RENEWABLE ENERGY AND OFFSETS WORKING GROUP

WORKING GROUP MEMBERS

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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

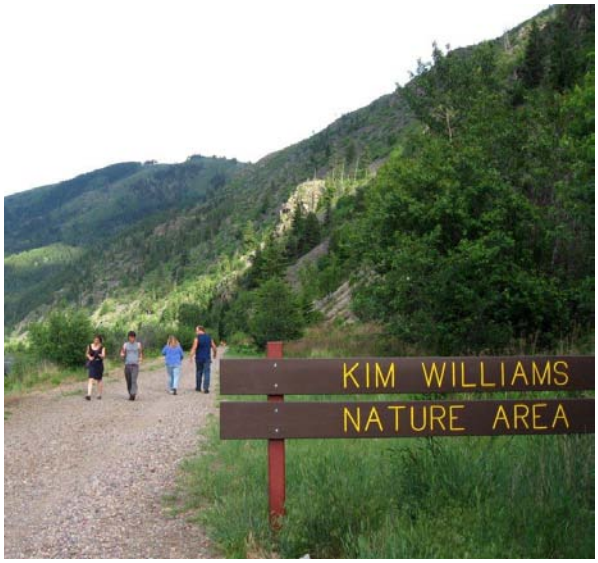
Table 3-7 below summarizes the Renewable Energy and Offsets working group strategies. Further details are described in the narratives below.

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%.