Appendix F
Residential, Commercial, Institutional, and Industrial Sectors
Policy Recommendations

Summary List of Policy Option Recommendations

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effective-ness ($/$tCO_2e$)	Level of Support
		2010	2020	Total 2007–2020			
RCII-1	Demand-Side Management Programs, Efficiency Funds and Requirements (and Financial Incentives)	0.04	1.15	6.6	–$141	–$21	UC
RCII-2	Market Transformation and Technology Development Programs	0.03	0.30	1.9	–$43	–$23	UC
RCII-3	State-Level Appliance Efficiency Standards and State Support for Improved Federal Standards	0.05	0.20	1.5	–$55	–$36	UC
RCII-4	Building Energy Codes	0.03	0.25	1.6	–$15	–$10	UC
RCII-5	"Beyond Code" Building Design Incentives and Mandatory Programs	0.07	0.52	3.4	–$17	–$5	UC
RCII-6	Consumer Education Programs	*Not quantified*					UC
RCII-7	Support for Implementation of Clean Combined Heat and Power	*Quantified in coordination with the Energy Supply TWG (as a part of ES-4)*					UC
RCII-8	Support for Renewable Energy Applications	*Quantified in coordination with the Energy Supply TWG (as a part of ES-4)*					UC
RCII-9	Carbon Tax	*Not quantified*					UC
RCII-10	Industrial Energy Audits and Recommended Measure Implementation	0.07	0.56	3.6	–$93	–$26	UC
RCII-11	Low-Income and Rental Housing Energy Efficiency Programs	0.05	0.75	4.7	–$41	–$9	UC
RCII-12	State Lead by Example	0.03	0.33	2.0	–$11	–$6	UC
RCII-13	Metering Technologies With Opportunity for Load Management and Choice	0.02	0.12	0.9	–$11	–$12	UC
	Sector Total After Adjusting for Overlaps	**0.28**	**2.95**	**18.4**	**–$304**	**–$17**	**N/A**
	Reductions From Recent Actions						
RCII-1	Expand Energy Efficiency Funds	0.30	0.79	6.5			N/A
RCII-11	Low Income Energy Efficiency Programs	0.02	0.05	0.4			N/A
	Sector Total Plus Recent Actions	**0.59**	**3.79**	**25.3**			**N/A**

UC = unanimous consent.
N/A = not applicable.

Note: Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost **savings** associated with the options. Also note that totals in some columns may not add to the totals shown due to rounding.

RCII-1. Demand-Side Management Programs, Efficiency Funds, and Requirements (and Financial Incentives)

Policy Description

This policy option involves increasing the efficiency of electricity and natural gas use in Montana through demand-side management (DSM) programs, funds, and/or requirements. This option focuses on what are typically termed DSM activities—programs, usually delivered by utilities or government-designated agencies designed to reduce energy consumption and/or change the timing of energy use. Examples of DSM programs include technical assistance for and implementation of energy efficiency and renewable energy measures, electrical and natural gas demand response, alternative rate schedules, and research activities. Note that the activities described for this option may also support implementation of other options recommended by the Climate Change Action Committee (CCAC), such as Residential, Commercial, Institutional, and Industrial Policy Option 11 (RCII-11) and RCII-12.

Policy Design

This policy design is focused on increasing energy efficiency programs through investor-owned and cooperative utilities and is linked with the energy efficiency element of Energy Supply Policy Option 1 (ES-1), "Environmental Portfolio Standard (EPS)." ES-1 would require that each utility capture 100% of its achievable cost-effective energy efficiency over a period of 15 years.

Implementation of energy efficiency/energy conservation programs could include the following elements:

- Creation of an independent, nonprofit, statewide provider of energy efficiency services to support, in particular, the provision of energy-efficiency/conservation programs in the service territories of smaller utilities, including cooperatives. Consideration should also be given to allowing utilities, such as NorthWestern Energy, that already implement DSM programs funded by their customers through energy supply charges to opt out of the program. A statewide energy efficiency provider tasked with undertaking DSM programs for participating utilities—proportionate to the amount invested by the customers of those utilities—would realize significant efficiencies and would ensure that all Montanans and all Montana utilities benefit from the acquisition of what is typically the lowest cost resource.
- Establish a revolving loan program, similar to the Alternative Energy Revolving Loan Program at the Montana Department of Environmental Quality (MDEQ), to focus on energy-efficiency/conservation investments.
- New or expanded state tax credits may provide an additional means of increasing investments in energy efficiency, particularly for appliances and equipment that require a significant initial outlay on the part of consumers.

Goals/Timing: The goals for this option follow the goals from the ES-1 option:

Each investor-owned and public utility should:

- Meet 20% of its load using renewable energy resources by 2020, increasing to 25% by 2025.
- Implement a plan to obtain 100% of achievable cost-effective energy conservation by 2025.
    - By 2010, identify its achievable cost-effective energy conservation for the subsequent 10 years.
    - Update its energy-efficiency assessment and plan regularly, possibly every 2 years.

      "Energy conservation" refers to both electricity and natural gas.

Parties Involved: Investor-owned utilities, electric cooperatives, Montana Public Service Commission (PSC), state government.

Implementation Mechanisms

Environmental Portfolio Standard: The goals noted above would be implemented through an EPS, to be adopted on the basis of legislation, regulation or other agreement. This standard will modify the existing Renewable Portfolio Standard (RPS) that sets requirements for renewable energy production to add requirements for energy efficiency.

Expanded Demand-Side Management Programs: A series of energy efficiency and renewable energy programs will be needed to achieve the goals set out. These programs will be offered by utility companies, state government, professional associations, and other organizations.

It is expected that additional energy efficiency programs would focus on:

- Providing expanded residential and commercial energy audit programs and offering incentives and assistance for building owners to follow up on audit recommendations.
- Promoting technologies for efficient heating and cooling of buildings, including homes, churches, schools, and commercial buildings, as applicable and cost-effective. Relevant technologies could include (but would not be limited to) ground source heat pumps, high efficiency boilers, and evaporative coolers.
- Conserving space-conditioning energy by promoting weatherization (insulation, high-efficiency window systems, and other measures) of homes and other buildings.
- Promoting and expanding water heater demand-control programs to reduce peak period electrical energy use and promoting the use of higher-efficiency water heaters.
- Promoting the use of compact fluorescent lamps (CFLs) and other high-efficiency lighting and lighting control systems, including applications in the commercial and institutional sectors.
- Promoting the use of Energy Star® appliances.
- Promoting fuel switching when doing so cost-effectively reduces overall (electricity generation plus direct fuel use) GHG emissions.
- Expanding existing effective energy efficiency activities.

Note that this listing of options is not meant to preclude any existing or future DSM options that might be applicable to Montana—it is intended only as a list of promising examples for use of expanded Universal System Benefits (USB) funds or funds otherwise earmarked for energy efficiency investments. In many cases, examples of such programs already exist but could be expanded in scope and effectiveness with additional resources.

Expanded Information and Education: Effective implementation of expanded DSM programs may require a larger pool of qualified and reliable contractors to implement energy efficiency measures. Owners of homes and commercial buildings must also be educated to understand the benefits of energy conservation/improved energy-efficiency/DSM. Consumer and specialist education are therefore important as supporting mechanisms to enable implementation of this policy.

Independent, Nonprofit Provider of Energy Efficiency Services: As noted above, it may be more efficient to provide some efficiency services in some utility areas through an independent provider, particularly where smaller utilities may not themselves have the capacity to offer such services to their customers.

Revolving Loan Program: Financing may be needed by consumers in order to purchase the appliances and equipment recommended for energy efficiency. The Alternative Energy Revolving Loan Program could be expanded or other financing mechanisms could be developed.

Related Policies/Programs in Place

Universal Systems Benefits Program: As part of its 1997 restructuring legislation, Montana established its Universal System Benefits Program (USBP). Beginning January 1, 1999, all electric utilities began annually contributing 2.4% of their 1995 revenues to the USBP. As of 2006, the total funds estimated to be collected from electricity consumers by NorthWestern Energy were approximately $9.4 million. The funds support energy efficiency, renewable-energy resources, low-income energy assistance, renewable-energy research and development, and large customer rebates. The guidelines for expenditures of USB funds (both gas and electric) for 2006 are established in an interim order of the Montana PSC dated November 2005 and are presented in Table F-1.[1]

Table F-1. 2006 Electric and natural gas USB allocations

Program category	Electric USB expense target	%	Gas USB expense target	%
Conservation	$1,239,352	14	$327,000	11
Market transformation	$112,036	1	N/A	
Renewables	$651,094	8	N/A	
R&D	$89,261	1		
Low-income	$3,505,277	40	$2,547,372	89
Bill discounts	$1,853,584		$1,945,800	
Energy share	$575,000		0	

[1] Montana PSC, Order No. 6679a in Dockets numbered D2004.7.99, D2004.12.292, and D2005.6.016. Table shown is from page 27 of the referenced order. Order is available as http://www.psc.mt.gov/eDocs/eDocuments/pdfFiles/D2004-12-192_6679a.pdf

Program category	Electric USB expense target	%	Gas USB expense target	%
Free weatherization	$962,843		$585,000	
Large customer	$3,126,527	36	N/A	
Total expenses	$8,723,547	100	$2,874,372	100
Projected USB revenue	$9,367,246		$2,278,585	
Surplus (deficiency)	$643,699		$(595,787)	

NorthWestern Energy programs have led to the installation of photovoltaics (PV) on residences, schools, fire stations, and commercial facilities throughout the state.

Electric cooperatives and Montana–Dakota Utilities Company (MDU) also contribute to the USBP. MDU support of the USB program for its electricity customers is shown in Table F-2. Rural electric cooperatives' contributions consisted primarily of energy efficiency and renewable energy programs included in the cost of the power the cooperatives bought from federal agencies such as the Bonneville Power Administration (BPA).

Table F-2. MDU 2006 electric USB allocations

Low-income discount	$92,252
Low-income weatherization	$127,200
Low-income energy audits	$10,000
Energy share endowment	$20,000
Energy share bill assistance	$26,000
Energy share furnace safety	$20,000
Low-income program promotion	$1,547
Commercial lighting rebates	$19,536
Total Montana–Dakota programs	$316,535
Large customer self-directed funds	$203,808
Amount transferred to State of Montana programs	$322,168
Total USB funds collected 2006	$842,510

A USB program applying to natural gas also exists (as authorized under MCA 69-3-1408). The natural gas USB program has recently been amended by the Montana Legislature (see http://data.opi.mt.gov/bills/2007/billpdf/HB0427.pdf), but what the impact of the amendment on existing USB-funded activities is not yet certain.

Montana's USBP is effective until December 31, 2009, when it is scheduled to "sunset." Note that the USB program has been scheduled to sunset on several previous occasions[2] but has been renewed each time. It is possible that the program will again be renewed in 2009 or will be replaced with a comparable or more effective program. Utilities may spend all or a portion of the funds on internal programs, or they may opt to contract or fund these programs externally. Large industrial customers with average monthly demand loads exceeding 1,000 kilowatts (kW) also

[2] The history of USB legislation includes the following: 1997, SB 390 established USB for the period January 1, 1999 to July 1, 2003; 2003, SB 77 extended USB from July 1, 2003 to December 31, 2005; and 2005, SB 365 extended USB from December 31, 2005 to December 31, 2009.

fall under the law and may choose to "self-direct" the funds that would normally go to the USBP for internal energy programs.[3]

At present, some utilities, including NorthWestern Energy, have shifted some of what were previously USB funds spent on energy efficiency into their rate base and are thus supporting energy-efficiency programs in the same manner that electricity supply resources are supported.

