior manager to coordinate the agencies' telework program
- Determine eligibility of employees, notify them of their eligibility status, and enter into written agreements with them for those who wish to telework
- Develop and implement telework training programs for managers and employees

The Act then went on to encourage local governments to do the same.[2]

Telecommuting reduces overhead costs for the employer, reduces costs incurred by the employee, and increases employee satisfaction.[3] Associated avoided emissions are mostly from trip reduction.[3] If 5% of Missoula's City employees telecommuted each work day, the City could avoid 31 mtCO2e of emissions from trip reduction alone,[3] saving City employees approximately $11,000 per year, collectively. The City would also experience reduction in energy use, but those costs still exist in the employee's energy bills. These considerations should be further researched and should be discussed in the Policy.

Department

> Human Resources

Strategy Target

> Reduce emissions associated with employee transportation and heating/cooling of facilities.

Related Strategies

> Rideshare Scheduling for Employees
> Employee Commuting Incentive Program

Timeline

> Less than 2 months

Potential Partners

> Missoula County
> Mountain Line
> MRTMA
> Missoula in Motion

Potential Funding Sources

> None needed.

IPP-2 Flexible Work Scheduling Continued

Compatibility of transit and work schedules is one potential obstacle to increased bus ridership and other sustainable commuting methods. By creating a formal policy that allows for flexible schedule to accommodate transit schedules, it is possible that more City employees would ride the bus. This same flexibility could apply to carpools and vanpools.

A flexible schedule policy would allow for employees to arrive/depart at designated times based on when their bus or carpool arrives and departs (not necessarily from 8 a.m.-5 p.m.).

While many employees and supervisors may have an understanding that the employee works 'around the bus schedule,' formalizing the policy will make the practice less ambiguous and more in line with other City personnel policies. This would also apply to telecommuting.

"There is tremendous potential in 450 City employees. Simple actions can often lead to big reductions in energy consumption and cost, as well as happier, healthier employees."

- GAIL VERLANIC

References

1. Missoula County Personnel Policies (2007) Section 216 and 217 http://www.co.missoula.mt.us/hr/employees/policies/MCPERPOL2007PROTECTEDFINALwithCOVER.pdf
2. Telework Research Network. "The State of Telework in the US". 2011 paper. http://www.workshifting.com/downloads/downloads/Telework-Trends-US.pdf
3. ICLEI – CAPPA v1.5 © 2010. "Promote Telecommuting". Used 21.3 mpg average fuel economy (FuelEconomy.gov. Avg. combined fuel economy of 2008 Ford Focus, Subaru Outback, and Ford F150).
4. Fuel and cost savings associated with this strategy are realized by the employee, and not the City. As such they are not included in the table here. As mentioned in the narrative, the City would experience lower energy costs from reduced use of space conditioning and electronics. However, the associated emissions may still fall within the scope of the City's greenhouse gas inventory. This should be further researched in the future, and consistent with Missoula's Greenhouse Gas Inventory.

IPP-3 Ride Share Scheduling Plan for Employees

RECOMMENDATION

Designate an online rideshare matching service. Train and encourage employees to use service.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
IPP-3	< $1000	--	--	0	$0	62	

BACKGROUND

Because of the traditional 8am-5pm nature of employment for many City employees as well as the downtown location of City Hall (where many employees work or could catch a bus to their final destination), ridesharing is a very viable alternative to driving alone to work. Currently, ridesharing is formally supported by the Missoula Ravalli Transportation Management Association (MRTMA) who coordinates car and vanpools.[1]

Ridesharing is limited primarily by the difficulties of linking people together. Some people are hesitant to ride with someone they do not know. The next "hurdle" is matching interested people together. There are many online options[2a,b,c] but they are only as successful as the number of people registered with them. The City should designate an online rideshare matching service and then direct City employees.

The City could also ask employees who are interested in participating in a rideshare to send their starting location to a centralized person who could map all the interested parties and then the City could facilitate "introductions."

Realizing a 10 percent reduction in commute vehicle trips due to implementation of this program would save approximately 6,551 gallons of gasoline and avoid emitting 62 mtCO2e per year. This would save those employees over $22,000, collectively.[3,4] Cost and fuel savings are realized by City employees, not the City itself so are not included in the table here.

Department

> OPG – Missoula in Motion

Strategy Target

> Reduce emission associated with employee transportation

Related Strategies

> Employee Commuting Incentive Program
> Fostering Sustainable Workplace
> Sustainable Commute Infrastructure

Timeline

> Three months

Potential Partners

> Missoula Ravalli Transportation > Management Association
> Missoula in Motion
> ASUM Transportation
> EPA

Potential Funding Sources

> EPA Grants for rideshare

References

1. Missoula Ravalli Transportation Management Association http://www.mrtma.org/
2. a. GoLoco. http://www.goloco.org/.
   b. Zimride. http://www.zimride.com/
   c. iCarpool. http://www.icarpool.com/
3. ICLEI – CAPPA v1.5 © 2010. "Promote Carpooling and Vanpooling". Fuel economy input: 21.3 mpg. (FuelEconomy.gov - average combined fuel economy of 2008 name brand midsize, wagon, and truck vehicles.).

IPP-4 Conservation and Sustainability in Work Plans and Performance Reviews

RECOMMENDATION

Develop and add conservation and sustainability components to work plans and performance reviews.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
IPP-4	Unknown	--	--	--	Indeterminable	Indeterminable	--

BACKGROUND

Work plans serve as the road map and establish expectations for most City employees throughout the year. While work plan procedure may vary according to position and department, conservation and sustainability components should be considered when plans are developed and inserted where appropriate. This practice integrates conservation and sustainability thinking, planning and communication into every stage of an employee's career as well as their duties and tasks during each project's succession. Finally, it opens and fosters an important dialogue between Supervisor and Staff.

Important complements to Work Plans in the City are Performance Reviews. Performance Reviews serve as a formal Supervisor/Staff check-in and are an important accountability tool to those work plans. As such, conservation and sustainability checks should be added to the Performance Review process. Details should be developed by Supervisors to fit certain situations and employees, but should at minimum include dialogue about individual work plan goals, the City's Green Policy, departmental goals as discussed in the "Fostering Sustainable Behavior" strategy, and City initiatives.

Adding Conservation and Sustainability components to both Work Plans and Performance Reviews ensures that these actions are integrated into day-to-day activities and integrated into all stages of work planning and review.

Department

> Human Resources
> All Departments

Strategy Target

> Increase sustainable behavior of City employees. Integrate Conservation and Sustainability into all aspects and phases of work planning and review.

Related Strategies

All, especially:

> Fostering Sustainable Workplace
> Include Sustainability in Employee Orientation
> Incorporate Sustainability into Job Descriptions

Timeline

> Implement in next work plan/ review cycle. It is important that all training needs are identified and met before performance reviews.

Potential Partners

> Sustainable Business Council
> ICLEI

Potential Funding Sources

> Strategy requires no funding

IPP-5 Fostering Sustainable Workplace

RECOMMENDATION

Coordinate and complete an assessment of sustainability efforts in each Department. Develop plans for improvement and encouragement.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
IPP-5	Unknown	--	--	--	Indeterminable	Indeterminable	--

BACKGROUND

In 2009, the City of Missoula adopted a green policy that listed 25 recommended action items that reduce environmental impacts from City employees. In order to follow up on progress and build on the Green Policy, each department should undergo an assessment or review current actions and efforts. The check in will involve 3 steps:

1. Departments and individuals should provide input and data to identify successes, as well as barriers, and those areas where greatest improvements can be made.
2. Departments will develop departmental targets and goals.
3. Departments will develop regular tracking and reporting methods.

Consistent follow up will ensure that goals are being met, employee motivation and awareness remains high, and ongoing innovations and solutions can be deployed. Achievements and best practices should be shared and celebrated across City departments.

Success of strategies of this nature rest largely on having an in-house person directed to facilitate steps and consistent follow up as part of their job duties. Therefore, it is recommended that a staff member is dedicated to coordinate these efforts.

Potential employee actions which could be addressed include:

- City of Missoula's Green Policy
- Commuting & work travel
- Waste Stream (Trash/Recycling)
- Green Purchasing & Procurement
- Energy use

Department

> All
> Human Resources

Strategy Target

> Increase sustainable behavior of City employees

Related Strategies

All, especially:
> Include Sustainability in Employee Orientation
> Incorporate Sustainability into Job Descriptions
> Work Plan Integration and Annual Review

Timeline

> Can begin immediately

Potential Partners

> Sustainable Business Council
> ICLEI
> Consulting firms which help foster sustainable office behavior;
> Energy reporting and monitoring consultants;
> Missoula County;
> University of Montana

Potential Funding Sources

> Energy Savings reinvested
> FTE investment
> Federal, State or local grants

IPP-6 Include Conservation and Sustainability in Job Descriptions

RECOMMENDATION

Develop and add conservation and sustainability components to all job descriptions.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
IPP-6	Unknown	--	--	--	Indeterminable	Indeterminable	--

BACKGROUND

Fostering sustainable behavior in City offices can be made easier by ensuring that new employees already have such knowledge. Including conservation and sustainability components to job descriptions is already a growing trend in businesses large and small.[1] One company, Clean Clothes, Inc., "start(s) at the beginning by screening new employees for their knowledge about organics and organic cotton. As a result, they have a corporate culture that attracts employees who are environmentally aware."[1] In addition, current employees' job descriptions will be updated as part of the Work Plan Integration and Annual Review strategy.

Developing and adding conservation and sustainability components to job descriptions will increase the likelihood that the City employees will participate in existing and ongoing efforts to reduce costs and environmental impact. "Engaged employees are a business' prime resource in cutting costs and finding innovative ways to reduce the firm's environmental and social impacts."[1]

Department

> Human Resources

> All

Strategy Target

> Support and strengthen the commitment to sustainability in City offices

Related Strategies

All, especially:

> Fostering Sustainable Workplace

> Sustainability in Employee Orientation

> Work Plan Integration and Annual Review.

Timeline

> Can begin immediately, and update future position descriptions on an on-going basis

Potential Partners

> None identified.

Potential Funding Sources

> Strategy has no cost.

References

1. Woofter, Jennifer. "How to Approach Employee Education on Sustainability." 2009. http://sustainabilityconsulting.wordpress.com/2009/04/08/resources-how-to-approach-employee-education-on-sustainability/

IPP-7 Include Sustainability in Employee Orientation

RECOMMENDATION

Add a sustainability component to employee orientation. Ensure existing employees receive the same information prior to implementation.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
IPP-7	Unknown	--	--	--	Indeterminable	Indeterminable	--

BACKGROUND

The most effective way to shift employee behavior is through early acculturation in which any new employee understands the expectations of the office culture. Employees introduced to concepts of sustainability and the expectations of the City of Missoula in their orientation have a better chance of accepting these expectations and incorporating them into their daily habits.

All new employees receive some orientation to the City's policies and procedures. During the orientation process, new employees will be informed of the City's environmental and sustainable values as well as ways to incorporate those values into their daily work routine. Further, employees should understand how these expectations will be evaluated in their performance review.

Many organizations include a sustainability component in their new employee orientation.[1a,1b,2,3,4] Webinars, videos, brochures, or slideshows highlighting steps the City has taken and opportunities for involvement should be developed. The orientation should address this Conservation & Climate Action Plan, including the memo describing the City's Green Policy;[5] commuting & work travel; waste stream (trash/recycling), and green purchasing & procurement. Mayor and department head input and review is crucial.

Before initiating this strategy, existing employees and department heads should receive this information. This will avoid any disconnect between current and new employees regarding these issues, and will allow current staff to act as guides and mentors for new employees.

References

1. Association for the Advancement of Sustainability in Higher Education.
   a. New York University - Sustainability in New Employee Orientation. https://stars.aashe.org/institutions/new-york-university-ny/report/2011-01-31/3/19/116/ (contact to ask about a web-based learning module).
   b. Portland State University – Sustainability in New Employee Orientation. https://stars.aashe.org/institutions/portland-state-university-or/report/2011-02-11/3/19/116/
2. Frederick County, Maryland Sustainability Action Plan: http://www.frederickcountymd.gov/documents/County%20Manager/Sustainability/Publications/Sustainable%20Action%20Plan%20for%20County%20Ops_Final.07.23.10.PDF
3. Woofter, Jennifer. "How to Approach Employee Education on Sustainability." Strategic Sustainability Consulting's Blog. Poster: April 8, 2009. http://sustainabilityconsulting.wordpress.com/2009/04/08/resources-how-to-approach-employee-education-on-sustainability/
4. Stratos, Inc. "Sustainability Integration into Business Processes." July 2007. http://www.docstoc.com/docs/2409690/SUSTAINABILITY-INTEGRATION-INTO-BUSINESS-PROCESSES-A-Study-of
5. Memo from Mayor John Engen to ALL City, OPG & Health department employees, regarding "New Green Policy for all City of Missoula, OPG, and Health Department employees." February 25, 2009.

