FLEET AND FACILITIES WORKING GROUP

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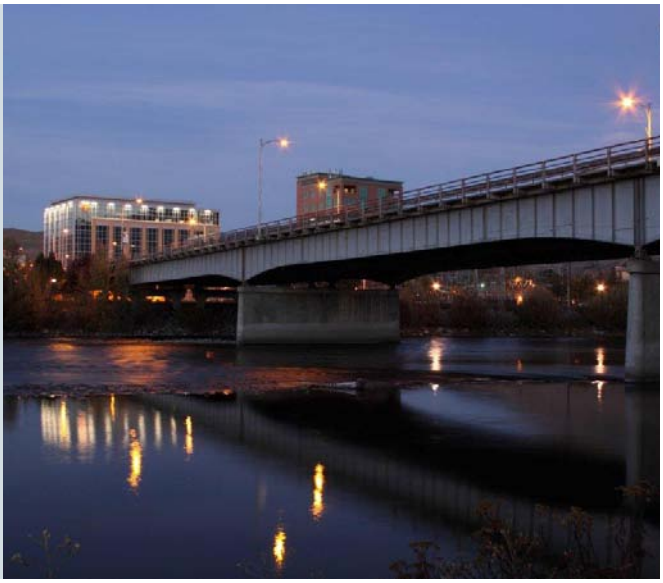


Nationally, building energy use and transportation are the two largest sectors of municipal emissions. As presented in the 2008 Greenhouse Gas Inventory, Missoula is no exception. The following Fleet and Facilities (FF) strategies include high-efficiency and updated equipment and will produce large decreases 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

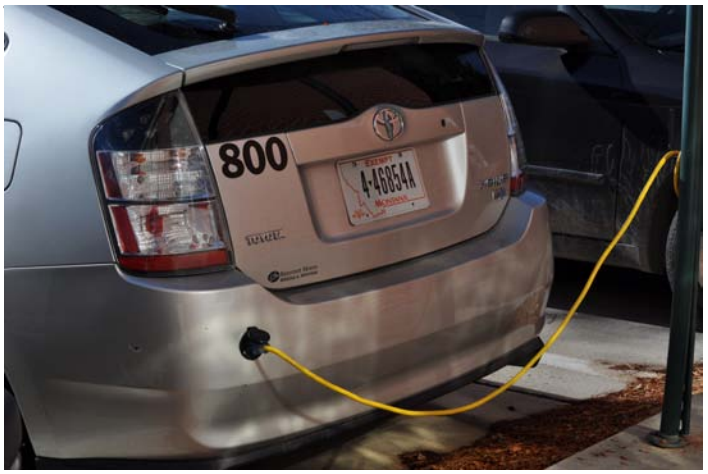
MSRP compared to fleet vehicle:

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.