Tax Incentives: There are many tax incentives designed to encourage investment in energy conservation and renewable energy in Montana. The incentives most applicable are the following: a $500 tax credit is available for investment in energy conservation (15-32-109 MCA [Montana Code Annotated]); a tax credit of $500 is available for investment in renewable energy systems (15-32-201 MCA); and a $1,500 tax credit is available for investment in a ground source heat pump or other geothermal heat source (15-32-115 MCA). A complete listing of tax incentives can be found at http://www.deq.mt.gov/Energy/Renewable/TaxIncentRenew.asp

The Alternative Energy Revolving Loan Program provides financing of up to $40,000 for renewable energy systems and for conservation done in association with renewable energy projects (MCA 75-25-101).

Type(s) of GHG Reductions

Principally, the reduction in GHG emissions (largely carbon dioxide [CO_2]) from avoided electricity production and avoided on-site fuel combustion. Less significant are the reduction in methane (CH_4) emissions from avoided fuel combustion and avoided pipeline leakage. Other GHG impacts are also conceivable but are likely to be small (black carbon, nitrous oxide [N_2O]) and/or very difficult to estimate (e.g., materials use, life cycle, market leakage).

Estimated GHG Reductions and Costs (or Cost Savings)

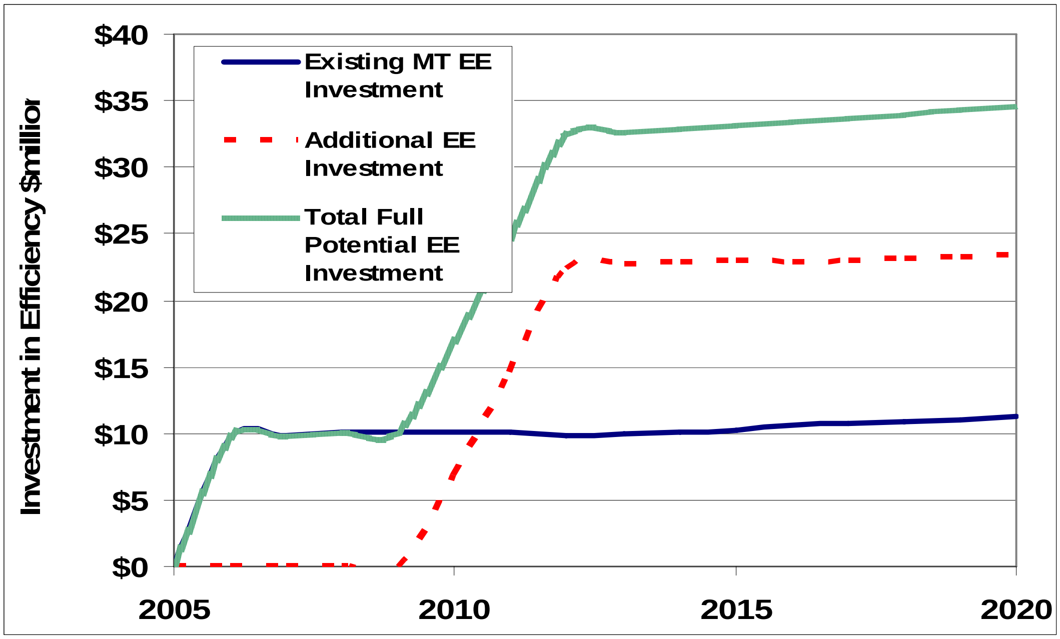
	Policy	Scenario/Element	Reductions		Cumulative Reductions 2007–2020 ($MMtCO_2e$)	NPV 2007–2020 ($ Millions)	Cost-Effective-ness ($/tCO_2$)
			2010	2020			
RCII-1	Demand-Side Management Programs, Efficiency Funds and Requirements	Current/Expected Energy Efficiency Investment	0.29	0.78	6.5	N/A	N/A
	Electricity Savings	(as above)	0.24	0.63	5.3	N/A	N/A
	Natural Gas Savings	(as above)	0.05	0.15	1.2	N/A	N/A
RCII-1	Demand-Side Management Programs, Efficiency Funds and Requirements	New/Expanded Energy Efficiency Investments	0.04	1.15	6.6	–$141	–$21
	Electricity Savings	(as above)	0.03	0.92	5.4	–$79	–$15
	Natural Gas Savings	(as above)	0.01	0.23	1.2	–$61	–$49

NPV = net present value; N/A = not applicable.

[3] Database of State Incentives for Renewables and Efficiency, available at http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=MT01R&state=MT&CurrentPageID=1&RE=1&EE=1

Note: Some totals in the table above may differ from the sum of their component elements due to rounding. Cost-effectiveness totals are weighted averages of component elements.

Figure F-1. Montana energy efficiency (EE) investments and potential



Data Sources: The analysis relies on the following key sources:

- The Energy Efficiency (EE) Task Force Report to the Clean and Diversified Energy Advisory Committee (CDEAC) of the Western Governors' Association (WGA), referred to here as the "WGA CDEAC EE report."[4] This report provides estimates of cost-effective efficiency potential and the average cost per megawatt-hour (MWh) saved ($25/MWh).
- Various other efficiency assessments by the Southwest Energy Efficiency Project (SWEEP), the Northwest Power Planning Council, and the California Energy Commission. Together, these sources suggest an average savings from utility energy efficiency programs of approximately 6 kWh per annual program dollar invested.
- Electricity avoided costs are provisionally based on the levelized value of long-term standard Qualifying Facilities Tariff from the Montana PSC ($49 per MWh).[5]

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[4] WGA, 2005. *The Potential for More Efficient Electricity Use in the Western United States, December 19, 2005.* http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency.htm

[5] Estimate derived from contract data underlying the "the long-term, standard QF [Qualifying Facilities] tariff," "Option 1" ($49.90 per MWh, nominal cost average of quarterly contract costs from 2007 through 2014) as set by the Montana PSC, in an order covering Docket No. D2003.7.86, Order No. 6501f 2; Docket No. D2004.6.96, Order No. 6501f; and Docket No. D2005.6.103, Order No. 6501f, dated December 19, 2006. The $49.90 cost indicated is shown in paragraph 184 of the PSC document. Cost shown here extends the stream of nominal costs in the original NWE/PPL (Northwestern Energy/PPL Montana) document by including values for 2015 to 2020 that increment the 2014 average value at the rate of inflation, levelize the resulting 2007 to 2020 stream, and adjust the levelized value to 2005 dollars.

- Average cost of gas DSM programs reported in S. Tegen, and H. Geller. 2006. "Natural Gas Demand-Side Management Programs: A National Survey," Southwest Energy Efficiency Project, www.swenergy.org
- Natural gas avoided costs based on costs of gas supply to Montana, with future gas costs estimated based on projections from the United States Department of Energy's (US DOE's) Annual Energy Outlook 2006.

Quantification Methods: Because Montana-specific electricity or gas efficiency potential studies are not presently in hand, estimates of efficiency savings and costs are based on regional studies and analyses/experience in other states. These studies were used to derive an estimate of efficiency savings per dollar spent on programs which, in turn, are used to translate spending levels into energy savings and program savings targets. The achievable efficiency potential was estimated based on the analysis of best practices and of other efficiency potential studies in the western United States (see WGA CDEAC EE, 2005). The WGA analysis suggests that savings of 0.8% to 1.0% per year is achievable, and we used the high end of that range here (1.0%), given the relatively low historical level of efficiency investment in Montana, at least until recent years (suggesting higher potential savings). The assumption of 1.0% annual energy savings results in an estimated annual energy efficiency investment level (for DSM only) on the order of 2.5% of revenues (for electric utilities). These estimates are based on programs and policies that aim for cost-effectiveness for all measures.[6]

Key Assumptions:

- Avoided costs of electricity ($49/MWh).
- Avoided cost of gas ($6.5/MMBtu, levelized).
- Average cost of electricity efficiency measures ($25/MWh saved). Note, however, that NorthWestern Energy's most recent default supply plan estimated an average levelized acquisition cost of energy efficiency of $20/MWh over a 20-year period, and the equivalent of about 870 GWh/year of cost-effective DSM potential, based on an avoided cost of $45/MWh.
- Average cost of gas efficiency measures ($2.1/MMBtu saved.)
- Full, achievable cost-effective efficiency improvements (1.0% reduction in sales per year).
- Savings target includes savings from existing programs.
- Savings from existing programs estimated based on the current (2005–2006) investments in efficiency by NorthWestern Energy (electric and gas) relative to total revenue from utility sales.
- Avoided electricity emissions (assumes that reductions in electricity generation requirements through 2010 will come from the average emissions rate of then-existing fossil-fueled

[6] By way of comparison, this level of energy savings corresponds roughly, by 2020, with what would be Montana's share (based on a comparison of total 2005 electricity sales in Northwest states), of the conservation included in the Northwest Power and Conservation Council's *Fifth Northwest Electric Power and Conservation Plan.*

sources; by 2020 the predominant effect is assumed to be a reduction in reference case new coal and gas builds during the 2010–2020 period).

Key Uncertainties

- Montana-specific costs of DSM programs at savings levels modeled.
- Levels of spending/savings from existing DSM programs in Montana (some utilities).
- Impact of electricity energy efficiency programs on peak demand as well as energy requirements.

Additional Benefits and Costs

Benefits

- Reducing use of electricity and natural gas through this option also reduces emissions of local and regional air pollutants, such as sulfur and nitrogen oxides, which in turn reduce the human health and other impacts of those emissions.
- Reducing peak demand and improving the utilization of the electricity system.
- Reducing the risk of power shortages.
- Supporting local businesses and stimulating economic development.
- Reduction in transmission/distribution system costs.

Costs

None cited.

Feasibility Issues

- Costs and performance vary substantially between measures that might be considered for DSM programs. Some measures may present low capital costs and higher operating costs (or vice versa), and there is uncertainty about the costs and savings for other measures.

Interaction with appliance standards and utility programs.

Status of Group Approval

Completed.

Level of Group Support

Unanimous consent.

Barriers to Consensus

None.

RCII-2. Market Transformation and Technology Development Programs

Policy Description

Market transformation is a relatively new term for energy efficiency programs that focus on voluntary efforts implemented by non-utility organizations to encourage greater uptake by consumers (residential, commercial, and industrial, as well as the professionals that service energy-using equipment) of cost-effective energy efficiency practices. Market transformation also seeks to ensure sufficient supplies of technologies and practitioners to meet the subsequent increased demand for energy efficiency. A market transformation program is thus designed to create a situation where the bulk of the private market automatically adopts or incorporates technologies or techniques that result in improved energy efficiency. The goal of a market transformation and technology development program is to position energy efficiency technologies and practices so that they will be demanded by the public, chosen by builders and manufacturers, and provided by retailers and contractors. Methods of transformation can be different for each technology or technique but often revolve around public and private review of quality and effectiveness, including partnerships between government agencies, retailers, manufacturers, and nongovernmental agencies. Market transformation programs can be statewide or regional.