Department
> Human Resources
> Mayor's Office

Strategy Target
> Increase awareness and foster sustainable behavior of City employees

Related Strategies
All, especially:
> Include Conservation and Sustainability in Job Descriptions
> Work Plan/Annual Review Integration
> Fostering Sustainable Workplace

Timeline
> Less than 1 month (immediately after Department Assessment and Improvement initiated)

Potential Partners
> Missoula County
> University of Montana
> Consulting firms which help foster sustainable office behavior

Potential Funding Sources
> Unknown, but should not cost much if the training is done by existing staff; most effective training would be by a Sustainability Coordinator

IPP-8 Green Purchasing Policy

RECOMMENDATION

Adopt a formal "Green" Purchasing plan for the City. Establish a system to track products and savings. Inform other departments with regular reports.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
IPP-8	Unknown	--	--	--	Indeterminable	Indeterminable	--

BACKGROUND

The City of Missoula purchases a large volume of products each year. Establishing a comprehensive green purchasing or environmentally preferable purchasing plan for city departments can identify and reduce the environmental impact of purchases and maximize resource efficiency.[1a,b] A green purchasing policy allows the city to set standards for purchasing that take into account social equity, environmental harm and fiscal criteria. In addition to the cost and energy benefits, adopting an environmentally preferable purchasing plan or green purchasing policy would demonstrate the City's commitment to sustainability.

An environmentally preferable product is one "that has a reduced negative effect or increased positive effect on human health and the environment when compared with competing products that serve the same purpose."[1b]

This takes into consideration factors such as packaging, raw materials, recycled content, energy efficiency, locality of business, etc.[1b,2] The Policy should be all inclusive, covering any and all items that the City purchases. This includes: electronics such as computers and printers/copiers, office supplies such as pens and paper, and other items such as water coolers and furniture. This has the potential to:

- Reduce hazardous materials management costs (e.g. using less-toxic products)
- Reduce operational costs (energy savings from efficient equipment)
- Reduce disposal costs (hazardous and solid waste) by generating less waste and using longer lasting products
- Reduce repair and replacement costs when using more durable and more repairable equipment
- Reduce employee safety and health costs at the facility (and liability) by improving the work environment and minimizing risks to workers
- Reduce material and energy consumption

Department

> All

> IT Department, to help establish central repository

Strategy Target

> Reduce contribution to secondary impacts

Related Strategies

> Paper and Printing Policy

> Fostering Sustainable Workplace

> Work Plan Integration/Annual Review

Timeline

> 1 year, for research on products and adoption of policy before implementation

Potential Partners

> Missoula Office City

> Other local office supply businesses

Potential Funding Sources

> Self-funded through energy savings

IPP-8 Green Purchasing Policy Continued

The City of Missoula does not have one central ordering location for all departments to use, so sharing of information will be essential to a successful implementation of this strategy. Establishing a central repository for information, potentially web based, would allow easy access for all departments and staff.

Savings and avoided emissions vary greatly with types of product and the degree to which they are implemented, so estimates are not made here.

References

1. ResponsiblePurchasing.org.
    a. City of Berkeley. Green Purchasing Policy. 2004. http://www.responsiblepurchasing.org/UserFiles/File/Ofice%20Electronics/Policies/City_of_Berkeley_CA_Green_Purchasing_Policy_2004.pdf
    b. City of Seattle. Sustainable Purchasing Policy. 2003. http://www.responsiblepurchasing.org/UserFiles/File/Computers/Policies/Seattle_Purchasing_policy_2003.pdf
2. City of Portland. Sustainable Procurement Policy. September 2010 Update. http://www.portlandonline.com/shared/cfm/image.cfm?id=204110

IPP-9 LEED for New Construction and Major Renovations Policy

RECOMMENDATION

Create and adopt a policy that all future City of Missoula new construction and major renovation building projects attain Leadership in Energy and Environmental Design (LEED) certification. The policy should include a minimum level of LEED certification over a certain square footage or cost.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
IPP-9	$43,500[10]	4,760[9]	213,950[9]	--	$25,438[9]	119[9]	< 2

BACKGROUND

In 2000, the U.S. Green Building Council (USGBC) established the LEED® green building rating system as a way to define and measure green buildings. LEED is an internationally recognized green building certification system, providing third-party verification that measures how well a building or community performs across established metrics.[1] Green facilities save tax-payer dollars, reduce resource consumption and greenhouse gases, and create demand for local green products and services.[2]

LEED for New Construction and Major Renovation certification is designed to guide and distinguish high-performance commercial and institutional projects. It certifies the design and construction activities of both new buildings and major renovations to existing buildings (affecting over 50 percent of the building).[3] When included in the pre-project planning and budgeting stages, green building designs can be included while remaining within the original budget, and often for less (excluding additional certification and documentation costs).[8,9,10] If the renovation scope does not involve significant design and construction activities, such as envelope modifications or total interior reconstruction, LEED for Existing Buildings: Operation & Maintenance certification will be the more appropriate rating system.[3]

In comparison to the average commercial building:

- Green buildings use 26% less energy
- Green buildings have 13% lower maintenance costs
- Green buildings have 27% higher occupant satisfaction
- Green buildings have 33% less greenhouse gas emissions[4]

Important Facts:

- Buildings account for 39% of the CO2 emissions per year, more than either the transportation (33%) or the industrial fields (29%).
- In comparison to the national building stock, the average LEED certified building uses 24% less electricity and saves 13.86 million metric tons of CO2 emissions annually.[5]

Department
> Facilities Maintenance
> Finance
> Administrative Leadership Team
> All departments and staff as necessary

Strategy Target
> Increase energy efficiency
> Conserve water
> Reduce waste
> Use environmentally responsible products
> Contribute to building occupant and visitor health
> Create demand for local green products and services
> Reduce Greenhouse Gas Emissions
> Reduce Operations and Maintenance Costs

Related Strategies
> LEED EBOM Policy
> Numerous MCCAP strategies across all working groups

Timeline
> 6 months

Potential Partners
> U.S. Green Building Council

Potential Funding Sources
> No funding need for policy creation

Why Build Green in the Public Sector?

Lead by Example. Promote local market transformation by using best practices in construction, operation and maintenance of government owned or leased buildings.

Reduce Operations and Maintenance Costs Over the Life of a Building. Energy and water efficient design paired with green operations practices reduce operations and maintenance costs over the entire life of the building.

Extend Infrastructure Capacity. Green buildings lessen the demands on infrastructure through waste and stormwater management efforts.

Reduce Staff-related Overhead and Relocation Costs. Improved indoor air quality, natural light and flexible design can contribute positively to staff satisfaction and productivity, reduce absenteeism, improve employee retention and reduce the costs associated with employee relocation.[6]

LEED is a useful public policy tool as outlined below. Many LEED rating systems can complement existing state and local green building policies and initiatives.

- LEED is transparent and reduces technical and administrative uncertainties.
- LEED saves time and resources by providing a comprehensive set of tools for application and use.
- LEED provides a consistent tool for quantifying and benchmarking green building program outcomes.
- Third-party certification through GBCI avoids the need to establish local certification bodies.
- LEED is revised regularly to continually improve performance thresholds and to stay current with changes in building technologies and markets.
- Government entities can participate in and influence the development of LEED through membership in USGBC.[7]

It should be noted that adding new buildings inherently increases the City's greenhouse gas footprint, unless the buildings are designed to have net-zero emissions. Thus, this strategy will not directly reduce the City's current emissions. One of the many benefits of a LEED certification is that certified buildings emit less greenhouse gases than non-certified buildings. As such, emissions from this strategy are better described as "avoided" emissions as opposed to "reduced" emissions.

References

1. http://www.usgbc.org/ShowFile.aspx?DocumentID=5486. Roadmap to Green Government Buildings. U.S. Green Building Council, Inc. (USGBC). Page 3-4.
2. http://www.usgbc.org/ShowFile.aspx?DocumentID=5486. Roadmap to Green Government Buildings. U.S. Green Building Council, Inc. (USGBC). Page 2.
3. http://www.usgbc.org/ShowFile.aspx?DocumentID=5486. Roadmap to Green Government Buildings. U.S. Green Building Council, Inc. (USGBC). Page 14.
4. http://www.usgbc.org/ShowFile.aspx?DocumentID=5486. Roadmap to Green Government Buildings. U.S. Green Building Council, Inc. (USGBC). Page 3.
5. http://www.usgbc.org/ShowFile.aspx?DocumentID=5486. Roadmap to Green Government Buildings. U.S. Green Building Council, Inc. (USGBC). Page 8.
6. http://www.usgbc.org/ShowFile.aspx?DocumentID=5486. Roadmap to Green Government Buildings. U.S. Green Building Council, Inc. (USGBC). Page 3.
7. http://www.usgbc.org/ShowFile.aspx?DocumentID=5486. Roadmap to Green Government Buildings. U.S. Green Building Council, Inc. (USGBC). Page 16.
8. http://www.usgbc.org/ShowFile.aspx?DocumentID=5486. Roadmap to Green Government Buildings. .S. Green Building Council, Inc. (USGBC). Page 25.
9. ICLEI - CAPPA v1.5 © 2010. "Green Building." Assumes 25% savings in both electricity and natural gas. The estimated savings shown are for City Hall, which is approximately 55,000 sq. ft.
10. Nusca, Andrew "LEED Certification: What it costs" SmartPlanet.com. The value shown in the table is for registration/certification and compliance costs only, but does not include documentation costs which represent staff/consultant time. As noted in the background, additional construction costs are minimal, and often less expensive when included early in the planning process.8,9 http://www.smartplanet.com/blog/smart-takes/leed-certification-what-it-costs/7973.

IPP-10 Paper and Printing Policy

RECOMMENDATION

Reduce paper use across City offices via duplex printing, green printing software and increased use of electronic files.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
Duplex Printing	< $1000	--	--	--	$171,000	1.4[10]	< 1 month
GreenPrint Software	$9,500	--	--	--	$58,000	0.5[10]	< 2 months
Electronic Files	< $1000	--	--	--	$135,000	1.1[10]	< 1 month
IPP-10[12]	$10,000	--	--	--	$115,000	0.95	1 month

BACKGROUND

The average American office worker uses 10,000 sheets of paper annually and wastes ~14% of those sheets.[3] At an average costof 6 cents/sheet[3] the City of Missoula's average office worker could be wasting up to $85 annually or $48,000 across all employees. Excessive printing is an issue in every office. The following strategies will reduce paper use and associated costs:

Duplex Printing. Duplex printing is the technical term for printing on both sides of the paper. Although this is currently used, it is not the default printing setting on City printers. All City printers should default to duplex printing, which could increase duplex printing by 50%,[2] saving tens of thousands of sheets annually. Duplex printing has a large environmental impact, but since the cost of paper is much lower than the cost of ink, toner, etc. the cost savings are not significant.[1] Larger savings would be realized by avoiding printing altogether by using electronic files, as noted below.

Green Printing Software. The City of Missoula should implement software, such as Green Print,[7] that "checks" printing jobs to ensure there are no unnecessary pages printed with a document. For example, web pages regularly print unwanted sheets with very few characters on them. This software avoids those sheets and educates the user on ways to reduce the overall use of paper.[9] The City of Portland implemented the Green Print system, reduced printing costs $620,000 annually.[6]

Electronic Files. The actual cost of printing documents is high when staples, tape, paperclips, toner, paper, labor, folders, and storage space are considered. Using electronic files more often would reduce the need for those items, drastically reducing the cost of documents and employee time. This change will require information technology updates as municipal operations interacts frequently with the public. Using PDF viewing software, such as Adobe or Bluebeam PDF Revu,[4] employees will still have the ability to annotate and make edits to files, as well as share them electronically.

Department
> Human Resources
> Building Maintenance
> IT Department

Strategy Target
> Reduce costs and emissions associated with paper use and waste

Related Strategies
> Green Purchasing Policy
> Employee Orientation
> Fostering Sustainable Workplace

Timeline
> One month to confirm changing settings

Potential Partners
> Green Print
> Missoula County
> Allied Waste

Potential Funding Sources
> None identified.

IPP-10 Paper and Printing Policy Continued

Ink Efficient Fonts. Using certain font types can save large amounts of money by conserving ink and toner use. EcoFont, for example, boasts 28% savings in printer and toner use[11] by including unnoticeable white dots in the font to reduce the amount of ink needed in each character.

Paper Recycling. The City of Missoula recycles office paper. However, the City could improve the rate of paper recycling. The average office employee discards 1.5 pounds of paper daily,[8] or 97.5 tons annually for the City of Missoula. This is equivalent to 1,600 trees or 18.8 million tons of air pollution mitigated. Improving the rate of recycling would make a significant dent in reducing waste from City operations. Presently, workers must take paper from their workstations to centralized recycling locations. Reducing the distance to recycling locations is an effective means of improving the rate of recycling.[5] Other measures include additional signage and employee orientation for recycling.