Policy Design

Market transformation is an important goal for Montana and an important mechanism for cost-effectively bringing energy-efficient products and services to consumers. It is recognized, however, that Montana constitutes a limited market, by itself, for energy-efficient products. As a result, Montana should focus its efforts on joining, supporting, or increasing its participation in regional market transformation alliances (e.g., the Northwest Energy Efficiency Alliance [NEEA] and the Midwest Energy Efficiency Alliance) that develop and implement technologies for reduction of energy use and GHG emissions. This could include working to extend market transformation efforts currently focused on specific parts of the state to consumers statewide, as well as expanding the number and types of different energy-efficient products included in market transformation efforts in Montana.

Market transformation and technology development efforts should stress addressing technologies of particular significance to Montana. One example is the testing and monitoring of residential and commercial high-efficiency structures to determine their performance under Montana conditions and to identify barriers to implementation of energy-efficient building practices.

The state should consider the establishment of an independent entity or an entity within state government to assess cost-effective efficiency potential (per the EPS in RCII-1) and should work with other states in the region to assess efficiency potential. In developing a new or extended market transformation effort for Montana, the lessons learned from previous efforts should be carefully incorporated, and the costs to state government and to consumers of an extended market transformation program should be carefully evaluated.

Goals: By 2009, put in place mechanisms to allow broader coverage of market transformation programs in Montana to additional geographic areas and also with regard to technologies covered.

Timing: As above.

Parties Involved:

- State government,
- Utility companies,
- Professional and trade organizations,
- Non-profit organizations, and
- Educational institutions.

Other: Under development.

Implementation Mechanisms

The following are some of the important implementation mechanisms for this option.

Information and education: Education is a key component to convincing consumers to use a new or different product that will result in energy savings. Residential, commercial, institutional, and industrial consumers of energy can influence the products and services available by demanding more efficient choices as well as by purchasing efficient choices that are offered. Education of professionals who set standards or specify particular appliances and equipment is particularly needed. These groups would include architects, engineers, builders, contract managers, and purchasing agents

Electricity and gas pricing: Appropriate pricing will encourage purchase of higher efficiency appliances and equipment or control systems.

Rebates for high-efficiency appliances and equipment: As applicable and appropriate, rebate offers for high-efficiency appliances and equipment such as high-efficiency front-loading clothes washers, may be needed to spur market acceptance. These could be offered in conjunction with utility DSM programs.

Tax incentives: Tax credits or deductions for the purchase of higher efficiency appliances and equipment would offset the often higher first cost to purchase these appliances and equipment. Existing tax incentives could be expanded. It would be important to ensure that older equipment was disposed of in a manner that took it out of the market place rather than just adding additional appliances and equipment.

Financing mechanisms: All consumers, whether residential, commercial, institutional, or industrial, should have financing mechanisms easily available for energy efficient improvements.

These mechanisms could include:

- Residential—A revolving loan program similar to the Alternative Energy Revolving Loan Program or a program of conventional bank loans to fund investments in efficient appliances and equipment. Partnerships with financial institutions should be explored to make funds readily available at favorable interest rates. (For example, one credit union has been offering slightly lower interest rates for consumers who purchase hybrid autos.)
- Commercial—Technical and financial assistance to encourage businesses to invest in energy efficiency needs to be examined. This should include assistance with choosing and purchasing more efficient equipment and designing and installing more efficient manufacturing processes, as well as investing in building efficiency upgrades for owned and leased space.
- Institutional—Schools should be encouraged to take advantage of the performance contracting mechanisms made available by the 2005 Legislature (90-4-1103 MCA). Financing available through the Board of Investments for schools should be expanded to provide adequate funding to take advantage of attractive efficiency improvement opportunities. The state buildings energy program should be expanded to rapidly acquire energy efficiency upgrades, including emphasizing the use of new products and technologies to improve the energy efficiency of state buildings (see RCII-12).
- Industrial—Financing options to provide mechanisms to increase the rate of industrial energy-efficiency improvements need to be explored.

Technical assistance and Montana-specific information: Technical assistance specific to Montana's climate, resources, and cost of energy needs to be readily available to consumers in all sectors. This assistance would be most effective if provided by a combination of experts from MDEQ, professional organizations, nonprofit groups, and utility companies.

Related Policies/Programs in Place

The NEEA (www.nwalliance.org) is a nonprofit corporation supported by electric utilities, public benefits administrators, state governments, public interest groups, and energy efficiency industry representatives. These entities work together to make affordable, energy-efficient products and services available in the marketplace.[7]

NEEA participation is limited, in principle, to utilities west of the continental divide (in BPA's service area). NorthWestern Energy (NWE), BPA, and electric cooperatives in the BPA service area are all partners in NEEA and provide some funding. The electric cooperatives outside the BPA service area and Montana–Dakota Utility are not partners.

The Midwest Energy Efficiency Alliance: This group (www.mwalliance.org) uses a similar model of partners and goals but does not currently cover Montana, extending only as far west as Illinois. However, utilities in the eastern portion of Montana might find stronger connections with programs in this area.

Bonneville Power Administration: Montana has participated in a number of market transformation efforts with the BPA and the states of Oregon, Washington, and Idaho. These

[7] See http://www.nwalliance.org/aboutus/index_aboutus.aspx

efforts have been effective in gaining a higher level of efficiency in new construction in the region. However, the efforts have focused primarily on western Montana, where funding was available for programs because that region is within the service territory of the BPA. Transfer of results to eastern Montana is occurring at a slower pace.

Department of Environmental Quality: The MDEQ provides technical assistance on energy efficiency and renewable energy; offers a loan program for renewable energy applications and financing for the improvement of state government buildings; trains builders and code officials; provides information to consumers; assists schools in entering into energy performance contracts; convenes working groups to further the development of wind, geothermal and biofuels; and collects data on energy use in the state. MDEQ actively participates in market transformation efforts with NEEA and transfers results of this work to areas outside of NEEA service territories as much as possible with very limited funding. The MDEQ offers these services primarily using federal grants from the US DOE and is designated as the State Energy Office to provide these services.

Montana State University–Integrated Design Lab: The Integrated Design Lab provides education and consulting and technical services to architects and engineers on energy-efficient lighting designs. Services offered through the lab include daylighting and electric lighting analysis, lighting system consultations, and education on efficient lighting techniques.

Type(s) of GHG Reductions

As with RCII-1, this option would principally yield reductions in GHG emissions (largely CO_2) from avoided electricity production and avoided on-site fuel combustion. Less significant are the reduction in CH_4 emissions from avoided fuel combustion and avoided pipeline leakage. Other GHG impacts are also conceivable but are likely to be small (black carbon, N_2O) and/or very difficult to estimate (e.g., materials use, life cycle, market leakage)

Estimated GHG Reductions and Costs (or Cost Savings)

	Policy	Scenario/Element	Reductions		Cumulative Reductions 2007–2020 ($MMtCO_2e$)	NPV 2007–2020 ($ Millions)	Cost-Effective-ness ($/tCO_2$)
			2010	2020			
RCII-2	Market Transformation and Technology Development Programs		0.03	0.30	1.9	–$43	–$23

Data Sources: Market transformation program costs and performance based on programs and experience of the NEEA.

Quantification Methods: Apply program results, expressed in percent savings, from the Northwest to Montana.

Key Assumptions:

- Market transformation programs can reduce electricity demand by 0.2% annually.

- Implementation of specific measures and programs must be timed correctly for maximum impact on market adoption of new technologies.
- Avoided cost for electricity as noted in RCII-1.

Key Uncertainties

Degree to which savings from regional efforts will continue to accrue as they have in the recent past; degree to which Montana consumers not in the NEEA area will be able to use or replicate successful NEEA programs.

Additional Benefits and Costs

Benefits

- The non-energy and non-emission benefits are almost always going to be the economic drivers behind the success of these programs. Focusing only on emission reductions or only on payback through the energy efficiency of the user will eliminate many technologies when they could otherwise provide substantial economic benefits. An example is an improvement to an industrial production line that may have negligible overall energy consumption reduction at the plant but that decreases the energy consumption per unit produced (energy intensity) while speeding up production and retaining jobs in the state.
- Co-benefits could include transmission/distribution system costs reduction.
- Programs could help lower capital and installation costs.

Costs

None cited.

Feasibility Issues

None cited.

Status of Group Approval

Completed.

Level of Group Support

Unanimous consent.

Barriers to Consensus

None.

RCII-3. State-Level Appliance Efficiency Standards and State Support for Improved Federal Standards

Policy Description

Appliance efficiency standards reduce the market cost of energy efficiency improvements by incorporating technological advances into base appliance models, thereby creating economies of scale. Appliance efficiency standards can be implemented at the state level for appliances not covered by federal standards, or where higher-than-federal standard efficiency requirements are appropriate.[8] Regional coordination for state appliance standards can be used to avoid concerns that retailers or manufacturers may a) resist supplying equipment to one state that has advanced standards or b) focus sales of lower efficiency models on a state with less stringent efficiency standards.

Policy Design

In recognition of the fact that Montana represents, on its own, a relatively limited market for appliances and equipment, this policy is designed to encourage the state to work with other states and with regional entities,[9] to

- Review federal appliance standards and work with federal agencies and others toward raising federal appliance and equipment energy efficiency standards where applicable.
- Implement, in concert with other states, higher-than-federal energy efficiency standards for appliances where technological advances allow. Analyses of possible energy efficiency standards that can be enacted at the state level are available at www.standardsasap.org[10] Draft legislative language can be found at http://www.apolloalliance.org/strategy_center/model_legislation/eelegis.cfm
- Develop and implement standards for residential-sector appliances not currently covered by federal standards.

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[8] In recent years, Arizona, Oregon, and Washington, among other states, adopted state standards for several appliances; this led to the inclusion of standards for these appliances in the 2005 federal energy bill.

[9] The CCAC noted the desirability of working with adjacent states, including Idaho and Wyoming, to adopt uniform standards, and possibly adopting standards across a wider region of the West, possibly including states covered in the Western Systems Coordinating Council.

[10] Appliances and equipment noted by the American Council for an Energy-Efficiency Economy and the Appliance Standards Awareness Project (in their report *Leading the Way: Continued Opportunities for New State Appliance and Efficiency Standards,* dated March 2006 (available at http://www.standardsasap.org/documents/a062.pdf) as being candidates for new or more stringent state-level standards included "bottle-type water dispensers, commercial boilers, commercial hot food holding cabinets, compact audio products, DVD players and recorders, liquid-immersed distribution transformers, medium-voltage dry-type distribution transformers, metal halide lamp fixtures, pool heaters, portable electric spas (hot tubs), residential furnaces and boilers, residential pool pumps, single-voltage external AC to DC power supplies, state-regulated incandescent reflector lamps, and walk-in (commercial) refrigerators and freezers." Other devices sometimes mentioned as candidates for state-level standards (or for federal standards) include ceiling fans and ceiling fan light kits and commercial clothes washers.

- Develop and implement standards for commercial-sector appliances and equipment not currently covered by federal standards.

It is anticipated that the process of setting higher energy efficiency standards in Montana, in concert with other states, will encourage higher federal standards and higher volume manufacturing of higher efficiency appliances and equipment, resulting in wider distribution and likely lower prices for these devices.

Goals: Review standards and report to Governor by 2008, with adoption of changes in standards by 2009 (activities designed to be timed to coordinate with consideration of energy matters by the Montana State Legislature).