References

1. University of Iowa. Duplex Printing Information: http://its.uiowa.edu/apps2/support/article/437
2. Rutgers University. Printing Conservation Program. http://www.nbcs.rutgers.edu/ccf/main/print/transition.php
3. Electronic files Management (pdf slideshow with background savings data): http://www.atlantaarma.org/userfiles/file/Going%20Green-%20Electronic%20Records%20Management%2010-14%20(2).pdf
4. Bluebeam PDF Revu. http://www.bluebeam.com/us/solutions/case-studies/grant-thornton.asp
5. Makower, Joel. "Between the Sheets: Taking the Wrinkles Out of Paper Recycling." http://environment.about.com/od/recycling/a/officepaper.htm
6. Hilkevitch, Jon, "To use less paper, Chicago transportation officials spend green on GreenPrint." August 2010, Chicago Tribune. http://articles.chicagotribune.com/2010-08-10/news/ct-met-green-print-cdot-20100810_1_print-job-greenprint-technologies-cdot
7. GreenPrint. http://www.printgreener.com/
8. Lane County Public Works Waste Management Division. "Recycler's Guide to The Glenwood Central Receiving Station." July 2011. http://www.lanecounty.org/Departments/PW/WMD/Recycle/Documents/GlenwoodCentralReceiving.pdf
9. McCool, Caitlin. "How to Reduce Printing Costs by 17%: A guide to Doing Well and Doing Good by Printing Less". GreenPrint Technologies White Paper. September 2008.
10. Calculations demonstrate the amount of carbon that would have been sequestered had the trees not been cut down and used to make paper. References: USE EPA: http://www.epa.gov/cleanenergy/energy-resources/refs.html and ConserveATree.org: http://conservatree.org/learn/EnviroIssues/TreeStats.shtml.
11. EcoFont.com http://www.ecofont.com/en/help/ecofont/faq/0030.html
    a. Example test page: http://www.ecofont.com/assets/files/ecofontsans/EcofontSans-Example.pdf
12. Implementation cost is the total estimated cost for all three listed costs. The annual dollar savings and estimated avoided emissions presented in this row of the table are the mean of the highest and lowest estimates.

IPP-11 Reduce Electronics Energy Usage

RECOMMENDATION

Conduct an audit/assessment of City electronics. Adopt energy conservation policies related to use of electronics by City staff.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
IPP-11	< $1,000	--	33,500	--	$3,350	14.5	< 4 months

BACKGROUND

Electronics left on all day use large amounts of energy while sitting idle and unused. Annually, these small loads produce significant energy waste. Policies that establish default power settings can help reduce this waste and save significant amounts of money by having the electronics automatically go into "sleep," or "energy saver" mode when not in use,[1] and turning them off completely at night and over weekends.

Even when shut down or turned off, many electronics still use energy. Standby loads (called "ghost" or "phantom" loads) are small amounts of energy used by electronics even when off or not in use.[1,2,3] This includes chargers and power supplies (e.g. for laptops, cell phones), items with a display clock (e.g. microwaves), and items with a small light or display screen (e.g. laptop computers, copiers/printers, computer monitors). Since these items are already off, the only way to avoid this energy waste is by unplugging the items. Having staff unplug every item in the office at night might be burdensome. By using certain types of power strips this process can be made easier or even automatic. There are many different types of power strips that have energy savings features, including timers (to be set to only be on from 7 am to 6 pm, for example),[4] and even remote controls,[5] that pay for themselves in a matter of months. These should be purchased and installed in all offices and kitchens throughout City buildings.

A conservative estimate of 1% savings in annual electricity use in Municipal buildings would result in over 33,500 kWh and $3,300 in energy savings.[7] This would amount to approximately 14.5 metric tons of avoided emissions annually.

The City should first conduct an audit/assessment of electronics throughout offices, kitchens, and conference rooms to see which items could have settings reconfigured and where items such as power strips can be installed. Using a Kill-o-Watt[6] for the audit/assessment will help collect data on energy use for each item being investigated. This device displays the amount of real-time electricity the machine is using. These should also be available for employees to borrow and use at home.

Department

> All

> IT to help implement changes

Strategy Target

> Reduce emissions associated with energy use

Related Strategies

> Green Purchasing Policy

> Fostering Sustainable Workplace

> Work Plan/Annual Review Integration

Timeline

> Four to six months for adoption of policies, integration of default settings, and installation of power strips/etc.

Potential Partners

> None identified at this time.

Potential Funding Sources

> None identified at this time. Low associated cost may remove need for outside funding.

References

1. Energy Star FAQs. http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_faq
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3. Lawrence Berkeley National Laboratory. "Standby Power". http://standby.lbl.gov/faq.html#much
   a. "Standby Power Summary Table". http://standby.lbl.gov/summary-table.html
4. Westek TM08DHB Designer Series Indoor Power Strip Timer. http://www.sears.com/shc/s/p_10153_12605_SPM2933788602P?blockNo=1&blockType=G1&prdNo=1&i_cntr=1328064127340#desc
5. Belkin Conserve power strips with remote: http://www.belkin.com/IWCatProductPage.process?Product_Id=459516
6. P3 International -"Kill-A-Watt". http://www.p3international.com/products/special/p4400/p4400-ce.html
7. Calculations for desktop and laptop computers and microwave ovens alone resulted in just under 1% in savings. Annual energy savings based on 128 non-work hours over 52 weeks. Assumes electronics are in "off" mode. Energy use statistics for "off" mode were found in "Standby Power Summary Table"[3a].

IPP-12 Waste Stream Reduction Policy

RECOMMENDATION

Develop and adopt a waste stream reduction policy.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
IPP-12	< $1,000	--	--	--	Indeterminable	Indeterminable	--

BACKGROUND

Each year millions of pounds of used materials are thrown into a landfill, generating large amounts of greenhouse gases. Many of these materials could be recycled or reused, or even avoided in the first place. According the EPA, "waste prevention often results in substantial savings through reduced purchasing costs and more efficient practices. It also can reduce waste disposal costs. In addition, waste prevention has environmental benefits, including reduced energy consumption and pollution, conservation of natural resources, and extension of valuable landfill capacity."[5a]

The City should perform a waste audit[1,2] to identify materials that should be recycled, as well as materials that could be purchased differently to reduce waste. Once a waste audit is completed, a comprehensive recycling strategy should be developed for items that can be recycled. This strategy should include methods for sourcing and tracking amounts of waste generated and materials recycled, which could include joining the EPA's free "WasteWise" program, which provides educational and technical assistance as well as helps track and report on waste reduction progress.[5] The policy should especially include methods for properly recycling electronics, or "e-waste", now one of the largest sources of waste in our waste stream.[3] Any funds generated from recycling should be used to further fund recycling efforts.[4] Materials that should be purchased differently should be incorporated into the green purchasing strategy.

Benefits of waste reduction efforts include:

- Reduced disposal costs (hazardous and solid waste) by generating less waste and using longer-lasting products
- Reduced costs associated with employee safety and health at the facility with reduced potential liability by improving the work environment and minimizing risks to workers
- Reduced material consumption which would also reduce related purchasing costs

Department

> All

Strategy Target

> Reduce contribution to secondary impacts

Related Strategies

> Green Purchasing Policy
> Fostering Sustainable Workplace
> Paper and Printing Policy
> Employee Orientation
> Work Plan/Annual Review Intergration

Timeline

> Less than one year
> Potential Partners
> Allied Waste
> EKO Compost
> University of Montana
> EPA WasteWise Program

Potential Funding Sources

> Initial funds will probably have to come from the city. However, once a recycling program is started, any money made from the program should be used to further recycling efforts

References

1. Georgia Department of Natural Resources, Sustainability Division. "The Sustainable Office Toolkit Module 1: Solid Waste Reduction." http://www1.gadnr.org/sustain/toolkit/modules_1_2.html
2. U.S. Department of Agriculture Forest Service, U.S. Environmental Protection Agency. "Waste Stream Analysis in Fire Camps." http://www.fs.fed.us/sustainableoperations/documents/waste-stream-analysis.pdf
3. Montana Department of Environmental Quality. http://deq.mt.gov/Recycle/Electronics/whyelectronics.mcpx
4. U.S. Department of Agriculture Forest Service. "Setting Up a Revenue Generating Recycling Program." http://www.fs.fed.us/sustainableoperations/documents/recycling-program-how-to.pdf
5. U.S. Environmental Protection Agency. WasteWise Program. http://www.epa.gov/epawaste/partnerships/wastewise/about.htm
   a. "WasteWi$e Tip Sheet. Waste Prevention." http://www.epa.gov/smm/wastewise/pubs/prvtpdf.pdf.

RENEWABLE ENERGY AND OFFSETS WORKING GROUP

WORKING GROUP MEMBERS

Bryan von Lossberg, *Alternative Energy Resources Organization (Working Group Chair)*

Brian Kearns, *University of Montana*

Greg Howard, *Watershed Consulting, LLC*

Jeff Crouch, *CTA Architects*

Molly White, *ClearSky Climate Solutions*

Ross Keogh, *Sagebrush Energy*

Renewable energy reduces the amount of emissions associated with fossil fuel sources. Combining the use of Renewable Energy with conservation, efficiency, and staff practices will amplify their effectiveness.

Renewable Energy strategies focus on using energy from renewable, domestic sources and utilize innovative technology such as solar photovoltaic, solar thermal systems, and methane recovery and reuse to augment a portion of the City's operational energy needs. Renewable energy is already being utilized by the City and as costs drop and new technologies are developed, new opportunities will be available to expand the use renewable systems to generate the City's energy. Strategies also focus on sequestration of greenhouse gases, through activities that absorb carbon dioxide and other greenhouse gases from the atmosphere. Finally, these strategies address Offsets. The City recognizes that in order to reach carbon neutrality, Carbon Offsets must play a role in the future. However, current Offset options are being considered only in our long-term strategy.

Renewable Energy and Offsets Completed Actions

Table 3-6 below lists actions already taken by the City within the scope of the Renewable Energy and Offsets working group categories. It is important to recognize these projects and programs and they be kept in place as we pursue greater reductions in operational costs, energy use, and emissions.

Table 3-6 Renewable Energy and Offsets Completed Actions

Action	Year Implemented
4.8 kW Solar PV Array Installed on Fire Station #4	2001
Methane Capture and Use at Missoula Wastewater Treatment Plant (WWTP)	2002
2.1 kW Solar PV Array Installed on City Hall	2005
Solar Hot Water Heater Installed on Fire Station #2	2005
12.96 kW Solar PV Array Installed on Fire Station #2	2009
Poplar Tree Pilot Project at Wastewater Treatment Plant	2009
Resolution 7398: City Sponsored Renewable Energy Certificates Program ("Green Power Missoula")	2009

Renewable Energy and Offsets Strategies

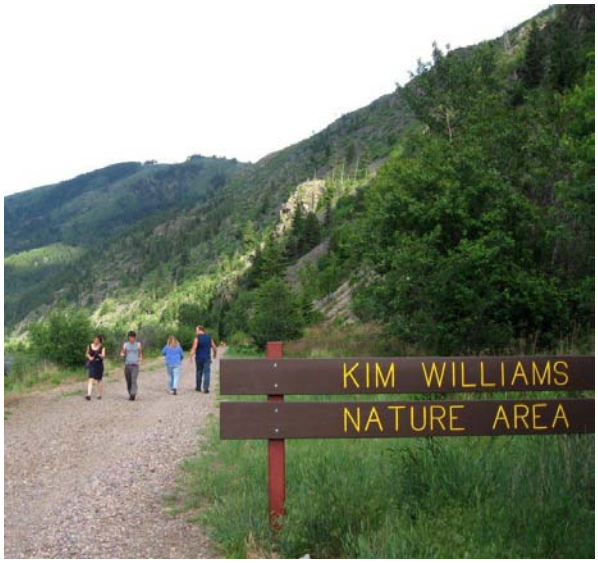
Table 3-7 below summarizes the Renewable Energy and Offsets working group strategies. Further details are described in the narratives below.

Table 3-7: Renewable Energy and Offsets Strategies

Strategy	Implementation Cost	Est. Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback (yrs)
RENEWABLE ENERGY				
REO-1 Expand Methane Capture at WWTP	$300k - $1,000,000	$55,357	259.7	5-18
REO-2 Micro-hydropower Electricity Generation at the WWTP	< $100,000	$10,000	43	10
REO-3 Solar PV Installations on Municipal Buildings	$1,100,000	$39,000	168.5	28
REO-4 Solar Thermal Heating System and Thermal Pool Blanket at Splash Montana and Similar Energy Efficiency Improvements at Currents	$515,000	$33,600	224	15-16
OFFSETS				
REO-5 Carbon Offset Development	$10,000-$250,000 per project	--	--	--
REO-6 Carbon Offset Purchasing	$69,240 / $167,907	$0	11,540 / 4,836	n/a
CARBON SEQUESTRATION				
REO-7 Missoula Open Space Portfolio	$237,000	--	57.99	Unknown
REO-8 Poplar Plantation near Wastewater Treatment Plant	$797,000	--	240.73-924.33	Unknown
REO-9 Urban Tree Planting and Maintenance	$44,000-$57,000	$4,750	20.8	9-12

"Parks and Recreation is committed to continually improving and evaluating our processes, systems and training as we work to provide our citizens with sustainably maintained spaces for active, healthy lifestyles. Through parks, trails, open spaces and recreation programs, citizens can enjoy the many benefits of green infrastructure. These benefits range from enhanced personal and mental health, to community economic vitality, to important connections with nature."

– DONNA GAUKLER



REO-1 Enhanced Methane Utilization at Wastewater Treatment Plant

RECOMMENDATION

Consider authorizing $5,000 to $30,000 in City funds to prepare a feasibility study, preliminary engineering, and cost estimates for increased utilization of biogas currently being flared at the Wastewater Treatment Plant via combined heat and power energy production.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
REO-1	$300k - $1,000,000	10,390	466,214	--	$55,357	259.7	5-18

BACKGROUND

The Missoula Greenhouse Gas Emissions Inventory reports that the wastewater treatment plant produced 808,872 cubic meters of biogas in FY 08. Approximately 49% of total biogas was used to produce boiler heat, approximately 49% was flared, and approximately 2% escaped as fugitive emissions. This produced 237,808 cubic meters of unutilized flared methane. Annual Electrical use is 5,014,224 kWh. Annual Natural Gas use is 25,920 TH. Annual Methane use is 17,785,296 ft^3. Note the Methane use represents partial capture and reuse of treatment by-products.[1,2]

Electrical generation efficiency of a methane-fired internal combustion engine coupled to an induction generator is approximately 35% - 36% on larger horsepower systems (for example, a 750 hp engine). The efficiency would not be this high on smaller engines. If waste heat is recovered off the engine/generator and used for space heating, the heat recovery efficiency is approximately 20%. If the co-generation system is used for both electric power generation and for space heating, the total efficiency would be (35% + 20%) or approximately 55%.[4] The examples here are for a cogeneration system.

Preliminary approximations estimate that the unutilized methane could be converted to approximately 466,214 kWh of usable electricity, 10,400 TH of natural gas, and save approximately $55,000 and 260 metric tons of CO2e per year.[3,4] More accurate values would be produced through the recommended feasibility study.

Department
> Public Works

Strategy Target
> Decrease use of purchased natural gas and electricity, and decrease methane emissions.

Related Strategies

Timeline
> One year

Potential Partners
> None Identified

Potential Funding Sources
> None Identified

References

1. Starr Sullivan, Wastewater Treatment Superintendent, 406-552-6600 (office), SSullivan@ci.missoula.mt.us
2. Molly White, ClearSky Project Developer, 406-721-3000, ext. 1242 (office), molly@clearskyclimatesolutions.com
3. Calculations were derived from those in “Anaerobic Digester at Wastewater Treatment Facility.” CAPPA v1.5. ICLEI ©2010.
4. John Campbell, ERM Inc., 406-565-1691.

REO-2 Micro-hydropower Electricity Generation at the Wastewater Treatment Plant

RECOMMENDATION

Issue an RFP for development of a Micro-hydropower electrical generation facility at Missoula's Wastewater Treatment Plant.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
REO-2	<$100,000	-	100,000	-	$10,000	43	10 years

BACKGROUND

It is estimated that a Micro-hydropower facility at the Wastewater Treatment Plant (WWTP) could generate approximately 100,000 kWh[1] of electricity annually utilizing the 6-9 million gallons per day of effluent flow.[2] Installed system cost is estimated at $100,000[3] with a simple payback of 10 years. 100,000 kWh would represent about 2% of the WWTP's approximately 5,000,000 kWh annual electrical use.[4]

Department

> Wastewater Division of Public Works

Strategy Target

> Generate 100,000 kWh of renewable energy annually to offset approximately 2% of the WWTP's annual electrical energy usage, estimated at 5,000,000 kWh.

Related Strategies

> None

Timeline

> Issue RFP and assess responses in 2012.

Potential Partners

> AERO (outreach)

Potential Funding Sources

> The project would be financed as a capital investment in the Wastewater Treatment Plant.

References

1. Estimates derived from two Micro-hydropower calculators:
    a. Micro hydro calculator #1: http://www.reuk.co.uk/Calculation-of-Hydro-Power.htm (power (W) = head (m) * flow (L/s) * gravity (m/s2) * efficiency; assumes: 6-9 million gallons of daily flow, 15' head, and 60% system efficiency)
        1. Calc. #1 yields 62,000 – 93,000 kWh per year
    b. Micro hydro calculator #2: From 2011 document "A Quick Guide to Micro-Hydro Power Generation in Colorado"; potential power (kW) = (water flow rate (cfs) * available head (ft) *0.8) /11.82
        1. Calc. #2 yields 82,000 – 124,000 kWh per year
2. City of Missoula website; Treatment Facility section: http://www.ci.missoula.mt.us/index.aspx?NID=579
3. Conservative rule of thumb used: ~$10,000 system cost per kW installed; thus, $100,000 for ~ 10 kW system.
4. Annual electrical use at WWTP per Energy Efficiency and Conservation Block Grant – Water/Wastewater Treatment Facilities – Criteria Questions – City of Missoula.

REO-3 Solar PV Installations on Municipal Buildings

RECOMMENDATION

Issue an RFP for development of solar (PV) systems on municipal buildings.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
REO-3	<$1,100,000	-	<390,000	-	<$39,000	< 168.5	28 years

BACKGROUND

Several municipal buildings currently have PV systems installed on their roofs. These include City Hall and Fire Stations 2 and 4, which combine for approximately 20 kW of total installed capacity.

It is estimated that expanding the installations of solar PV systems on up to 23 suitable municipal buildings (273 kW of total capacity) could generate approximately 390,000 kWh of electricity annually with a total cost of installed systems estimated at $1,100,000, yielding a simple payback of 28 years.

Actual paybacks would depend on anticipated electricity escalation, monetization of federal and state subsidies, building specific costs, and the financial structure of capital costs. Federal and State subsidies can reduce fixed costs by 20-40%.[3] Given the long-run nature of the project, specific pro forma models should be developed to assess feasibility with the RFP results.

To boost public visibility and awareness of these projects, public outreach campaigns should be developed to inform the public of the City's efforts.

Department

> Vehicle Maintenance & Facilities

Strategy Target

> Generate renewable energy annually for municipal buildings' annual electrical energy usage, kWh.

Related Strategies

None

Timeline

> Two years, to complete projects on all suitable buildings.

Potential Partners

> SBS Solar, AERO (outreach)

Potential Funding Sources

> Municipal debt
> Municipal renewable energy grants

References

1. Estimates assume the following:
    a. Avg. installation cost (per kW) = $4,000
    b. Avg. building install size: 12 kW
    c. Number of buildings: 23
    d. Net capacity factor: 0.16
2. SBS Solar. http://www.sbslink.com/
3. Ross Keogh, Sagebrush Energy.

REO-4 Solar Thermal Heating System and Thermal Pool Blanket at Splash Montana and Similar Energy Efficiency Improvements at Currents

RECOMMENDATION

Release a set of RFPs to: install a solar water heater to heat the Lazy River, Catch Pool, and the Pond at Splash Montana; an energy blanket to cover the Lap Pool; and to conduct similar energy efficiency improvements made at Splash at Currents.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
REO-4	$515,000[5]	40,000	-	-	$33,600	224	15-16

BACKGROUND

Operation of Splash begins Memorial Day through mid-September of each calendar year (approx. 3.5 months). The design would be for 269 solar thermal panels to cover 13,400 ft^2 (with a solar fraction of 45%) and an energy blanket (164' by 75'). The new demand of the system would be approximately 66,000 therms[4] (compared to existing demand of approx. 106,000 TH). The heater and blanket will create approximately 14,340 TH/yr and 25,660 TH/yr of savings, respectively. The life expectancy of the heater is approximately 25 yrs and the blanket is approximately 15 yrs. The estimated figures shown in the table above are based on values from the existing Splash systems.

In addition to these various savings, this project could be used as an educational interpretive center for solar energy.

Department

> Parks and Recreation – Aquatics Program

Strategy Target

> Reduce natural gas usage by 40,000 therms per year.

Related Strategies

> Continuous Building Retro and Re Commissioning

> Expansion of Solar Thermal at Fire Stations

Timeline

> Six months or less, to complete installation

Potential Partners

> None identified at this time.

Potential Funding Sources

> None identified at this time (Parks and Recreation Department Budget, Carbon offset generating RFPs, or Municipal Renewable Energy grants)

References

1. ClearSky Climate Solutions NWE RFP response 4/30/10
2. Jack Stucky, Fleet and Facilities Superintendent, 406-552-6387 (office), JStucky@ci.missoula.mt.us
3. Molly White, ClearSky Project Developer, 406-721-3000, ext. 1242 (office), molly@clearskyclimatesolutions.com
4. Estimated using a RET screen.
5. This estimate does not include future operating or management costs; assumed both improvements would be under limited or lifetime warranty.

REO-5 Carbon Offset Development

RECOMMENDATION

Release an RFP to conduct pre-feasibility assessment(s) and bid(s) for developing carbon offsets from Missoula City projects contingent upon the,

1) Need for additional project financing, and

2) The project meeting carbon offset development "economy of scale" (see Background).

If either (1) and (2) are not identified, it does not make sense to create carbon offsets in terms of mitigating the City's own carbon footprint, and the City should rather quantify the emission reductions and claim them as a direct benefit within their annual greenhouse gas assessment.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
REO-5	$10,000-$250,000 per project	--	--	--	--	--	--

BACKGROUND

A carbon offset is one metric ton of carbon dioxide equivalent (CO_2e) that is taken out of the atmosphere, or one metric ton of CO_2e that is not emitted to the atmosphere.

Eligible carbon offset generating activities include projects which either remove CO_2e from the atmosphere or avoid CO_2e from being released into the atmosphere. If the City wants to command a decent price, the projects must also demonstrate carbon offset best practices (real, additional, permanent, mitigate leakage, certified, registered, contain ancillary benefits, etc.).

Fixed costs associated with certifying carbon offsets within a Voluntary Carbon Market Standard include: One validation event and multiple verification events (est. $10,000-$30,000/visit), issuance and registry fees (est. $0.10/carbon offset), and project development services either by an external consultant or internal staff. These fixed costs do not include operations and maintenance of the actual project activity, nor do they include operations and maintenance sometimes associated with producing carbon offsets, for example: costs associated with measuring and monitoring the emission reductions.

Before conducting pre-feasibility of a carbon offset generating activity, a rough rule-of-thumb for "economy of scale" can be used: Is it greater than 1,000 acres or produces or avoids greater than 100 MWh/year?

While the Ecosystem Marketplace Report reports a 2010 price average of $6/offset, note that the average credit price by project types ranged from $1-$20. Further, $6/offset reflects both wholesale and retail exchanges and takes into account a unique market event in 2010, namely the collapse of one voluntary market place (CCX).

Department
> Public Works
> Parks and Recreation
> Planning and Grants

Strategy Target
> To help finance an emission reduction activity.

Related Strategies
> Internal Policies & Practices

Timeline
> One to two years, to complete the carbon offset certification process prior to or at the beginning of emission reduction project activity.

Potential Partners
> ClearSky Climate Solutions

Potential Funding Sources
> Average price per offset based on 2011 Ecosystem Marketplace Report[3] was $6/offset in 2010.

References

1. ClearSky Climate Solutions: www.clearskyclimatesolutions.com
2. Molly White, ClearSky Project Developer, 406-721-3000, ext. 1242 (office), molly@clearskyclimatesolutions.com
3. Back to the Future: State of the Voluntary Carbon Markets 2011: http://www.ecosystemmarketplace.com/pages/dynamic/resources.library.page.php?page_id=8351&section=our_publications&eod=1

REO-6 Carbon Offset Purchasing

RECOMMENDATION

Release an RFP to purchase high-quality carbon offsets and/or renewable energy credits to balance the City's unavoidable greenhouse gas emissions to meet carbon neutral goals of the City. Prioritize Montana Carbon Offset projects.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
REO-6	$69,240[5]	-	-	-	$0	11,540	n/a
RECs	$167,907[7]	-	11,193,797	-	$0	4,835.9	n/a

BACKGROUND

Carbon Offsets are generated by carbon sequestration or emissions reduction activities that are quantified, reported, verified, validated, and certified via the regulatory or voluntary market.[1] Achieving carbon neutrality typically requires the purchase of some form of Carbon Offsets to account for emissions that remain after conservation and other forms of reduction have been fully explored.

Carbon Offset projects often have a myriad of environmental and social benefits that go beyond the benefit to the atmosphere. A vast variety of Carbon Offset types exist in both the voluntary and regulatory market.[6]

Renewable Energy Credits (RECs): REC's are a specific type of Offset. One REC represents 1 MWh of electrical energy. REC's can be purchased from a variety of providers including project developers, brokers, utilities and commercial retailers.[8] They provide a certified non-carbon credit for electrical energy purchases, where the buyer own the environmental attributes from a renewable energy project. A range of prices can be expected depending upon the provider, source of REC's (wind, solar, geothermal, etc.), prevailing market conditions, length of purchase, and degree of quality assurance (i.e. 3rd party REC certification, auditing, registration). Through the efforts of the City's Greenhouse Gas and Energy Conservation Team, a City-sponsored program exists called Green Power Missoula. It allows industries, businesses, institutions, organizations and citizens to purchase competitively priced REC's through an agreement with a national provider.

The process for purchasing offsets generally involves:

1. Become familiar with basic concepts: Climate change, Greenhouse gas emissions, carbon offsets, and climate neutral.
2. Measure your emissions – your carbon footprint.
3. Reduce your emissions – this may involve implementing a Climate Action Plan.
4. Decide appropriate carbon offset market.
5. Identify the climate narrative you would like to support.