Timing: as above.

Parties Involved:

- Electric and gas utilities;
- State government agencies, including the MDEQ, the Department of Labor and Industry, and the Department of Commerce;
- Appliance manufacturers and appliance/equipment industry representatives; and
- Other states, particularly northwest states.

Other: None cited.

Implementation Mechanisms

Potential implementation mechanisms and supporting activities for this option include

Appliance standards: These could be promulgated by legislation or developed administratively.

Low-income assistance programs: Financial assistance to help low-income consumers with purchase of appliances meeting more stringent standards to reduce the higher-first-cost burden of higher efficiency appliances on those consumers.

State Lead by Example: Elevated energy standards for appliances and equipment purchased by public agencies.

Impacts on manufacturers: Work with manufacturers and consider impacts on manufacturers when setting new standards.

Related Policies/Programs in Place

None cited.

Type(s) of GHG Reductions

GHG impacts are similar to those noted for RCII-1 and RCII-2 above.

Estimated GHG Reductions and Costs (or Cost Savings)

	Policy	Scenario/Element	Reductions		Cumulative Reductions 2007–2020 ($MMtCO_2e$)	NPV 2007–2020 ($ Millions)	Cost-Effective-ness ($\$/tCO_2$)
			2010	2020			
RCII-3	State-Level Appliance Efficiency Standards and State Support for Improved Federal Standards	Electricity Plus Natural Gas	0.05	0.20	1.5	–$55	–$36
		Electricity Savings	0.05	0.17	1.3	N/A	N/A
		Natural Gas Savings	0.00	0.03	0.2	N/A	N/A

N/A = not applicable.

Data Sources: Fractional savings and costs drawn from the Appliance Standards Awareness Project (ASAP) and American Council for an Energy-Efficient Economy (ACEEE), 2006. "Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards."[11]

Quantification Methods: Results for Montana from the report above adapted by adjusting for different analysis period, discount rate, and energy prices.

Key Assumptions: Costs and savings from efficiency improvements via standards will be similar in Montana to those indicated in the ASAP/ACEEE report cited above.

Key Uncertainties

The effectiveness and cost-effectiveness of the higher-than-federal standards adopted by Montana will depend, in part, on the standards implemented by other states, including other states in the region.

Additional Benefits and Costs

Benefits

Reduction in water use for some appliance upgrades.

Costs

None cited.

Feasibility Issues

Feasibility enhanced by ongoing efforts in nearby states.

[11] See, for example, the following from the Appliance Standards Awareness Project (ASAP) Web site: http://www.standardsasap.org/documents/a062states.htm and http://www.standardsasap.org/documents/a062_mt.pdf

Status of Group Approval

Completed.

Level of Group Support

Unanimous consent.

Barriers to Consensus

None.

RCII-4. Building Energy Codes

Policy Description

Building energy codes specify minimum energy efficiency requirements for new buildings or for existing buildings undergoing a major renovation. Given the long lifetime of most buildings, amending state and/or local building codes to include minimum energy efficiency requirements and periodically updating energy efficiency codes could provide long-term GHG savings. Implementation of building energy codes, particularly when much of the building occurs outside of urban centers, can require additional resources.

Policy Design

The proposed policy to improve energy efficiency–related elements of building codes in Montana to reduce the amount of fossil fuel energy input needed to operate buildings in the state, includes the following elements:

- Undertaking a comprehensive review of existing building codes in Montana to determine where increased energy efficiency can be achieved.
- Increasing standards such that the minimum performance of new and substantially renovated buildings, both commercial and residential, is at least 15% higher by 2010 than that required by today's building codes (International Energy Conservation Codes [IECC] 2003, though IECC 2006 codes are under consideration), and 30% higher by 2020.
- Encouraging and working toward achieving the goal of "carbon-neutral"[12] status for new buildings. Reductions in GHG emissions related to building energy use can be achieved through a combination of increased energy efficiency, switching to low- and no-carbon fuels (including solar energy) for previously fossil-fueled end-uses, purchases of "green power" from off-site providers, and/or installing on-site power generation fueled by renewable energy sources.
- Encouraging the use of recycled and local building materials.
- Expressing energy efficiency standards on a per-unit-floor-space basis for commercial buildings, and on a per-dwelling-unit basis for residential buildings.
- Periodically and regularly (no less frequently than every 3 years) reviewing building codes, including energy efficiency requirements of building codes, to ensure that they stay up-to-date. Include a review of standards related to air infiltration, building "tightness," and related ventilation requirements.
- Offering, and requiring as appropriate, education to equip building code officials, builders, designers, and others to effectively implement building energy code improvements. This might include, for example, developing a corps of licensed independent contractors who

[12] "Carbon-neutral" status for a building means that any energy needs of a building, net of building design to reduce energy use and of on-site renewable energy use, should be supplied by renewable energy sources (such as "green power").

could inspect buildings for compliance with the new energy codes, especially in rural areas that currently may have minimal code inspection.

- Exploring new mechanisms, such as working with financial institutions, and the use of spot checks, to improve code implementation in rural areas.

Goals: See above.

Timing: See above. Code and enforcement changes begin to take effect in 2008.

Parties Involved:

- Building Codes Council, which includes representatives from the League of Cities and Towns as well as builders, engineers, local government officials, and representatives of state agencies;
- Code-enforcing jurisdictions;
- Citizens/consumer advocates, including expanding Council membership to include citizen representation;
- Department of Labor and Industry;
- MDEQ; and
- Electric utilities.

Other: Under development.

Implementation Mechanisms

Education and Technical Assistance: Education is expected to be a significant component of improving building codes. It may be necessary to increase the training of code officials, builders, and others and provide consumer education on building energy use. Continuing education programs for builders and others may be helpful in improving compliance with new codes.

Statewide Building Permit Program: Institute a statewide building permit program to ensure consistency with regard to code application and enforcement among buildings built in both urban and rural areas.

Additional Code Enforcement: Consider providing additional code enforcement to improve understanding of and compliance with more rigorous energy efficiency codes.

Utility Assistance: Consider using utility resources to help implement building energy codes—for example, having utilities review building designs and monitor energy performance. Utilities might play a role in enforcement through the application of interconnection rules, tariffs, and connection charges that encourage the construction of buildings that use energy efficiently and at an appropriate level.

Related Policies/Programs in Place

Building Codes: Montana has previously adopted the 2003 version of the IECC. The Montana Building Codes Council will consider adoption and amendments to the 2006 IECC during meetings sometime in 2007.

Legislative Interest: Recent legislative interest in state energy efficiency building codes is indicated by the 2003 Montana Senate Joint Resolution (No. 13), which called for "an interim study to investigate options for improving energy efficiency building codes laws and other energy efficiency and conservation practices."[13]

Type(s) of GHG Reductions

CO_2 reduction from avoided electricity production and avoided on-site fuel combustion.

Modest reduction in CH_4 emissions from avoided fuel combustion and avoided natural gas pipeline leakage, relatively small reductions in N_2O and black carbon emissions from avoided fuel consumption.

Estimated GHG Reductions and Costs (or Cost Savings)

	Policy	Scenario/Element	Reductions		Cumulative Reductions 2007–2020 ($MMtCO_2e$)	NPV 2007–2020 ($ Millions)	Cost-Effective-ness ($/tCO_2$)
			2010	2020			
RCII-4	Building Energy Codes	Electricity Plus Natural Gas	0.03	0.25	1.6	–$15	–$10

Data Sources: WGA CDEAC EE report and detailed results prepared for that report by the Building Code Assistance Project (BCAP); US DOE Building Energy Survey and related documents. (Note that state-level building activity/building stock statistics were not available for this analysis.) BCAP analyses by state (including Montana) to derive base savings.

Quantification Methods: Apply general BCAP method to estimate code savings, but apply 15% and 30% target savings figures.

Key Assumptions: Average costs of building code improvements, ratio of gas improvements to electricity improvements.

Key Uncertainties

Relative cost of code improvements that are more aggressive than those reflected in the WGA analysis.

[13] See http://data.opi.mt.gov/bills/2003/billhtml/SJ0013.htm

Additional Benefits and Costs

Benefits

- Potential to also yield water savings, comfort and indoor air quality improvements, with related improvements in health and productivity.
- Saving consumers and businesses money on their energy bills. More stringent energy codes for buildings will benefit low-income tenants by reducing their monthly energy bills.
- Reducing dependence on imported fuel sources and reducing vulnerability to energy price spikes.
- Electricity system benefits: reduced peak demand, reduced capital and operating costs, improved utilization and performance of the electricity system, reduced pollutant emissions from power plants and related public health improvements, and reduced water use in power plants.
- Supporting local businesses and stimulating economic development

Costs

None cited.

Feasibility Issues

Interaction with appliance standards and utility programs.

Status of Group Approval

Completed.

Level of Group Support

Unanimous consent.

Barriers to Consensus

None.

RCII-5. "Beyond Code" Building Design Incentives and Mandatory Programs

Policy Description

This policy provides incentives and targets to induce the owners and developers of new and existing buildings to improve the efficiency with which energy and other resources are used in those buildings, along with provisions for raising targets periodically and resources to help achieve the desired building performance. Many "green building" programs have been developed that define standards for efficient energy and resource use and that encourage demand for these green buildings through recognition, incentives, and government mandates.[14] This policy includes elements to encourage the improvement and review of energy use goals over time and to encourage flexibility in contracting arrangements to encourage integrated energy- and resource-efficient design and construction.

Policy Design

A combination of financial incentives and regulatory policies would be used to induce owners and developers of new and existing buildings to improve their structures, or to build new structures that exceed energy efficiency (and net GHG emissions) provisions of building codes in force.

Goals:

- Reduce per-unit-floor-area consumption of grid electricity and natural gas by 20% by 2020 in existing buildings and by 50% in new buildings by 2020. Up to 10% of the targeted reduction for new homes can come from use of off-site electricity generation from renewable energy.[15] These requirements should be phased in over time and will have the following targets:
- Improve 25% of existing residential units in Montana by the year 2020.
- Improve 25% of existing commercial floor space in Montana by the year 2020.
- Provide incentives such that 25% of new or substantially remodeled residential units in Montana exceed building energy and GHG emissions codes in force by 20% in existing residences and 50% in new residences by the year 2020.
- Provide incentives such that 25% of new or substantially remodeled commercial floor space in Montana exceeds building energy and GHG emissions codes in force by 20% in renovated buildings and 50% in new buildings by the year 2020.

Timing: See above.

Parties Involved:

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[14] Existing programs include EPA's Energy Star Homes and Leadership in Energy and Environmental Design (LEED).

[15] Note that this limit on the use of renewable off-site electricity generation is assumed to count only the renewable fraction of electricity purchased that is beyond that included in any statewide RPS.

- MDEQ, Department of Labor and Industry, local government permitting agencies;
- Utilities;
- Financial services industries; and
- Building industries.

Other: Under development.

Implementation Mechanisms

Implementation mechanisms, as noted above, could include a combination of financial assistance, special regulatory or administrative consideration for buildings projects that achieve "beyond code" performance, and other types of incentives. The following are specific examples of such mechanisms.

Fee Adjustments: Offering programs to adjust impact fees or connection fees—such as reduced fees for sewer and water hookups for homes that use less hot and cold water—for new and upgraded existing buildings that meet specific higher-than-code energy efficiency standards. Municipalities could be compensated for fee reductions from a revolving loan fund or by some other mechanism. Develop systems and programs that recognize reduced impacts and adjust fees accordingly. Such fees adjustments could be made by utilities, municipalities, or other entities, as applicable.

Permitting Advantages: Offer regulatory advantages, such as fast-track (expedited review) processing of applications, for buildings certified as having "beyond code" energy efficiency and environmental performance.

Rewards Programs: Develop systems and programs that reward "beyond code" energy efficiency and emissions reduction improvements, including "green mortgages," or adding "points" in project review processes for building features that meet or exceed environmental targets.

Property Tax Adjustments: Consider property tax adjustments that waive all or a portion of additional taxes on investments for improving building performance to "beyond code" levels.

Increased Tax Incentives: Increase existing tax incentives for building energy efficiency improvements.

Related Policies/Programs in Place

Existing Montana Residential Energy Tax Credits for selected energy efficiency improvements.

Type(s) of GHG Reductions

- CO_2 reduction from avoided electricity production and avoided on-site fuel combustion.
- Modest reduction in CH_4 emissions from avoided fuel combustion and avoided natural gas pipeline leakage, relatively small reductions in N_2O and black carbon emissions from avoided fuel consumption.

Estimated GHG Reductions and Costs (or Cost Savings)

	Policy	Scenario/Element	Reductions		Cumulative Reductions 2007–2020 ($MMtCO_2e$)	NPV 2007–2020 ($ Millions)	Cost-Effective-ness ($\$/tCO_2$)
			2010	2020			
RCII-5	"Beyond Code" Building Design Incentives and Mandatory Programs	Electricity Plus Natural Gas	0.07	0.52	3.4	–$17	–$5
		Electricity Savings	0.06	0.43	2.8	–$9	–$3
		Natural Gas Savings	0.01	0.09	0.54	–$8	–$15

Data Sources: Costs of energy efficiency improvements based on studies of costs of building improvements and code changes.

Quantification Methods: Estimates of fractional savings in energy intensities needed to meet targets in new commercial and residential buildings. Allocates intensity savings among energy efficiency, renewable energy sources, and off-site green power.

Key Assumptions: Fractions of electric and gas intensity improvement accounted for by efficiency improvements, solar thermal, solar PV, increased biomass use, and purchases of renewable-generated power from off-site; fractional savings targets over (new) code levels; growth in housing stock and commercial sector floor space (linked to projections of Montana population growth); and incremental cost of green power.

Key Uncertainties

- Total commercial building space in Montana (regional estimates can be adapted to provide estimates if needed).
- Fractions of new and existing commercial buildings, and residential units, participating in program.

Additional Benefits and Costs

Benefits

Potential to also yield water savings and comfort and air quality improvements.

Costs

None cited.

Feasibility Issues

Interaction with appliance standards and energy efficiency programs.

Status of Group Approval

Completed.

Level of Group Support

Unanimous consent.

Barriers to Consensus

None.

RCII-6. Consumer Education Programs

Policy Description

The ultimate effectiveness of emissions reduction activities in many cases depends on providing information and education to consumers, as well as to future consumers (primary and secondary school students), regarding the energy and GHG emissions implications of consumer choices. Public education and outreach is vital to fostering a broad awareness of climate change issues and effects (including co-benefits such as clean air and public health) among the state's citizens. Such awareness is necessary to engage citizens in actions to reduce GHG emissions. Public education and outreach efforts should integrate with and build upon existing outreach efforts involving climate change and related issues in the state. Ultimately, public education and outreach will be the foundation for the long-term success of all of the mitigation actions proposed by the CCAC, as well as those that may evolve in the future.

To effectively implement many of the other options in the residential, commercial, institutional, and industrial sectors, as well as in other sectors, specific and targeted education, outreach, and licensing requirements will be required for professionals in a variety of building-related and other trades to ensure that they have the expertise to support aggressive GHG mitigation options in Montana.

Policy Design

Elements of the design for this policy will

- Offer consumer education related to energy efficiency and the environmental consequences of energy and other choices.[16] Dovetail with public broadcasting media.
- Direct the Montana Office of Public Instruction and others to develop and implement curricula for primary and (particularly) secondary schools that educate students so that they can evaluate the implications of consumption choices.
- Implement and enhance professional education and certification programs for teachers and for those involved in providing products and services related to energy use and GHG emissions, so as to build the statewide pool of individuals trained to support RCII and other policy options. This training for professionals (including architects, engineers, builders, code inspectors, lighting and heating, ventilation, and air conditioning (HVAC) equipment installers, electricians, plumbers, and others) who advise the public on energy choices is seen as a crucial component to the success of other RCII initiatives.
- Provide education programs with a strong focus on energy savings in existing buildings that include follow-up surveys on the actions that have been implemented by participants.
- Educate businesses and retailers about the GHG emissions associated with products and supply chains. Explore regional efforts to rate the GHG emissions of products.

[16] Note that there is overlap between this RCII option and some of the elements of an option (CC-4) being elaborated by the Cross-Cutting TWG.

- Discourage use of excessive lights, such as yard lights and unneeded street lights. The following are some possible guidelines:
  - Allow only cutoff or semi-cutoff luminaries.[17]
  - Allow only fluorescent lighting or high-intensity discharge (HID) bulbs in yard lights (no incandescent bulbs).
  - Limit lighting levels on pedestrian walkways to 1.0 fc (foot-candles) on the horizontal and vertical planes.
  - Limit lighting levels in parking areas to an average of 1.5 fc on the ground plane, with a uniformity ratio of 6:1 and a minimum of 0.25 fc.
  - Limit lighting levels on community roadways to 1.0 fc on the ground, with a 3:1 uniformity ratio.
  - Limit lighting levels for main roads to 1.5 fc.
  - Limit lighting levels for building entryways to 3.0 fc.
  - Encourage the use of motion detection switches and other types of control mechanisms to minimize the use of lights when they are not needed.

  Quantitative analysis of the impacts of these lighting guidelines is not expected to be undertaken.

Goals: Educate consumers, businesses, retailers, and children so they can make informed choices to reduce energy use, improve efficiency, and reduce environmental consequences of their actions. Educate energy efficiency professionals so they can better inform consumers and make wise decisions.

Timing: Synchronize education initiatives with development and implementation of other RCII options so that those who will make decisions related to energy efficiency and GHG emissions reduction and those who will implement improvements will have the background to do so effectively.

Parties Involved:

- Utilities,
- Government agencies (local, state, and federal),
- Private entities,
- Primary and secondary schools,
- Building trade organizations,
- Extension services, and

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[17] To reduce glare, cutoff luminaires (light fixtures) allow very little or no light above the horizontal (a maximum of 2.5% of the fixture's light output at an angle of 90 degrees from the fixture, and 5% at an angle of 80 degrees from the fixture), and semi-cutoff luminaires produce limited light above the horizontal (a maximum of 5% of the fixture's light output at an angle of 90 degrees from the fixture, and 20% at an angle of 80 degrees from the fixture). See, for example, http://www.lrc.rpi.edu/programs/NLPIP/lightinganswers/lightpollution/cutoffShielded.asp#

- Colleges and universities (including involving both in the development of curriculum for education programs)

Other: Additional discussion of information and education under Cross-Cutting recommendations, CC-4.

Implementation Mechanisms

The following are potential implementation mechanisms for this option.

Financial Support for Training: Financial support for energy efficiency training sessions. This could involve, for example, funding to bring in speakers and organize workshops and conferences.

Advertising: Wide advertisement of education and training sessions and regular and consistent offering of such services.

Incentives: Offering incentives or vouchers (e.g., for energy efficient products or other goods or services) for consumers who undertake consumer education and/or change their consumption patterns so as to reduce GHG emissions (this could be applied in a manner analogous to safe driver discounts for car insurance).

Education for Primary and Secondary School Children: Develop or improve curricula for primary and secondary schools on the topics of energy efficiency and GHG emissions and climate change so that students can evaluate the impacts of the choices they make.

Related Policies/Programs in Place

Training for Building Professionals: Some training is provided by professional organizations, utility companies, and MDEQ.

Education: Montana Energy Education Council (MEEC) provides training for teachers and students on energy.

Dark Sky Ordinance: In Bozeman, the Dark Sky ordinance limits light pollution by regulating outdoor lighting.

Type(s) of GHG Reductions

These education and information programs are crucial in enabling and supporting GHG emissions reductions in a number of RCII areas and in other sectors, but their direct GHG reduction impacts are very difficult to assess.

Estimated GHG Reductions and Costs (or Cost Savings)

Because this option supports many other RCII (and some ES) options and because it is difficult to attribute specific GHG-savings, the emissions reductions associated with this option will not be quantified.

Data Sources: Under development.

Quantification Methods: Under development.

Key Assumptions: Under development.

Key Uncertainties

None cited.

Additional Benefits and Costs

None cited.

Feasibility Issues

Potential contribution of consumer education programs to reducing GHG emissions is difficult to estimate.

Status of Group Approval

Completed.

Level of Group Support

Unanimous consent.

Barriers to Consensus

None.

RCII-7. Support for Implementation of Clean Combined Heat and Power

Policy Description

Distributed generation with clean combined heat and power (CHP) systems reduces fossil fuel use and GHG emissions both through the improved efficiency of the CHP systems, relative to separate heat and power technologies, and by avoiding transmission and distribution losses associated with central power stations that are located far away from where the electricity is used. Implementation of these systems by residential, commercial, institutional, and industrial energy consumers should be encouraged through a combination of regulatory changes and incentive programs.

Policy Design

The Energy Supply TWG developed a similar option as a part of ES-4, “Incentives and Barrier Removal (Including Interconnection Rules and Net Metering Arrangements) for Combined Heat and Power (CHP) and Clean Distributed Generation (DG).” Please see description of ES-4 for additional details.

Goals: See ES-4 description.

Timing: See ES-4 description.

Parties Involved: See ES-4 description.

Other: See ES-4 description.

Implementation Mechanisms

See ES-4 description.

Related Policies/Programs in Place

See ES-4 description.

Type(s) of GHG Reductions

CO_2 reduction from avoided electricity production and avoided on-site fuel combustion less additional on-site CO_2 emissions from fuel used in CHP systems.

Other gases: Modest potential changes in emissions of CH_4 from avoided fuel combustion and avoided natural gas pipeline leakage, net of any additional on-site emissions or additional leakage from increased gas use, likely relatively small reductions in emissions of N_2O from avoided fuel combustion, net of any increased on-site emissions, and also some possible small net changes in emissions of black carbon, depending on the balance between avoided and additional consumption of oil, coal, and biomass fuels, and of emission control.

Estimated GHG Reductions and Costs (or Cost Savings)

See ES-4 description.

Data Sources: See ES-4 description. Includes estimates of potential from WGA *Clean and Diversified Energy Initiative Combined Heat and Power White Paper* (January 2006).

Quantification Methods: See ES-4 description. Approach is modeling of the incremental implementation of a target fraction of Montana's CHP potential achieved through adoption of CHP systems fueled with gas, coal, or biomass.

Key Assumptions: See ES-4 description. Includes CHP generation capacity (as a fraction of Montana's potential, by sector) achieved via this option, and types of fuels used in CHP.

Key Uncertainties

- Ultimate CHP potential in Montana.
- Heating fuels and electricity actually displaced by CHP.