Department

> Mayor's Office
> Finance

Strategy Target

> Balance annual greenhouse gas emissions from Missoula's municipal operations, estimated total similar to FY 2008 of 11,540 tons of CO_2e[4].

Related Strategies

> None

Timeline

> One month or less, to release RFP and complete purchase

Potential Partners

> ClearSky Climate Solutions

Potential Funding Sources

> None identified at this time.

REO-6 Carbon Offset Purchasing Continued

6. Determine your criteria for telling that narrative – Location, project activity, project actors, certification, registry, co-benefits, price, etc.
7. Identify a carbon offset project which fits your criteria.
8. Exercise due diligence and request as much information as necessary from the carbon offset provider about the project.
9. Balance your unavoidable emissions by purchasing offsets.

Cost estimates in the table above are for scenarios in which offsets are used to account for 100% of annual municipal electricity use[7] (RECs) and total annual greenhouse gas emissions[5] (Offsets). The annual municipal electricity use and emissions were taken from Missoula's most recent Greenhouse Gas Inventory.[4]

The Renewable Energy and Offsets committee recommend that the Carbon Offset purchase policy includes the following, to further define what the City will determine are its purchase preferences or necessary attributes of high-quality carbon offsets:

Location: Preference for project activity to occur in the following order of locations: Missoula, Western Montana, Montana, the Pacific Northwest, and then International.

Project Activity: Preference for project activity to be generated from another municipality project activity (i.e. the concept of 'climate sister cities'). Preference for activities to be forestry, renewable energy, or methane destruction based.

Project Actors: Preference for project owners, brokers, investors, or developers to operate business out of the following order of locations: Missoula, Western Montana, Montana, the Pacific Northwest, and then International.

Standard Certification: Preference for projects certified by the Verified Carbon Standard (VCS), Climate Action Reserve (CAR), Gold Standard (GS), or Climate, Community and Biodiversity (CCB) Standard.

Registry: Preference for projects registered on a 3rd-party registry.

Vintage: No preference for vintage year.

Ancillary Co-Benefits: Preference for co-benefits to mirror the City of Missoula's initiatives or goals (e.g. job creation, preservation of open space, sustainable low-income housing, etc.)

Price: Preference for pricing which meets budget allocation.

References

1. ClearSky Climate Solutions: www.clearskyclimatesolutions.com
2. Molly White, ClearSky Project Developer, 406-721-3000, ext. 1242 (office), molly@clearskyclimatesolutions.com
3. Ross Keogh, Sagebrush Energy.
4. Missoula Greenhouse Gas Emissions Inventory and Analysis, 2003-2008: Toward a Blueprint for Municipal Sustainability, September 2010.
5. Back to the Future: State of the Voluntary Carbon Markets 2011. Implementation cost based on the Price Average of $6/offset. http://www.ecosystemmarketplace.com/pages/dynamic/resources.library.page.php?page_id=8351&section=our_publications&eod=1
6. White, Molly. "Carbon Offsets: Understanding the Variety". June 2010.
7. Valued at $15/MWh. This is a 20-year levelized REC rate, based on 4% discount value for the City.
8. This link provides an abundant listing of REC providers: http://apps3.eere.energy.gov/greenpower/markets/certificates.shtml?page=2

REO-7 Missoula Open Space Portfolio

RECOMMENDATION

Expand the Conservation Lands Program. Include the Conservation Lands Program in subsequent greenhouse gas assessment reports.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
REO-7	$237,000[5]	--	--	--	--	57.996	Unknown

BACKGROUND

Land conservation (as opposed to land development) prevents greenhouse gas emissions from entering the atmosphere. The goal of carbon-related conservation management is mainly to conserve existing carbon pools in forests, soils, or rangeland vegetation as much as possible through a host of activities. These activities may include land protection, controlling deforestation, preventing development, changing harvest or grazing regimes, or controlling for other anthropogenic disturbances such as fire or pest outbreaks. For illustrative purpose, 0.1 metric tons of carbon can be captured with each acre of enhanced conservation.[5,6]

The City of Missoula currently has approximately 3,600 acres[4] included in its Conservation Lands Program. These lands would be included in future inventories through a calculation of annual greenhouse gas sequestration based on the vegetation and soil types delineation completed in the most recent Open Space Management Plan.

There are numerous other benefits to expanding the Conservation Lands Program. Some include:

- Protection of riparian zones, forests, grass lands or rangelands.
- Wildlife, fish, and bird habitat improvement.
- Potential increase in recreational opportunities and economic benefit for citizens and visitors.
- Avoided heat island effect and improving water infiltration (avoided concrete or asphalt development).

Department
> Parks and Recreation

Strategy Target
> Capture the carbon benefit of land and habitat conservation.

Related Strategies
> Water Wise Park Areas

Timeline
> Unidentified at this time. Time necessary to process easement or land sale.

Potential Partners
> None identified at this time.

Potential Funding Sources
> None identified at this time (City Open Space bonds and Public Works Department)

References

1. ClearSky Climate Solutions NWE RFP response 4/30/10
2. Jacquelyn Corday, Open Space Program Manager, 406-552-6267 (office), JCorday@ci.missoula.mt.us
3. Molly White, ClearSky Project Developer, 406-721-3000, ext. 1242 (office), molly@clearskyclimatesolutions.com
4. Conservation Lands Management Plan August 4th, 2010: http://www.ci.missoula.mt.us/DocumentView.aspx?DID=4499
5. Clouse Example. Total size: 158 acres. Per conversation with Open Space officials, $1,500/acre.
6. Representative Carbon Sequestration Rates and Saturation Periods for Key Agricultural and Forestry Practices: http://www.epa.gov/sequestration/rates.html (For Clouse example, 0.1 metric tons of carbon per acre per year was used.)

REO-8 Poplar Plantation near Wastewater Treatment Plant

RECOMMENDATION

Release an RFP for the establishment of a hybrid Poplar forestry plantation on acquired lands that will use wastewater from the sewage treatment plant to irrigate the trees.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
REO-8[5]	$797,000	--	--	--	--	583	Unknown
Biomass Fuel	$797,000	--	--	--	--	924.33[4]	Unknown
Durable Wood	$797,000	--	--	--	--	240.73[4]	Unknown

BACKGROUND

The City of Missoula currently has approximately two acres of an experimental Poplar plantation located at the Wastewater Treatment Plant. The plantation was developed in May of 2009 and is now entering the fourth growing season. It utilizes final municipal effluent as an irrigation and fertilization source for 3 species of poplars (~274), 3 species of willow (~12), and 2 species of conifer (~25) for a total of 324 irrigated trees. Current research has focused primarily on the Poplars. Research goals pertain to soil and ground water chemical changes resulting from effluent irrigation. At this point, continuing research is focused on following soil and groundwater characteristics through time, as well as monitoring tree growth through yearly intervals and biomass development. A final and important goal is to eventually conduct a destructive biomass accumulation study which should offer some finite insight to Montana specific growth rates and CO2 sequestration.

Contingent on the successful completion of the pilot, the city should expand the existing pilot project that the Wastewater Treatment Plant is doing to irrigate hybrid poplars for tertiary water treatment (nitrate, orthophosphate and other secondary chemical removal). Currently, hybrid poplars are harvested on three, 10-year rotations with harvested wood going either to durable wood products or biofuel for a heat boiler.

The end use of harvested Poplar will strongly influence the expected carbon capture. Calculations for use as either durable wood or fuel are included, which were defined as the two outside outcomes (the final project is likely to blend a variety of final uses). Avoided emissions are higher in the biomass scenario as the wood is being used to replace other more emissions intensive fuel sources.

Using wastewater from the treatment plant to irrigate a poplar plantation will increase local water quality (especially in the low flows during the summer) and will act as a tertiary wastewater treatment (without direct discharge into the river).

Department
> Public Works

Strategy Target
> Capture the carbon benefit of fast growing trees and renewable fuel sources.

Related Strategies
> Green Purchasing Policy

Timeline
> ~2 years with DEQ to obtain appropriate approvals and permits for land application of wastewater effluent.
> ~2 years to install irrigation infrastructure and first planting.
> ~30 years to carry out three 10-year rotations of poplars.

Potential Partners
> Previous potential partners have included Heath Carey (pilot-project) and Tom Platt (Hybrid Energy Group, LLC)

Potential Funding Sources
> None identified at this time (Open Space Program, Public Works Department)

REO-8 Poplar Plantation near Wastewater Treatment Plant Continued

Cost breakdown in either scenario includes: $35,000 (permits), $200,000 (irrigation system), $462,000 (three rotations of plantation and operation and maintenance), $100,000 (admin, reporting and monitoring for 30 years). Cost does not take into account the benefit from the sale of product, either biomass fuel or durable wood. The estimated cost also does not include the capital cost avoidance of potential necessary upgrades/expansion to the Wastewater Treatment Plant by effluent land/Poplar Plantation application. A full cost benefit analysis should be conducted at part of recommended RFP.

> "Working on this team helped the Wastewater Treatment Plant strategize how to continually work to preserve the environment and public health in the most energy efficient way possible."
>
> - STARR SULLIVAN

References

1. Molly White, ClearSky Project Developer, 406-721-3000, ext. 1242 (office), molly@clearskyclimatesolutions.com
2. Heath N. Carey, Founder, Terra Mater Solutions, www.terramatersolutions.com. Environmental Scientist, Bioroot Energy, www.biorootenergy.com. 406-396-5147
3. Starr Sullivan, Wastewater Treatment Superintendent, 406-552-6600 (office), SSullivan@ci.missoula.mt.us
4. ClearSky Climate Solutions NWE RFP response 4/30/10
5. The likely outcome of the plantation will be a mix of the two, so average values are presented for the final estimates.

REO-9 Urban Tree Planting and Maintenance

RECOMMENDATION

Include urban tree planting and maintenance in subsequent greenhouse gas assessment and increase urban tree planting.

Strategy	Implementation Cost	Estimated Annual Energy Savings			Estimated Annual Dollar Savings	Annual Avoided Emissions (mtCO2e)	Simple Payback
		Therms	*kWh*	*Gallons of Fuel*			
REO-9	$44,000-$57,000[7]	-	47,500	-	$4,750	20.8	9-12

BACKGROUND

Urban trees provide shade and wind protection, indirectly reducing energy use of buildings and vehicles. Trees sequester and store carbon, accounting for about half the dry weight of most trees (roots, trunk, branches, and leaves). This storage occurs until the trees die and are allowed to decay completely, and are therefore considered a "sink" for carbon in the atmosphere.

A medium growth coniferous tree, planted in an urban setting and allowed to grow for 10 years, sequesters 23.2 lbs of carbon which is equivalent to 0.039 mtCO2 per urban tree planted[4,5] (an average of 0.004 mtCO2 annually).

Trees properly placed around buildings can reduce air conditioning needs by 30% and can save 20-50% in energy used for heating.[6] In Boulder, CO, for example, energy savings for a one to two story single family detached home are approximately 950 kWh per year.[6]

In addition, trees filter pollutants from the air, improve water quality, reduce storm water runoff, and reduce soil erosion. The presence of trees increase property values and improve human health and sense of well-being.

The table included in this strategy assumes planting of 100 trees.

Department

> Parks & Recreation, Urban Forestry Division

Strategy Target

> To capture the emission reduction activity of tree planting and maintenance, as it relates to the City's tree services (i.e. tree planting, pruning, removal, cost share planting, memorial trees, mulch and firewood supply)

Related Strategies

> Missoula Open Space Portfolio

Timeline

> Tree planting: Less than 1 year to complete
> Include urban trees in next greenhouse gas assessment

Potential Partners

> None identified at this time

Potential Funding Sources

> None identified at this time

References

1. David Selvage. dselvage@ci.missoula.mt.us, (406) 552-6252
2. Greg Howe. Missoula Urban Forester: ghowe@ci.missoula.mt.us, (406) 552-6270.
3. Molly White, ClearSky Project Developer, 406-721-3000, ext. 1242 (office), molly@clearskyclimatesolutions.com.
4. EPA Calculations and References: Number of tree seedlings grown for 10 years. http://www.epa.gov/cleanenergy/energy-resources/refs.html
5. U.S. Energy Information Administration. "Method for Calculating Carbon Sequestration by Trees in Urban and Suburban Settings." April 1998. ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/sequester.pdf
6. City of Boulder Climate Action Plan (Sep. 2006)
7. Implementation cost includes labor and supplies during planting, and 3 years of maintenance (watering, mulching, and pruning). Mortality rates without maintenance increase from 10-20% to 60%.

ADDITIONAL ACTIONS AND STRATEGIES IDENTIFIED

There were many ideas and suggestions for reduction measures that were not included as strategies for various reasons. These were organized into three categories: Recommended Actions, Demonstration Projects, and Strategies for the Community Conservation & Climate Action Plan.

Recommended Actions. These recommended actions are known to have positive impacts in many sectors, including energy conservation, water conservation, air quality, and greenhouse gas reduction. Recommended actions differ from strategies and demonstration projects in that they are supportive in nature and enhance existing City programs and practices as well as strategies included herein.