Additional Benefits and Costs

Benefits

- Programs could help to lower capital and installation costs of CHP.
- Develop local expertise with CHP systems.
- Develop market for locally derived biomass fuels.
- Utility system co-benefits.
- Cost savings and decreased impacts of transmission and distribution (by deferring or displacing the need for additions).

Costs

None cited.

Feasibility Issues

None cited.

Status of Group Approval

Completed (as a part of ES-4).

Level of Group Support

Unanimous consent.

Barriers to Consensus

None.

RCII-8. Support for Renewable Energy Applications

Policy Description

Distributed electricity generation sited at residences and commercial and industrial facilities and powered by renewable energy sources (typically solar but also wind and hydro), displaces fossil-fueled generation and avoids electricity transmission and distribution losses, thus reducing GHG emissions. This policy can also encourage consumers to switch from using fossil fuels to using renewable fuels in applications such as water, process, and space heating, as well as to supply new energy services using fuels that produce low or no GHG emissions. Increasing the use of renewable energy applications in homes, businesses, and institutions in Montana can be achieved through a combination of regulatory changes and incentives.

Policy Design

This policy was also developed in the Energy Supply section under option ES-4 and considered by the Agriculture, Forestry and Waste Management (AFW) sector under option AFW-7. More details on the policy are provided as part of the description of option ES-4.

The design of this policy may include the following elements:

- Utility incentives for consumers to develop distributed generation, including net metering policies.
- Removal of barriers to the implementation of distributed generation, including revising interconnection rules as appropriate.
- Tax or other incentives, or favorable tax treatment, for investments in distributed generation.

This policy encompasses solar (thermal and photovoltaic) systems and biomass fuels for use in homes and business, as well as geothermal (ground source) heat pumps.

Goals: Goals for this option are incorporated in those developed as a part of Energy Supply option ES-4, “Incentives and Barrier Removal (Including Interconnection Rules and Net Metering Arrangements) for Combined Heat and Power (CHP) and Clean Distributed Generation (DG).” Current penetration of solar photovoltaic systems in the NWE service territory in Montana suggest that about 0.1% or less of Montana homes currently use these systems. The penetration of solar thermal water heating systems is also quite limited.

Timing: See ES-4 description.

Parties Involved: See ES-4 description.

Other: See ES-4 description.

Implementation Mechanisms

See ES-4 description.

Related Policies/Programs in Place

National “Million Solar Roofs” program, adopted in 1997, suggests a target of 1,000 home systems (of 3 kW) for Montana by 2010. NWE and other Montana utilities offer net metering programs for some distributed generation.

Type(s) of GHG Reductions

CO_2 reduction from avoided electricity production and avoided on-site fuel combustion.

Modest reduction in CH_4 emissions from avoided fuel combustion and avoided natural gas pipeline leakage, relatively small reductions in N_2O and black carbon emissions from avoided fuel consumption.

Estimated GHG Reductions and Costs (or Cost Savings)

See results and related material provided in the description for ES-4.

Data Sources: As above.

Quantification Methods: As above.

Key Assumptions: As above.

Key Uncertainties

None cited.

Additional Benefits and Costs

None cited.

Feasibility Issues

None cited.

Status of Group Approval

Completed (as a part of ES-4).

Level of Group Support

Unanimous consent.

Barriers to Consensus

None.

RCII-9. Carbon Tax

This option was being considered jointly with the Energy Supply TWG. See descriptions for options ES-8 and ES-9.

Policy Description

A CO_2 tax would be a tax on each ton of CO_2 emitted from an emissions source covered by the tax. A CO_2 tax could be imposed upstream based on carbon content of fuels (e.g., fossil fuel suppliers) or at the point of combustion and emission (e.g., typically large point sources such as power plants or refineries). Taxed entities would pass some or all of the cost on to consumers, change production to lower emissions, or a combination of the two. As the suppliers respond to the tax, consumers would see the implicit cost of CO_2 emissions in products and services and would adjust their behavior to purchase substitute goods and services that result in lower CO_2 emissions. CO_2 tax revenue could go completely to state revenue and be used in a variety of ways such as income tax reduction or policies and programs to assist with CO_2 reductions. CO_2 tax revenue can also be directed to helping the competitiveness of industries or assisting communities most affected by the tax.

Policy Design

The RCII TWG has coordinated with the Energy Supply TWG in considering and developing this option. The ES TWG has expressed the sense that a regional/national approach would be far preferable to Montana-alone tax (which should likely not be considered).

Goals: None identified.

Timing: None identified.

Parties Involved: None identified.

Other: None identified.

Implementation Mechanisms

Carbon tax revenues should be used, in part, to offset the impact of carbon taxes on low-income customers. This could be accomplished, for example (and as applicable) by using carbon tax proceeds to fund weatherization projects that will reduce energy costs for low-income households.

Related Policies/Programs in Place

See Annex 1: "Summary Table of Carbon Tax Programs," for information on selected carbon tax initiatives to date in Europe, Japan, and North America.

Type(s) of GHG Reductions

See ES-8/ES-9.

Estimated GHG Reductions and Costs (or Cost Savings)

Largely a qualitative analysis focusing on review of existing studies germane to the Montana situation and on the impacts in Montana of the implementation of a national or regional carbon tax. The focus of analysis will thus be on regional programs and design elements rather than on specific quantification of this option.

Data Sources: See ES-8/ES-9.

Quantification Methods: See ES-8/ES-9.

Key Assumptions: See ES-8/ES-9.

Key Uncertainties

None cited.

Additional Benefits and Costs

None cited.

Feasibility Issues

None cited.

Status of Group Approval

Completed (as a part of ES-8/ES-9).

Level of Group Support

Unanimous consent.

Barriers to Consensus

None.

RCII-10. Industrial Energy Audits and Recommended Measure Implementation

Policy Description

This policy option includes providing industrial-sector energy technical assistance (energy audits) to identify and recommend options for reducing fossil energy and electricity use and for reducing non-energy emissions of GHGs. For example, an agency could be set up (or housed at an existing post-secondary institution) that hires experts who will visit industrial sites to assess current practices and equipment and provide recommendations for reducing GHG emissions. A combination of incentives, expertise, and information to implement recommended options are included in the policy to encourage the operators of industrial-sector facilities to follow up on audit recommendations.

Policy Design

The cost-effective potential for industrial electricity savings in Montana has been estimated at 40 to 84 MW. To address this potential, a program of energy audits for the industrial sector is recommended, coupled with a program of low- or no-interest loans designed to encourage industrial customers to take up energy efficiency measures that reduce both electricity and natural gas consumption.

Goals: The estimated cost-effective potential for industrial-sector electricity savings noted above (40 to 84 MW) is approximately 6% to 12 % of Montana's industrial-sector electricity use in 2005. Savings of 10% of industrial electricity and natural gas use is taken as an overall target for RCII-10 programs to achieve by 2020. The goal of this option is to address 8% of this (10% reduction in industrial electricity and gas use) target annually, starting in 2009 with a phase-in year, and continuing thereafter.

Energy consumers covered by this option, as a rule of thumb, are expected to be those with peak electricity demand of about 1 MW, using, for example, the qualification rules for self-directing universal systems benefits funds in Montana.[18]

Timing: As noted above.

Parties Involved:

- Industrial consumers of electricity and natural gas,
- State government agencies,
- Electric utilities,
- Industrial audit providers (engineers and technicians, including specialists in equipment for particular industries), and

[18] See, for example, http://data.opi.state.mt.us/bills/mca/69/8/69-8-402.htm, Montana Annotated Code 2005, § 69-8-402, "Universal system benefits programs."

- Suppliers of industrial energy efficiency measures.

Other: None cited.

Implementation Mechanisms

Low-Cost Financing: Low- or no-interest loans for efficiency improvements, particularly for efficiency improvements for larger equipment.

Monitoring and Evaluation: Monitoring and evaluation arrangements to confirm effectiveness of installed measures, thus ensuring that emissions reduction levels are appropriately matched to incentives (including tax credits) awarded.

Energy Star Incentives: Provide incentives and information to encourage industries to adopt US EPA Energy Star standards and measures.

Tax Incentives: Tax incentives for industrial energy efficiency improvements, possibly as an extension to the energy-related tax incentives recently adopted by the legislature (House Bill [HB] 3 in the 2007 Special Session).

Waste Heat to Energy: Encourage collaboration between utilities and large industries that may have waste heat that could be tapped for power generation (this may also be an implementation option for RCII-7 and ES-4).

Self-Audits and Incentives: Offer opportunities for industrial facilities to self-identify measures for GHG reduction and to apply for incentives to implement identified measures that lead to demonstrable and cost-effective GHG emissions reduction.

Related Policies/Programs in Place

Universal Systems Benefit Funds: Industries may self-direct USB payments into their facilities for efficiency upgrades.

Montana Manufacturing Extension Service: MMES provides assistance to small manufacturing businesses to improve process and system efficiencies. While not targeted at energy use, energy can be a part of efficiency improvements.

Type(s) of GHG Reductions

GHG impacts are likely similar in nature to those noted for RCII-1 and other options above, except to the extent that audit recommendations included emissions reduction efforts that targeted non-energy emissions, GHG impacts will vary on a case-by-case basis.

Estimated GHG Reductions and Costs (or Cost Savings)

	Policy	Scenario/Element	Reductions		Cumulative Reductions 2007–2020 ($MMtCO_2e$)	NPV 2007–2020 ($ Millions)	Cost-Effective-ness ($\$/tCO_2$)
			2010	2020			
RCII-10	Industrial Energy Audits and Recommended Measure Implementation		0.07	0.56	3.6	–$93	–$26

Data Sources: Estimate of cost-effective industrial-sector energy efficiency potential in Montana from John Campbell of NWE.

Quantification Methods: The savings target above, the rate at which it is addressed by the option, and the average (2005) consumption of electricity and gas per industrial consumer are used to derive a target number of audits per year which, in turn, is used to estimate electricity and natural gas savings, by year, from the option. The costs of saved energy from the measures applied under this option are calculated based on the assumptions regarding the average simple payback and lifetime of energy efficiency options noted below. Net costs of energy savings for electricity and natural gas are calculated as the difference between the cost of saved energy for the measures installed and the avoided costs for electricity and natural gas in Montana.

Key Assumptions:

- Cost-effective industrial electricity savings are as noted above and are available with an average simple payback of 2.5 to 3 years, based on industrial power costs.
- Available savings through industrial-sector natural gas measures are similar to those for electricity measures and provide similar simple paybacks.
- The average lifetime of industrial-sector energy efficiency improvements is taken to be 12 years.

Key Uncertainties

Actual savings available from industrial sector measures and average costs of those measures.

Additional Benefits and Costs

None cited.

Feasibility Issues

None cited.

Status of Group Approval

Completed.

Level of Group Support

Unanimous consent.

Barriers to Consensus

None.

RCII-11. Low Income and Rental Housing Energy Efficiency Programs

Policy Description

Energy efficiency programs are a key component of other RCII options, and energy efficiency programs typically yield significant economic benefits (as well as GHG reductions) to consumers who participate. Low-income consumers, however, are frequently unable to participate in energy efficiency programs because they lack funds to pay for improvements or, in the case of renters, an inability to either make changes to their residences or fully benefit from any cost savings. In recognition of this barrier, this policy urges the implementation of programs specifically targeted to the needs of low-income residents for services such as home weatherization or replacement of manufactured homes for which weatherization is inappropriate, updating or repairing inefficient appliances, and funding for renewable energy systems. These programs could be designed to offer low-income residents energy efficiency services with a minimum of up-front costs and should be marketed through an aggressive campaign of outreach to low-income households and communities. Programs designed to work with both landlords and tenants could also be considered and are particularly important in university towns where weatherization of rental homes is difficult due to a transient population, low tenant incomes, and a limited supply of housing.