Demonstration Projects. Like recommended actions, demonstration projects are known to have positive impacts in many sectors, including energy conservation, water conservation, air quality, and overall greenhouse gas reduction. The level to which these projects will benefit a City or community is often contingent upon region, climate, or availability of physical space for implementation, budget, and other such factors. As such, the benefits of implementation in Missoula are not fully understood or known. These projects are recommended as small scale demonstration projects, to be used to better understand the level to which full implementation of each project will benefit the City and community. With successful demonstration, each of these projects could and should become full strategies in future revisions of Missoula's Conservation & Climate Action Plan and should be implemented at appropriate larger scales.

Strategies for the Community Conservation & Climate Action Plan. These strategies were determined to be outside the scope of the Municipal Conservation & Climate Action Plan, but were important enough to be preserved for future community wide Climate Action efforts. The narratives give a brief synopsis of the strategy and its relation to the reduction of greenhouse gases in the Missoula Community, however further development and research of the strategies may be required.

Recommended Actions

FLEET AND FACILITIES

Aeration Blower Retrofit at the Wastewater Treatment Plant

A study conducted by Energy Resource Management, Inc. investigated the implementation of a retrofit of the aeration blower system at the Missoula Wastewater Treatment Plant. Typical benefits from a retrofit of older systems include updated efficiency and new technology, e.g. variable frequency drives and dissolved oxygen control.[1] The Missoula blowers already have these two technologies, thus reducing the overall impact of the retrofit to 8-12% in annual electrical savings, as opposed to a typical 35-33% savings. This increases the simple payback period to 17-26 years. The aeration blowers should continue to be monitored as they age and decrease in efficiency until such a time when they become more economically feasible to retrofit.

Deconstruction, Reuse and Recycling in Future Municipal Building Demolitions and Renovations

The City of Missoula should require a Deconstruction, Reuse and Recycling plan for future building demolitions and renovations. Deconstruction plans reduce unnecessary landfill contributions, related Greenhouse Gas emissions (primarily Methane), and waste disposal fees. Past Projects have demonstrated savings ranging from $50,000 to over $150,000.[2] In addition deconstruction can create revenue streams with sale of salvaged and recyclable materials, creates jobs and conserves energy and natural resources. According to the EPA, the waste from building demolition removal constitutes nearly half of all building related construction and demolition debris. Renovation and remodeling projects are estimated to generate an additional 40% of the total debris, and new construction makes up the rest.[1] Missoula is uniquely positioned for successfully implementing these activities with the existence of Home ReSource – who serves both as a provider of Deconstruction services and established building material reuse retail outlet.

This Recommended Action integrates with LEED New Construction & Major Renovations, LEED Existing Buildings Operations & Maintenance, Waste Stream Reduction Policy, and Sustainable Operations and Maintenance strategies.

References

1. Energy Resource Management, Inc. “Energy Optimization Study for the Missoula Wastewater Treatment Plant”. October 2011.

References

1. Environmental Protection Agency, “Analyzing What’s Recyclable in C&D Waste,” Ken Sandler, BioCycle, November 2003. http://www.epa.gov/epawaste/conserve/rrr/imr/cdm/index.htm
2. Environmental Protection Agency, “Building Savings: Strategies for Waste Reduction of Construction and Demolition Debris from Buildings”. EPA-530-F-00-001. June 2000. “Model Programs”, Page 3. http://www.epa.gov/epawaste/nonhaz/municipal/pubs/combined.pdf

Recommended Actions

FLEET AND FACILITIES

Review Operation and Maintenance Program for Municipal Conservation and Climate Action Plan Integration

Missoula's Operations and Maintenance (O&M) program should be reviewed by a diverse team of the City Staff who are knowledgeable of current practices and will be charged with implementation. For purposes of this plan, the program scope should include 1) Establishing an O&M Team of Building Champions 2) Establishing an Energy Monitoring and Reporting System, 3) Establishing Energy Performance Targets, 4) Establishing a Building Performance Rating (such as ENERGY STAR), 5) Define a Maintenance Strategy 6) Assess Staff and Training.[1] Best-practice operation and maintenance programs increase the efficiency of facility staff, improve building operational practices, and reduce utility costs. The O&M process helps sustain a building's profitability by reducing costly equipment failure and maintaining tenant comfort and indoor air quality. The review and revision of an operations and maintenance program is generally straightforward and does not significantly affect budget. It primarily reorganizes and reallocates existing resources to be more efficient and productive. Implementing a best-practice O&M program can reduce facility energy use by 5-20% without significant capital investment.[1] Note that, depending on program design, costs could be associated with implementing revisions. For example, it could be decided that an O&M software and subscription should be purchased.

This recommended practice is closely related to LEED Existing Buildings: Operations and Maintenance and both should be considered when implementing to ensure seamless integration and that they act as complements.

References

1. BetterBricks, an initiative of the Northwest Energy Efficiency Alliance. http://www.betterbricks.com/building-operations/best-practice-om#EstablishPerformanceGoalsAndFollowUpActivities.

INTERNAL POLICIES AND PRACTICES

Incentives and Department Competitions

The City of Missoula should develop incentive programs and competitions between departments for various energy savings and sustainability activities. Success in sustainability initiatives is largely determined by buy-in from employees. One way to strengthen employee motivation is to encourage participation through incentives and/or awards. Incentives can be given for small actions as well as large accomplishments and may be awarded to a department or individual. A friendly competition between departments can determine nominees and winners or awards, and can help foster full department participation. The competition should not only inform employees of sustainable activities but also encourage their adoption. Activities can be divided into categories or footprint areas. Example categories could include energy, waste reduction and recycling, green purchasing, fleet, and water savings. A rating of bronze, silver or gold (or something Missoula-based and ecological) can be given to each department for their success. Awards may be associated with the ratings, for example, for "Sustainable Employee of the Year." To help develop these competitions, the organizers should use social marketing techniques[1] and should focus on education and outreach strategies to ensure buy in and participation.

References

1. McKenzie-Mohr, Doug. 2011. "Fostering Sustainable Behavior: An Introduction to Community Based Social Marketing." Especially sections on: "Social Diffusion: Speeding Adoption" and "Incentives: Enhancing Motivation to Act."

Recommended Actions

RENEWABLE ENERGY AND OFFSETS

Solar Thermal Hot Water Systems at Fire Stations

Solar thermal hot water systems are systems that use the sun's energy to heat water, which is then used for indoor water heating and use, space conditioning, and other applications. "Research shows that the average household with an electric water heater spends about 25% of its home energy costs on heating water."[1] Much or all of this cost could be offset with a solar thermal system. During the extensive remodel of Missoula's Fire Station 2 in 2008, a solar thermal hot water system was integrated into the design and installed in the building. The system was deemed feasible due to economies of scale. In general, fire stations are good candidates for this technology because of consistent activity through all hours of the day. Opportunities for solar thermal hot water should be considered in all future renovations and new construction of fire stations to realize the potential energy and cost savings, and environmental benefits.

References

1. U.S. Department of Energy – National Renewable Energy Laboratory. "A Consumer's Guide: Heat your water with the sun." http://www.nrel.gov/docs/fy04osti/34279.pdf

Conservation & Climate Action Plan Demonstration Projects

FLEET AND FACILITIES

Green Roofs

A green roof is a vegetative layer grown on a rooftop. Green roofs provide shade and remove heat from the air, reducing temperatures of the roof surface and the surrounding air.[1] General green roof components include conventional structural support, waterproof roofing membrane, root repellent system, drainage system, filtering layer, growing medium and plants.[2] The benefits of green roofs include reduced energy use through insulation, reduced air pollution and Greenhouse Gas emissions, reduced urban heat island effects, enhanced storm water management and quality, increased lifespan of roof surfaces, creation of wildlife habitat, and improved human health and comfort.[1,3] Common obstacles to green roof installation include higher than conventional roofing costs, possible increased maintenance, and need for additional structural support. Green Roof installation can result in 6-25% whole-building cooling energy savings.[3] It is estimated that Green Roofs can be installed for $10-$25/square foot.[1] The City of Missoula could implement a green roof demonstration project on all or part of a City of Missoula building to better understand the net impacts of widespread installations on municipal buildings considering our cooler, northern climate and unique storm water management system.

References

1. U.S. Environmental Protection Agency. http://www.epa.gov/heatisland/mitigation/greenroofs.htm.
2. Ecolife.com. http://www.ecolife.com/define/green-roof.html
3. Hodges, Matthew. "Green Roofs in the Garden City: Exploring the Opportunities for Green Roof Policies in Missoula, Montana" 2009.

Conservation & Climate Action Plan Demonstration Projects

FLEET AND FACILITIES

Composting

Organic trash in the waste stream is a major generator of methane gas in landfills.[1] Methane gas is 21 times more potent than carbon dioxide, so reducing methane gas production is very important in the fight against greenhouse gas emissions.[1] The average office worker produces over one pound of organic waste daily[1,2] in the office. Though the composting process itself produces some greenhouse gases doing so still results in a net reduction of greenhouse gas emissions through ancillary benefits. These include reduced time, money, and transport costs associated with conventional disposal and reduced cost of fertilizer when used on local gardens.[1] Most importantly, composting reduces the stress put on local landfills. The City of Missoula could implement a composting program in the office kitchens, parks waste facilities, and other organic waste sites to be removed and taken to EKO Compost.[3]

Native and Water Wise Garden at City Hall

City Hall stands at the center of Missoula as a public hub of activity. While it is in an urbanized area, there are landscaped areas or beds on the perimeter of most of the building. Current landscaping, while beautiful, is completed each year with labor, water and fertilizer-intensive plants and practices. The City of Missoula should convert these areas to a mix of native and water wise perennial grasses, wildflowers, shrubs, trees and features. In addition, water wise practices such as rainwater harvesting, drip irrigation (if needed), and mulching/ composting should be implemented. These practices will reduce operations costs over time by reducing labor costs of planting and maintenance and eliminating annual plant and fertilizer costs. Converted areas, such as those around municipal buildings, should also include interpretive signs as a public education tool to promote how these landscapes make fiscal sense at work and at home, contribute to a healthier environment, and how they encourage and celebrate local cultural heritage and promote urban wildlife habitat.

Permeable Surfaces

Non-permeable paved surfaces are direct conduits for pollutants to reach surface waterways. Permeable or pervious surfaces allow air and water to penetrate the soil strata underneath; however, CO2 outputs and inputs are believed to be negligible. Cook and Knapton 2009[1] suggest that permeable surfaces reduce "embodied carbon" by 50% when considering a given non-permeable paved site - due, largely in part, to the elimination of traditional drainage provisions. Moreover, the authors suggest that the entire paving project could be rendered carbon neutral with the addition of planting trees per paving project. The authors state that planting approximately 10 trees per 100 m^2 of permeable surface will render the project carbon neutral within 50 years. Permeable surfaces have numerous other benefits as well, including glare reduction, heat reduction (through reduction of the urban heat island effect), and provide an opportunity to use recycled materials.[2] Missoula could partner with Terra Firm Enterprises[3] and also with the Missoula Institute for Sustainable Transportation,[4] who has already expressed interest in establishing a pilot project.

References

1. GreenYour.com. "Compost organic office waste." http://www.greenyour.com/node/13264
2. CanWest News Service. "Office compost system for green-conscious businesses."http://www.financialpost.com/story.html?id=1301c697-79d8-47e5-acbc-f9c5314b9fbe&k=10858
3. EKO Compost. http://www.ekocompost.com/

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2. City of Chicago Department of Transportation. "The Chicago Green Alley Handbook." http://brandavenue.typepad.com/brand_avenue/files/greenalleyhandbook.pdf
3. Terra Firm Enterprises. http://www.terrafirmenterprises.com/
4. Missoula Institute for Sustainable Transportation. http://www.strans.org/

Conservation & Climate Action Plan Demonstration Projects

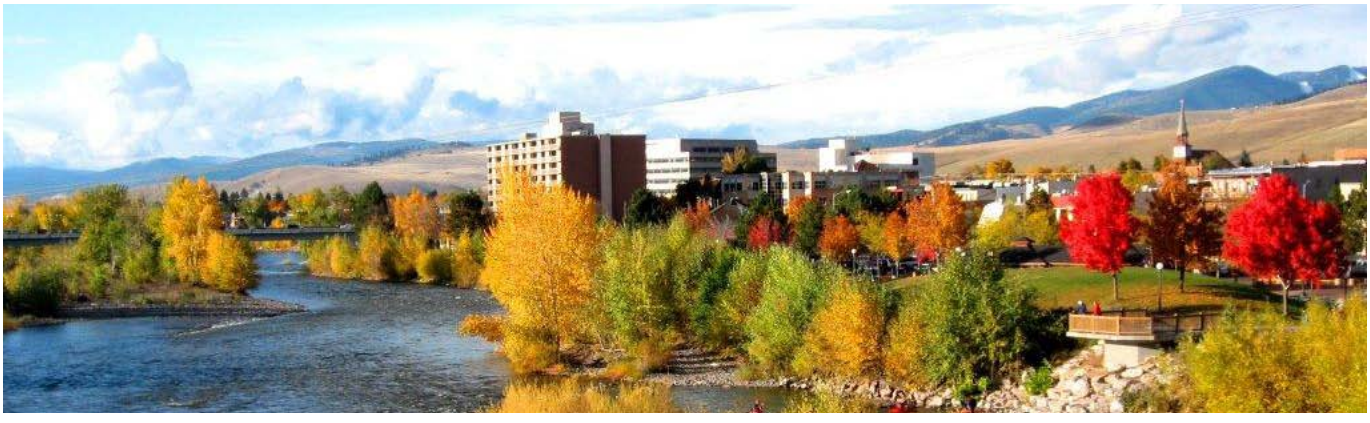
FLEET AND FACILITIES

Gray Water Systems

The Missoula Wastewater Treatment Plant currently discharges approximately 8 million gallons of treated effluent into the Clark Fork River daily – which is approximately 2.9 billion gallons of effluent yearly; effluent which still contains nutrients vital to plant growth. Gray Water Systems, or "purple pipe," is a concept which utilizes treated wastewater for a variety of irrigation purposes ranging from landscaping to golf courses. This technology is widely used in drought prone and water-shortage prone areas such as southern California. For the purpose of this report, we explore reusing effluent at the Larchmont Golf Course on South Reserve. The Environmental Institute for Golf[1] suggest that the average golf facility in the Upper/West Mountain region of the US uses approximately 98 million gallons of water a year. Ignoring water traps which may serve as additional effluent storage, this irrigation volume equates to 12 days' worth of effluent removed from the Clark Fork River. Assuming turfgrass sequesters 800 lbs of carbon per year[2] and the average Upper/West Mountain region contains an average of 103 acres of turfgrass, Larchmont Golf Course potential sequesters 82,400 lbs of carbon per year. Implementing treated nutrient rich effluent as a means of irrigation could also reduce the amount of CO2 associated with current fertilization requirements.