Policy Design

Goals:

- Starting in 2009, increase energy efficiency by 30% in 50% of eligible low-income residential units in Montana by the year 2015.
- Increase energy efficiency by 50% in 75% of eligible low-income residential units in Montana by the year 2020.
- Eligible homes are those whose household income is below 150% of the federal poverty level.
- Extend program to rental housing in general.

Timing: As above.

Parties Involved:

- Government housing and other state and federal government agencies,
- Weatherization service providers,
- Owners of rental property,
- Tribal representatives and authorities,
- Community Action Agencies and Human Resource Development Councils,

- The Montana Conservation Corps working with and within the Governor's "Warm Hearts/Warm Homes" initiative,[19] and
- Nongovernmental organizations such as AARP Montana (formerly the American Association of Retired Persons), which can assist with education and outreach; Habitat for Humanity.

Other: None cited.

Implementation Mechanisms

Implementation mechanisms could include the following.

Energy Audits and Implementation: Residential energy audits and installation of measures identified as needed in the audits.

Grants: Weatherization grants to qualified homeowners.

Financing: Low-interest loan programs for homeowners and/or rental property owners or managers.

Education for Installers: Training programs for weatherization providers, possibly in collaboration with some of the parties noted above.

Replace Substandard Manufactured Housing: State support for financing or purchase of efficient manufactured housing to replace manufactured (or other) housing that cannot be practically weatherized.[20] Replaced homes will be permanently removed from the housing stock and their components will be recycled to the extent practicable.

Increase Efficiency in Program Delivery: Controlling overall program costs and increasing the number of homes that can be serviced by focusing on installation of measures shown by experience to provide significant energy savings in the majority of homes (such as additional ceiling insulation), even if a full assessment of energy efficiency improvement needs has not been performed on a given dwelling. This may include developing a list of prescribed measures (including, for example, R-38 ceiling insulation) to be applied to most of the homes weatherized.

Prioritize Services: Prioritize providing services to homes that currently have minimal weatherization, including homes that have already applied for services but have not yet received them because of a lack of resources.[21]

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[19] See, for example, http://deq.mt.gov/Energy/warmhomes/. Note that the residential weatherization activities currently performed by Conservation Corp staff are typically limited to rapid, low-cost or no-cost measures.

[20] An outlay of $354,886 was authorized in the Montana budget (HB 2 in the 2007 special session) for a revolving loan program for manufactured home replacement. See http://data.opi.mt.gov/bills/specsess/0507/billpdf/HB0002.05.pdf .

[21] Over time, as homes with minimal weatherization are serviced, it is possible that the amount of effort (and cost) required to raise the energy efficiency in the average home in the program to goal levels may rise. Improvements in weatherization technologies and in procedures for carrying out low-income and rental housing energy efficiency in Montana, however, may help to counteract this trend.

Additional implementation mechanisms aimed at rental dwellings could include the following.

Tax Credits for Landlords: Income tax credits for rental property owners who weatherize rental properties to meet energy efficiency standards set by the program.

Utility Bill Disclosure: Time of sale or rental disclosure of utility bills for a dwelling.

Tenants' Rights to Know Utility Costs: Tenants' rights laws relating to energy efficiency, possibly including tenants' rights to request an energy audit of their rental property.

Rental Property Efficiency Requirements: Command-and-control requirements similar to those applied to rental of private homes to vacationers, including, for example, a program for licensing or certification of the energy efficiency of rental properties.[22]

Related Policies/Programs in Place

Tax Credits: Last year 3% of eligible Montana households used state tax credits for energy conservation.

Low-Income Weatherization Assistance Program: This Department of Public Health and Human Services (DPHHS) program currently provides weatherization and related health and safety improvement services to about 1,700 qualifying low-income households annually, with average savings equal to about 22% of household energy use.

Warm Homes Campaign: Governor Schweitzer launched an initiative to provide assistance to all Montana households, but particularly to low-income households, in the winter of 2005–2006. This campaign focuses on neighbors helping neighbors and includes using the Montana Conservation Corps to provide simple weatherization in some homes each fall.

Type(s) of GHG Reductions

GHG impacts are likely to be similar to those noted for RCII-1 and other options related to building energy efficiency improvements.

Estimated GHG Reductions and Costs (or Cost Savings)

	Policy	Scenario/Element	Reductions		Cumulative Reductions 2007–2020 ($MMtCO_2e$)	NPV 2007–2020 ($ Millions)	Cost-Effective-ness ($\$/tCO_2$)
			2010	2020			
RCII-11	Low Income and Rental Housing Energy Efficiency Programs		0.05	0.75	4.7	–$41	–$9

[22] The overall energy consumption of a rental home is a function of both the energy efficiency of the home itself and of how the tenants use energy. Both parameters should be taken into account when judging whether a structure meets efficiency standards.

Data Sources: Average costs and savings achieved by low-income weatherization programs currently operating in Montana obtained from representatives of the DPHHS and the Missoula Community Action Program form the basis for extrapolation of per-household costs to reach the performance goals listed above.

Discussions with DPHHS experts involved in the existing Montana low-income household energy efficiency program have informed the revised estimates presented above.

Quantification Methods: Starting with an estimate of eligible low-income and rental households, estimate the rate of penetration of the program over time (with eligible households reduced by the number of households participating in the existing DPHHS program), and apply target savings rates and costs to estimate savings in electricity and heating fuel use, option total cost, and option cost net of avoided electricity and fuel costs.

Key Assumptions:

- Savings of 30% of energy use in low-income households are available at an average cost of $2,900 per housing unit for energy efficiency–related options.[23]
- Savings of 50% of energy use in low-income households are available at an average cost of $5,400 per housing unit for energy efficiency–related options.
- The average consumption of electricity, gas, and other heating fuels in low-income households is similar to the average consumption in all households in Montana.[24]
- The 2005 estimated fraction of persons with incomes below 150% of the federal definition of poverty, 23.7%, holds throughout the analysis period.[25] The same fraction of occupied housing units is assumed to be occupied by households with incomes below 150% of the poverty level. Based on U.S. Census Bureau statistics, this equates to about 20.3% of **all** Montana homes (occupied or not).
- An additional 14.6% of Montana housing units are rental units occupied by households with incomes above 150% of the federal definition of poverty and are thus eligible for the program.
- Low-income weatherization programs in Montana currently operating reach 1,700 households per year and continue to do so.

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[23] The existing MDEQ low-income assistance program also implements health- and safety-related measures that do not necessarily provide energy efficiency (or GHG-reduction) benefits. The average per-household costs shown are net of the estimated costs of these primarily health- and safety-related measures.

[24] This assumption should be reviewed but takes into account that although low-income homes may be smaller than average homes in Montana, they use more energy per unit floor space than average homes because of poor insulation and other problems. It may also be that low-income customers may depend on electric heating to a higher degree, on average, than other customers.

[25] 2005 fraction of Montana residents of all ages living at incomes below 150% of the poverty threshold, from http://pubdb3.census.gov/macro/032006/pov/new46_135150_01.htm. Data used to derive the fraction of rental units occupied by residents with incomes above the poverty level are from the U.S. Bureau of the Census 2005 American Community Survey, Table S2503: Financial Characteristics, accessed through http://factfinder.census.gov/, and from year 2000 U.S. Bureau of the Census data on the income level of households in rental units in Montana.

Key Uncertainties

None cited.

Additional Benefits and Costs

Benefits

Additional comfort for low-income residents.

Costs

None cited.

Feasibility Issues

None cited.

Status of Group Approval

Completed.

Level of Group Support

Unanimous consent.

Barriers to Consensus

None.

RCII-12. State Lead by Example

Policy Description

The Montana state government can provide leadership in moving the state toward a stock of buildings with much higher energy efficiency and toward improving efficiency in the operations of state buildings. The proposed policy provides energy efficiency targets that are much higher than code standards for new state-funded buildings. Efficiency targets should also be applied to state-leased buildings and to other government buildings. The proposed policy also includes elements to encourage the improvement and review of efficiency goals over time and to encourage flexibility in contracting arrangements to encourage integrated energy efficient design and construction. Targets are also provided for upgrading energy efficiency in existing state government facilities.

Policy Design

Key elements of this policy include the following.

- New state government buildings will be in operation for many years and should be designed and constructed in a manner that greatly exceeds the minimum standards set by the building code for energy efficiency. If savings are not achieved in design and construction, opportunities for efficiency will be lost. Because buildings built for state government will be in operation for many years, savings will pay for themselves many times in operating costs reductions. All new state buildings should be should be Leadership in Energy and Environmental Design (LEED)-certified at the "silver" level,[26] and meet or exceed the energy efficiency and renewable energy goals below.
- Existing state government buildings should be upgraded for energy efficiency achieving 100% of cost-effective energy efficiency over a period of 15 years. To achieve this, all state buildings should be benchmarked in the next 3 years.
- State government should consider the environmental impacts as well as the energy efficiency of its operations. Waste should be reduced, recycling should be increased, and toxic or harmful chemicals should be avoided.
- Contracts for leasing building space and entering into building maintenance agreements for owned or leased buildings should require efficiency in operations.
- State government purchasers should purchase Energy Star–certified appliances and equipment where available. Energy Star–certified appliances and equipment use less energy to operate and typically pay for any additional cost in operational savings in a short time period. Procurement officers should specify Energy Star for bulk purchase programs and in contracts that may be used by local governments. State government should also purchase appliances and equipment with higher-than-standard energy efficiency for device types where Energy Star ratings do not apply.

[26] See www.usgbc.org. Note also that an analysis by KEMA of DSM options for buildings in Montana is currently underway.

- County and local governments should be encouraged to adopt the same or similar policies covering their buildings and purchases.

State government should consider a requirement for carbon-neutral bonding for new construction and building renovations. Climate-neutral bonding means that there is no net increase in GHG emissions within the bond issuing agency's geographical jurisdiction after the project becomes operational. A climate-neutral performance standard will require architects and engineers to design buildings that minimize the amount of energy they use in the first place. High-performance buildings meeting a climate-neutral requirement and built to meet or exceed the state's existing sustainable building guidelines will save taxpayers money over the long term as a result of their lower operating costs.

Goals:

- Reduce per-unit-floor-area consumption of grid electricity and natural gas by 20% by 2020 in existing buildings and by 40% in new buildings by 2020. These requirements should be phased in over time.
- Require 25% of electrical energy use to be generated from renewable sources by 2025 in new and existing buildings. These goals may be met through any combination of on-site generation and green power purchases. Green power purchases must be in excess of the amount of renewable energy supplied as a standard product by the utility in order to count toward the goal (that is, must be in excess of the renewable energy included in grid power as a part of any RPS.
- Implement bulk-purchase programs that affect 10% of government energy demand by 2020, reducing that demand by 20%.

Timing: See above. Begin implementing program by 2010, with full implementation as above.