Hydrogen Fleet Retrofits

In the spring of 2009, the Missoula Vehicle Maintenance Division of Public Works had two hydrogen fuel canisters installed in test vehicles. One was installed in unit 174, a diesel powered pothole patching machine. The second was installed in unit 701, a gasoline powered small administrative pickup. Both vehicles have shown slight improvements in fuel consumption. Unit 174 is showing a 0.033 reduction in fuel use per hour. Unit 701 is showing a 1.04 improvement in miles per gallon. Both vehicles have a noticeable improved clarity in exhaust. More data as to the actual exhaust reductions will be available in the future.[1] This may not be a cost effective solution at the current technological levels.[2,3] It is however, a window of opportunity that needs to be left open. Electrolysis produced hydrogen is very friendly in terms of CO_2 emissions and other gases.[2] The recommendation is to continue to explore and implement hydrogen fuel cell and canister technology where it is applicable.



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2. Bremer, Dale. "Carbon Sequestration in Turfgrass: An Eco-Friendly Benefit of Your Lawn." October 2007. http://bremer.ksuturf.org/files/Turf%20C%20seq%202007.pdf

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2. U.S. Energy Information Administration. "The Impact of Increased Use of Hydrogen on Petroleum Consumption and Carbon Dioxide Emissions" August 2008. http://www.eia.gov/oiaf/servicerpt/hydro/hydrogen.html
3. U.S. Department of Energy - Energy Efficiency and Renewable Energy – Fuel Cell Technologies Program. http://www1.eere.energy.gov/hydrogenandfuelcells/accomplishments.html

Conservation & Climate Action Plan Demonstration Projects

RENEWABLE ENERGY AND OFFSETS

Algae Carbon Sequestration Project at the Wastewater Treatment Plant

The City should partner with Algevolve to begin establishing a pilot project at the Wastewater Treatment Plant to use algae based technology to capture carbon for green energy and nutrient removal in wastewater. The by-product will be an algae biomass that can be used for plastics manufacture, protein animal feed supplement, pharmaceuticals supplement and organic fertilizers. A full scale operation at the WWTP has the potential to remove 30 pounds of phosphorus a day from the Clark Fork River and utilize all of the excess digester gas produced at the WWTP. This technology could eliminate the need for more expensive tertiary treatment that would do nothing to offset greenhouse gas production. A 1 MGD pilot project is estimated to cost $50,000.[1] Note that outflow from the algae process will no longer have the required nutrients to support the growth of Poplar trees, and the two may not co-exist if the algae project is implemented on a full scale. A financial and greenhouse gas cost/benefit analysis for the two projects could reveal to what extent each should be implemented at the plant.

References

1. Algevolve. 406-363-4139. http://www.algevolve.com

Strategies for the Community Conservation & Climate Action Plan

FLEET AND FACILITIES

Street Light Efficiency Retrofits

Streetlights using inefficient lighting technology should be upgraded using more energy and cost efficient technologies. LED's, for example, use 50% of the energy of the lamps currently in common use for street lighting.[1] Cost savings come from other elements of the system as well, including fewer and shorter poles, decreased light spillage (i.e. lighting areas that do not need to be lit), and lower operation and maintenance costs.[1] Certain rebates and incentives are available through Northwestern Energy, but specific guidelines must be followed to qualify. For example, LED technology must be included on a preapproved certified listing.[2]

Street Lighting Feasibility Study, Final Report. December 2011. Prepared by WGM Group for the City of Missoula.

Traffic Light Efficiency Retrofits

The same cost and energy efficiency justifications for the streetlight retrofits apply to traffic light retrofits. However, unlike streetlights that are only on at night, traffic lights are on 100% of the time. As such, an even greater amount of energy and cost can be saved annually by upgrading existing traffic lights using more efficient lighting technologies.

References

1. Northwestern Energy Light Emitting Diode (LED) Policy for Electric Conservation Project Submittal. Released and effective November 2011.

Strategies for the Community Conservation & Climate Action Plan

INTERNAL POLICIES AND PRACTICES

Community Wide Rideshare Program

The recommended strategy for this Municipal Plan regarding ridesharing should be expanded to encompass the entire community of Missoula. Currently, ridesharing is formally supported by the Missoula Ravalli Transportation Management Association (MRTMA).[1] Ridesharing is limited primarily by the difficulties of linking people together. The next "hurdle" is matching interested people together. There are many online options[1a,b,c] but they are only as successful as the number of people registered with them.

An online rideshare matching service should be established, and then people directed there. There should also be opportunities created to meet other members in the rideshare program, to help remove the hesitancy to share rides. The City of Missoula has a population of approximately 66,000 people. Realizing even a 1 percent reduction in commute vehicle trips due to implementation of this program could save up to 86,000 gallons of gasoline and avoid emitting 812 mtCO2e per year.[2]

References

1. Missoula Ravalli Transportation Management Association. http://www.mrtma.org/
   a. GoLoco. http://www.goloco.org/
   b. Zimride. http://www.zimride.com/
   c. iCarpool. http://www.icarpool.com/
2. ICLEI – CAPPA v1.5 © 2010. "Promote Carpooling and Vanpooling". Inputs: 66,000 employees; $3.45/gallon (EIA Fuel Update. November 2011), 5.8 miles average one way commute length (Missoula in Motion Way to Go! Club data), 21.3 mpg average fuel economy (FuelEconomy.gov. Avg. combined fuel economy of 2008 Ford Focus, Subaru Outback, and Ford F150).

Strategies for the Community Conservation & Climate Action Plan

RENEWABLE ENERGY AND OFFSETS

Community Solar PV Project

A community solar project can be defined as "a solar-electric system that, through a voluntary program, provides power and/or financial benefit to, or is owned by, multiple community members."[1] Essentially, community members interested in solar installations pool resources to build a large, centralized project where economies of scale come into play. Many different ownership models exist depending upon the circumstances of the proposed project. A compelling reason for such a project is that many interested citizens may not be able to independently install solar PV on their residences due to terrain obstacles (tree, buildings), ownership issues (rental tenants or deed restrictions) or financial reasons. Before setting up a program, further research and public input should be used to determine which model(s) would best fit the Missoula Community. Models to explore include installations placed on residences of some of the investors,[2] or installations placed in a separate, central location.[1] The included reference from the DOE[1] provides detailed information on several models and the differences in allocation of costs and benefits of each.

Further investigations into tax incentives and credits and utility incentives[3,4,5] should also be included in future development of such projects, which can significantly lower implementation and life cycle costs.

Wetland Development and Riparian Enhancement

Wetland Development and Riparian Enhancement strategies have potential to act as an offset to the City's Greenhouse Gas emissions through carbon sequestration as well as a source of renewable energy through aquatic biomass. In addition, such strategies could contribute to improved wastewater treatment and river health. Success of these strategies would require application that includes City property as well as adjacent lands not owned by the City. The following sites are being presented as potential location for implementation of strategies.

EKO Compost and Clouse Property. EKO Compost is located adjacent to the treatment plant and has land feasible for wetland development. The Clouse Property is also within close proximity to the treatment plant and located on the west side of the EKO Compost Property. The Clouse Property is currently being considered for a Poplar plantation to utilize wastewater and operate a sustainable wood business. The Clouse Property has additional lands that exist outside the proposed plantation that may be useful for wetland development or enhancement to the floodplain and riparian areas. These areas and proposed strategies will provide emissions offsetting, wastewater treatment, and / or wetland mitigation / banking.

Grant and Rattlesnake Creeks. Both creeks have segments within the city limits. Sites may exist along the floodplain and riparian areas with potential for enhancements. These areas offer potential sites that would provide emissions offsetting, wetland development and the other intrinsic benefits for natural resources.

References

1. U.S. Department of Energy - Energy Efficiency and Renewable Energy. "A Guide to Community Solar: Utility, Private, and Non-profit Project Development." November 2010.
2. "Clean Energy Collective, LLC, Colorado" Page 17.
3. Solarize Portland. http://www.portlandonline.com/bps/index.cfm?c=51902
4. Database of State Incentives for Renewables and Efficiency: Montana http://www.dsireusa.org/
5. Northwestern Energy E+/Renewable Energy Program. http://www.northwesternenergy.com/display.aspx?Page=Renewable_Energy_Program

IMPLEMENTATION

Establish a Full-Time, Dedicated Staff

A dedicated, full-time staff member to oversee this Plan is needed to successfully implement recommended strategies across all departments and staff and produce the desired results and expected benefits. This staff person would take responsibility for coordinating the City's conservation and climate action efforts. The job functions would include: providing vision and leadership in the implementation of this plan, dedicating time to researching and developing projects and activities not yet identified, researching and establishing funding mechanisms, establishing metrics and tracking systems to document the impact of the strategies, fostering a culture of sustainability in City government, communicating the City's efforts to City committees and to the public, and building coalitions and partnerships within the community to further and amplify the City's efforts. Research on the impact of having staff oversight of conservation and climate action plan implementation and activities has shown that cities without a dedicated staff member working to implement the plan have failed to make progress towards interim and overall emissions goals. Without a dedicated staff person to fulfill the duties listed above, Missoula runs the same risk.

The Task Force recognizes that implementation success increases with strong, top-down support and cross-departmental collaboration therefore, it is recognized that the Mayor/Administration and Administrative Leadership Team (ALT) are to be tasked with identification of project initiatives, priorities, and assessment of options in coordination with dedicated, full-time energy conservation staff. Each City department Director has the requisite knowledge of their programs, staffing needs, service delivery model, legal obligations, and costs to ensure initiatives/projects can be appropriate and properly integrated without negative impacts on legal obligations, baseline services and budget, therefore individual projects and initiatives must be the responsibility of the corresponding Director of each City department with full support, coordination and tracking by full-time, dedicated energy conservation staff.

The importance of establishing a full-time, dedicated staff to oversee the City of Missoula's Conservation & Climate Action Plan and associated activities was recognized and approved in the budget for Fiscal year 2013 with an FTE. Specific job description, details and hiring will occur in fiscal year 2013. Once hired, the FTE will interact and collaborate where appropriate with all levels of City government including the Mayor/Administration, Staff, City Council, Mayor's Advisory Group on Climate Change and Sustainability, Greenhouse Gas Energy Conservation Team and stakeholders to ensure success.

CLARK FORK COALITION

"At the Clark Fork Coalition, we believe that clean water is our community's most vital natural asset. We're excited to endorse and support the common-sense solutions outlined in this plan, which will help the City of Missoula to conserve water, reduce energy use, and save money."

- JILL ALBAN

Establish a Data Monitoring and Reporting System

Collecting data and reporting on the impacts of each strategy is essential to the climate action planning process. Tracking and monitoring provides evidence of energy, fuel, water, and cost savings, feedback on project success, and progress toward goals. In addition, it provides sound reasoning and results to justify continued internal and external investment and funding. This task must be conducted regularly, ideally by the above mentioned FTE. Although some strategy recommendations cannot be specifically quantified, the majority can with thoughtful planning, software and other technology application, and a responsible staff. The Task Force believes that all are critical to maximizing efficiency, saving money, maintaining a healthy environment, and addressing climate change.

Programs and software should be used to monitor and report on progress and establish new baseline measures of greenhouse gas emissions. Using a third party software tool will remove the time cost and burden of data management on City staff. Data can be logged, organized, and presented using software or via an online database for the user to download and analyze. The graphs and tables that these systems present can be used and directly inserted in reports and other communications to City staff and the public as needed.

Establish a Timeline for Updates, Presentations, and Reports

Reporting on the City's sustainability efforts should be presented annually in a public forum. In addition, brief, informal updates, especially regarding specific efforts and projects, should be made to appropriate City committees, groups, and staff as needed and when possible. Reporting and communicating the City's efforts to the public, specifically, is essential. The Missoula community has provided invaluable input and assistance with the development of this plan. Reporting on the implementation of their efforts will validate their work, increase stakeholder buy in, and help develop partnerships that will be essential for future community-wide efforts. Communication efforts should include a regularly updated website, a newsletter, and potentially an annual public "State of Sustainability" presentation.

Establish a Working Timeline for Implementation of the Strategies

The above mentioned FTE should lay out a working timeline for implementation of each strategy. This person should use the established suites, or phases, included and described in this document to guide this effort. The collection of strategies should be continually assessed and updated. This timeline should provide guidance, and should not restrict implementation of other strategies should opportunity arise.

As described in CHAPTER 1, each strategy was placed in a grouping, called "suites", to be implemented within a set time frame, acknowledging that availability of funding and staff time will influence the actual timing of implementation. The placement into the different suites was based on both quantitative and qualitative factors. The quantitative factors were primarily annual GHG reduction and simple payback. The qualitative factors included simplicity of implementation, pre-existence of groundwork related to the strategy, ability to be a "quick win", and time required for full scale implementation. Once the suites were established, interim GHG emission reductions goals were created based on the reduction potential from the suites.

In the tables below, the Working Group and intended implementation year are identified for each strategy included in each suite. The table also details the interim reduction goal and associated timeframe for each suite. Note that the intended implementation year for some of the strategies does not coincide with that suite's time frame. This is due to factors such as time to implement, and required background work before implementation can begin. The implementation year is the year that implementation is intended to begin, acknowledging that some strategies will take longer than one year to implement.

Table 4-1: Suite 1 Strategies and Intended Implementation Years

Suite 1 Goal: Achieve 10% reduction from 2008 baseline by 2015

Working Group	Strategy	Intended Implementation year
Internal Policies and Practices	Conservation and Sustainability in Work Plans and Annual Review	2013
Fleet and Facilities	Eco Drivers Manual	2013
Fleet and Facilities	Efficient Fleet Vehicle Purchasing (Fuel economy)	2013
Internal Policies and Practices	Employee Commuting Incentive Program	2013
Fleet and Facilities	Expand Route Optimization Software/GPS	2013
Internal Policies and Practices	Fostering Sustainable Workplace	2013
Fleet and Facilities	Hybrid/Electric Vehicle Purchasing	2013
Internal Policies and Practices	Include Sustainability in Employee Orientation	2013
Internal Policies and Practices	Paper and Printing Policies	2013
Internal Policies and Practices	Reduce Electronics Energy Use	2013
Renewable Energy and Offsets	Solar PV Installations on Municipal Buildings	2013
Renewable Energy and Offsets	Urban Tree Planting and Maintenance	2013
Fleet and Facilities	Continuous Building Retro and Re-commissioning for Existing Buildings	2014
Renewable Energy and Offsets	Enhance Methane Utilization at WWTP	2014
Internal Policies and Practices	Flexible Work Scheduling	2014
Internal Policies and Practices	Green Purchasing Policy	2014
Renewable Energy and Offsets	Solar Thermal Heating System and Thermal Pool Blanket at Splash Montana and Similar Energy Efficiency Improvements at Currents	2014
Fleet and Facilities	LEED Existing Buildings: Operations & Maintenance Policy	2014

Table 4-2: Suite 2 Strategies and Intended Implementation Years

Suite 2 Goal: Achieve 30% reduction from 2008 baseline by 2017

Working Group	Strategy	Intended Implementation year
Fleet and Facilities	Real-time Energy Monitoring Systems	2016
Fleet and Facilities	Bike Fleet Infrastructure	2016
Internal Policies and Practices	Include Conservation and Sustainability in Job Descriptions	2016
Internal Policies and Practices	LEED for New Construction and Major Renovations Policy	2016
Internal Policies and Practices	Rideshare Scheduling plan for Employees	2016
Fleet and Facilities	Shut Off/ Remove Water Fountain Cooling	2016
Internal Policies and Practices	Waste Stream Reduction Policy	2016
Fleet and Facilities	Water Wise Bathroom Features	2016
Fleet and Facilities	Sustainable Commute Infrastructure (Bike, etc)	2017
Fleet and Facilities	Utilize Cleaner Fuels	2017

Table 4-3: Suite 3 Strategies and Intended Implementation years

Suite 3 Goal: Achieve 50% reduction from 2008 baseline by 2020

Working Group	Strategy	Intended Implementation year
Fleet and Facilities	Groundwater Cooling Systems	2018
Fleet and Facilities	Water Wise Park Areas	2018
Renewable Energy and Offsets	Micro-hydropower Electricity Generation at WWTP	2019
Renewable Energy and Offsets	Poplar Plantation near WWTP	2019

Table 4-4: Suite 4 Strategies and Intended Implementation Years

Suite 4 Goal: Achieve carbon neutrality by 2025

Working Group	Strategy	Intended Implementation year
Renewable Energy and Offsets	Missoula Open Space Portfolio	2020
Renewable Energy and Offsets	Carbon Offset Purchasing	2025

"This plan for a sustainable Missoula is an important step on the path to becoming a more sustainable city. It's those next steps though that are equally vital to staying the course … turning our plan into actions, gauging our progress toward carbon neutrality, learning from our experiences, making adjustments, and renewing our commitments. Sustainability is forever after all!"

- ROBIN SAHA

Establish a Review Cycle for the Action Plan

This Action Plan is a living document, and should be continually updated. As mentioned in CHAPTER 1, advances and changes in technology, pricing, and incentives will affect the impacts and cost effectiveness of the strategies included in this plan, as well as present new opportunities and strategies that will contribute to achieving the interim and carbon neutrality goals. These newly identified strategies should be included in future versions of the plan and implemented on an opportunistic basis. Formal publication of revisions to this plan should be produced every other year, starting in 2014.

Establish a Timeline for Updating the Greenhouse Gas Inventory

Missoula's Municipal Greenhouse Gas Inventory needs updating. City operations are dynamic and constantly changing, and concerted efforts have been made to reduce the City's emissions since the inventory was published. Continually updating the inventory as new data and methods become available will help track and show progress and allow for analysis of the effectiveness of each strategy. It will help identify areas for improvement and continue to guide the timing and implementation of new and documented strategies. The Task Force recommends that the Inventory for municipal operations be regularly updated every two years starting in 2013 to offset revisions of the Action Plan. After the 2013 update, the two year update cycle should be evaluated for feasibility by the Administration and City staff, and lengthened if a longer update cycle is deemed more effective and economically viable.

Establish a Budget and Financing Strategy

This plan presents a wide variety of strategies, and thus requires a robust mix of funding mechanisms. Many recommendations will require both financial and human investment. One of the primary functions of the dedicated City staff in charge of conservation and climate action activities will be to research and establish funding and financing mechanisms needed to implement strategies. Below is a list of commonly used mechanisms to be included and used as appropriate and available.

- Integration and Inclusion in annual City Budget
- Grants
- Energy Savings Performance Contracts
- Bonds
- Revolving Loan Funds
- Utility Rebates and Incentives
- Reinvestment of Rebates, Incentives, and/or Energy Savings*
- Public/Private Partnerships

*The Task Force strongly recommends incentivizing departmental action by reinvesting all or part of rebates, incentives and savings into the department responsible for additional energy saving/emissions reduction activities.

"Creating a sustainable community takes collaboration like the partnership between UM, the City, and other community members to develop Missoula's Conservation & Climate Action Plan."

- CHERIE PEACOCK

APPENDIX

APPENDIX

Abbreviations

BTU	*British Thermal Unit (measure of heat energy, roughly equivalent to the amount of energy in a kitchen match)*
CAP	*Climate Action Plan*
CAPPA	*Climate and Air Pollution Planning Assistant (produced by ICLEI)*
CO2e	*CO2 equivalent*
DKT	*Dekatherms (10 therms)*
FF	*Fleet and Facilities (reference to working group)*
GHG	*Greenhouse Gas*
GHGEC	*Greenhouse Gas and Energy Conservation Team*
ICLEI	*International Council for Local Environmental Initiatives (goes by ICLEI - Local Governments for Sustainability)*
IPP	*Internal Policies and Practices (reference to working group)*
kW	*Kilowatt (1,000 watts of power)*
kWh	*Kilowatt-hour (1kW of power used for one hour)*
MCCAP	*Municipal Conservation and Climate Action Plan*
mt	*Metric tons or"tonnes"(1 mt = 2,204 lbs)*
MWh	*Megawatt-hour (1,000 kWh)*
PV	*Photovoltaic (Type of solar electrical energy generation)*
REO	*Renewable Energy and Offsets (reference to working group)*
TH	*Therms (10,000 BTU's of heat energy)*

Key Definitions

Climate Change: Climate change refers to any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among others, that occur over several decades or longer.[13]

Carbon Dioxide Equivalent (CO2e): the common unit used to express the global warming potential for greenhouse gases. A unit of CO2e is the amount of CO2 that would be needed to produce the equivalent warming effect as a given amount of another greenhouse gases. CO2 is used because it is the most common of the greenhouse gases.

Carbon Neutrality: through conservation and reduction measures, along with the purchase of Carbon Offsets, net greenhouse gas emissions will be zero. Achieving carbon neutrality requires the purchase of some form of Carbon Offsets to account for emissions that remain after conservation and other forms of reduction have been fully explored.

Carbon Offset: one metric ton of carbon dioxide equivalent (CO2e) that is taken out of the atmosphere, or one metric ton of CO2e that is not emitted to the atmosphere. Carbon Offsets are generated by carbon sequestration or emissions reduction activities that are quantified, reported, verified, validated, and certified via the regulatory or voluntary market.[12]

Greenhouse Gas: Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, carbon dioxide, methane, nitrous oxide, ozone, chlorofluorocarbons, hydrochlorofluorocarbons, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride.

Global Warming Potential: A measure of the total energy that a gas absorbs over a particular period of time (usually 100 years), compared to carbon dioxide.[13]

References

12. ClearSky Climate Solutions: www.clearskyclimatesolutions.com

13. Environmental Protection Agency: http://epa.gov/climatechange/glossary.html#G

CONVERSION FACTORS AND COMMON VARIABLES

Table 5-1 below shows conversion factors and variables that were commonly used in the calculations for the strategies. Variables and conversion factors that were only used for a specific strategy are listed in the References section of that particular strategy.

Table 5-1: Conversion Factors and Common Variables used in Calculations

Costs	Value	Units	Reference
Electricity	$0.10	$/kWh	Northwestern energy, rates as of January 1, 2012
Natural Gas	$0.84	$/TH	Northwestern energy, rates as of January 1, 2012
Unleaded gasoline	$3.45	$/gal	As of 11/17/2011 http://www.eia.gov/oog/info/gdu/gasdiesel.asp
Diesel fuel	$4.09	$/gal	As of 11/17/2011 http://www.eia.gov/oog/info/gdu/gasdiesel.asp
Bio-diesel fuel	$4.29	$/gal	On average, biodiesel is $0.20 more expensive than regular diesel. http://www.biodiesel.org/using-biodiesel/market-segments/fleets
Water	$0.26	$/gal	Rate from Mountain Water, metered rate: $1.95/cubic foot converted. http://www.mtnwater.com/tariffs/missoulatariffs2011-10-01.pdf
EMISSIONS FACTORS			
Electricity	0.4320	mtCO2e/MWh	CAPPA v.1.5
Natural Gas	0.0056	mtCO2e/TH	CAPPA v.1.5
Unleaded gasoline	0.0089	mtCO2/gal	http://www.epa.gov/otaq/climate/documents/420f11041.pdf
Diesel fuel	0.0102	mtCO2/gal	http://www.epa.gov/otaq/climate/documents/420f11041.pdf
OTHER CONSTANTS			
Average one way commute distance for a Missoula County Resident	5.1	miles	Missoula In Motion Way to Go! Club data, provided by Jennifer Thompson
Number of City employees	570	FTE's	City of Missoula Human Resources Office. Equivalent FTE's.

Calculation of Savings/Cost per Metric Ton of CO2e Reduced for Figure 3-1

The savings/cost value presented in Figure 31 is a way to take three important metrics from each strategy (implementation cost, annual savings, and annual emissions reduction) and combine them into one value that can be used to compare all of the strategies at once.

The equation for this value is shown below. It is calculated by subtracting the implementation cost from the net present value of the strategy, and dividing it by the life of the project, which was set as 13 years. This is the amount of time from publication to the target date for Carbon Neutrality. The resulting value was then divided by the annual emission reduction. This final value is the savings (if positive) or cost (if negative) per metric ton of CO2e reduced. The net present value was calculated using a discount rate of 3% over 13 years.

Equation 1 Calculation of Savings/Cost per mtCO2e reduced

$$\text{Savings or cost per mtCO2e reduced} \left(\frac{\$}{\text{mtCO2e}}\right) = \frac{\text{Net Present Value (\$)-Implementation Cost (\$)}}{\text{Life of Project (years)}} \div \text{Annual Emissions Reduction} \left(\frac{\text{mtCO2e}}{\text{year}}\right)$$