Parties Involved: State agencies such as MDEQ, building owners, developers, municipal governments, financial institutions (for climate-neutral bonding), building inspectors, architects, engineers, and air monitoring professionals.

Other: None specified.

Implementation Mechanisms

Collect Data on State Building Energy Use: A key implementation mechanism for this option will be to first provide a thorough assessment of the status and energy consumption of all existing state buildings, including establishing a database of buildings and building attributes including floor area, insulation level, energy-using equipment, and history of energy consumption. This assessment would serve as the basis for evaluation of efficiency improvement opportunities in state buildings.

Benchmark State Buildings: Benchmarking is a process of using the data on building size, use, and energy use to quickly compare a building against others of similar size and use to get an idea of how efficiently the building is operating. It is an important step in identifying opportunities for savings and prioritizing work to be done.

Commission State Buildings: Building commissioning is a process of reviewing and tuning up the operation of building systems and controls much like the tune-up of a vehicle. Potential targets for commissioning might include commissioning of state buildings upon completion of construction or renovation and whenever the energy use in a building shows an unexpected and unexplained increase in energy use.

Purchase Green Power: Enter into agreements to purchase green power for a portion of the states electricity needs. Increase purchases over time until 25% of power needs are met through direct use of renewable energy or green power purchased by 2025.

Energy Use Targets: Set targets for energy use in the operation of state buildings, potentially including capping state building energy use per square foot. Motion sensors are a specific technology for reducing lighting energy use in government buildings that may have broad application in Montana.

Renovate State Buildings Through an Expanded State Buildings Energy Program: Renovate all state buildings with more than 10,000 square feet and smaller buildings identified through energy benchmark process as having a high potential for energy savings within 15 years. Expand the State Buildings Energy Program to provide funds for energy audits, engineering analyses, and renovation costs.

Increase the Efficiency of Operations Through Purchasing and End-of-Life Disposal or Recycling: Establish policies for purchasing only energy efficient products and services by specifying Energy Star–certified and other efficient equipment and appliances, stocking only energy efficient and environmentally preferable products in Central Stores, and planning for end-of-life disposal of equipment and other goods when initial purchase is made. Purchase items that can be recycled rather than thrown away.

Develop and Use Renewable Energy Resources: Evaluate the potential for direct use of solar, wind, biomass, geothermal, and hydro power to meet the needs of state government operations. Take advantage of these renewable resources whenever it is cost-effective to do so, and as a means to lead by example in investing in these systems when it is practical to do so.

Carbon-Neutral Bonding: Climate-neutral bonding will require that any building projects financed with the issuance of state, county, or local/municipal bonds result in no net increase in GHG emissions.

- If a new construction project is projected to result in an emissions increase, there must be GHG emissions offsets within the state or particular jurisdiction. Offsets could include on-site renewable energy development, renewable energy purchases, energy efficiency (in existing state buildings), carbon sequestration (tree planting), and switching to cleaner or renewable fuels. Any GHGs emitted after the bond-financed project becomes operational will have to be offset.
- The new buildings could also offset their emissions by purchasing renewable electricity from their local utility. Paying a premium for what’s known as “green pricing” electricity will usually be a more expensive offset option than energy efficiency.

- A community or state could install their own renewable energy project as a way to offset their GHG emissions.
- Monitor building emissions over time.

Related Policies/Programs in Place

The Montana State Buildings Energy Program: This program provides funding for energy conservation in state buildings as authorized by each Legislature.[27] Some monitoring of building energy use has been carried out under the program. The State Buildings Energy Conservation Bond program is designed to finance energy improvement projects on state-owned buildings. The MDEQ administers the program, which typically uses bond proceeds to fund the projects and energy savings to repay the bonds. The 2007 Legislature authorized $3 million in funding for this program. Previous legislatures had authorized general obligation bonds in amount up to $3.75 million per biennium. The state of Montana encourages agencies to participate in the program to achieve available energy savings and requires that all renovations to state buildings that are proposed through the Architecture and Engineering Division be evaluated for energy savings and possible funding through the State Buildings Energy Program (90-4-605 MCA).

Waste Reduction in State Government: MDEQ is responsible for assisting state agencies in developing waste reduction plans under the Integrated Solid Waste Management Act (75-10-111). The MDEQ and the Department of Administration have responsibility for a program to develop specifications for supplies that have recycled content (75-10-806 MCA).

Type(s) of GHG Reductions

As with RCII-1 and other energy efficiency and building improvement options, this option would principally yield reductions in GHG emissions (largely CO_2) from avoided electricity production and avoided on-site fuel combustion. Less significant are the reduction in CH_4 emissions from avoided fuel combustion and avoided pipeline leakage. Other GHG impacts are also conceivable, but are likely to be small (black carbon, N_2O) and/or very difficult to estimate (materials use, life cycle, market leakage).

Estimated GHG Reductions and Costs (or Cost Savings)

	Policy	Scenario/Element	Reductions		Cumulative Reductions 2007–2020 ($MMtCO_2e$)	NPV 2007–2020 ($ Millions)	Cost-Effective-ness ($/t$CO_2$)
			2010	2020			
RCII-12	State Lead by Example	Total for Policy	0.03	0.33	2.0	–$11	–$6
		Building Improvement	0.03	0.31	2.0	–$10	–$5
		Bulk Purchasing	0.00	0.01	0.1	–$1	–$22

[27] See, for example, *State Bonding Program Update*, available at http://leg.mt.gov/content/publications/fiscal/interim/financecmty_dec2001/state_bonding_program.pdf. As of May 2007, the Montana State Bonding Energy Conservation Program has been funded at $3 million for the 2008–2009 biennium.

Note: Some totals in the table above may differ from the sum of their component elements due to rounding.

Data Sources: Costs of energy efficiency improvements ($37/MWh electrical energy saved and $4.7/MMBtu gas saved) are based on studies of costs of building improvements and code changes (WGA CDEAC EE Report; see full reference and derivation of cost estimates in Annex 2). An incremental cost of $12/MWh saved is assumed for the bulk purchase component of this option, based on the costs of existing market transformation programs.

Quantification Methods: Estimate fractional savings in energy intensities needed, after code improvements, in new and existing government buildings. To do this, the per-unit-floor-area goals described above (energy use intensities) are adjusted to account for savings already provided through code improvements being phased in under RCII-4. Required reductions in energy use are then allocated among energy efficiency and renewable energy sources (including green power), and the portion of each component of building electricity and fossil energy use reduction is calculated.

Key Assumptions: Fractions of electric and gas intensity improvement accounted for by efficiency improvements, solar thermal, solar PV, green power purchase beyond RPS requirements, and/or increased biomass use; fractional savings targets over new code levels. Fractional savings (20%) and fraction of state electricity demand addressed (10%) by bulk purchase program.

Key Uncertainties

- Total government building space in Montana (regional estimates currently used).[28]
- Fraction of government agencies occupying leased space in Montana (assumed to be 20% of total government-owned space).[29]
- Rate of building renovations versus new construction in the government sector (presently estimated at 50%).[30]

[28] Montana state government, including the university system, is estimated to have 16,995,890 square feet of state-owned building space in buildings that are 1,500 sq ft or larger. It also leases 3,000,000 sq ft of space. (Data on square footage of buildings greater than 1,500 square feet are from Montana Department of Labor and Industry, Tort-Claims Division. Non-university leased area is 1.5 million square feet, based on data from the Department of Administration.) Data on non-state government floor space in Montana have not yet been identified; thus, estimates for total government-sector floor space in Montana are based on regional (Mountain states) estimates of government floor space normalized to Montana's population.

[29] By way of comparison, assuming that the Montana University system uses the same amount of leased space as non-university buildings, total leased space used by state government (including University) organizations is 17.6% of total owned space.

[30] It has been estimated that 15% of construction for state government is new construction, and 85% is renovation of existing buildings (source: 2008/2009 Montana Budget Book, Department of Administration Long-Range Building Plan), but it is unclear at this writing what fraction of the referenced renovation is likely to involve changes in building envelopes or energy systems, or whether this ratio is likely to hold for non-state government buildings. As these issues are clarified, a revision to the renovations-to-new-construction ratio used for analysis may be in order.

Additional Benefits and Costs

Benefits

Co-benefits could include transmission/distribution system costs reduction.

Costs

None cited.

Feasibility Issues

Costs for this option are uncertain, depending on the measures included.

Potential interaction with appliance standards and utility programs.

Status of Group Approval

Completed.

Level of Group Support

Unanimous consent.

Barriers to Consensus

None.

RCII-13. Metering Technologies With Opportunity for Load Management and Choice

Policy Description

Providing energy consumers with price and other information via metering that allows consumers to more clearly identify the outcomes of their choices is a potentially useful tool in improving energy efficiency, reducing GHG emissions, and saving consumers money in Montana. This policy encourages the implementation of electricity metering technologies and tariff systems, including real-time energy pricing and rates that reflect the cost and GHG implications of the resources that must be used to provide power. This provides consumers with incentives to manage their energy consumption to reduce both costs and GHG emissions.

Policy Design

Building on experience in Europe[31] and elsewhere, Montana utilities would implement a system of metering of electricity demand and consumption that a) allows a consumer to purchase electricity from specific types of generating resources and b) allows the distribution utility and electricity generators to provide information on the cost and source of the electricity that the consumer is using at any given time. This system allows for interaction on a time-sensitive basis between the consumer, the utility, and the generating source. Through utility reports, the state can review the choices made by the consumers and can target state incentives, rules, and tax structures to move electricity consumption and production toward choices that produce lower GHG emissions.

This option could accommodate different types of electricity tariff structures, including time of use rates (which typically have impacts on the overall cost of generation but modest if any impacts on GHG emissions) and increasing-cost block rate structures (in which tier rate structures charge more per unit used as consumers use more electricity per month), which can encourage electricity conservation. The metering system can also be used by the customer to place restrictions on the timing and amount of energy use, including restricting overall demand.

Goals: Develop and implement a pilot program of installation of smart meters at residential and some nonresidential customers' sites starting in 2009, with a target implementation of 45,000 residential meters by 2011. The pilot program would thus result in the installation of smart meters in less than 10% of homes in Montana. Following the pilot program, implement a program resulting in the installation of smart meters for an additional 30% of residences by 2020.

Timing: As above.

Parties Involved: Utilities, electricity generators, electricity consumers, state regulatory agencies.

Other: Under development.

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[31] For example, see the ENEL Contatore Elettronico program offered in Italy.

Implementation Mechanisms

Technical Committee: Set up a stakeholder technical committee to consider the option, and report back with technical recommendations, which could include a recommendation to move forward with pilot programs in applicable consumer classes.

Pilot Program: The steps in carrying out the smart metering pilot program noted above include the following:

- Design pilot program (stakeholder/utility representatives/consumers).
- Implement and evaluate pilot program.
- Publish results of pilot program with recommendations.
- Proceed with statewide implementation of meters if the pilot program is successful.

Continued Utility Investment: Encourage continued investment on the part of utilities, communities, and other parties to enhance the benefits of introduction of new metering technologies.

Related Policies/Programs in Place

NWE is considering running a time-of-use pilot program in Missoula. NWE and the Montana PSC are investigating the cost-effectiveness of the program and have not yet decided whether to implement it.

Type(s) of GHG Reductions

As with RCII-1 and other energy efficiency and conservation options, this option would principally yield reductions in GHG emissions (largely CO_2) from avoided electricity production and avoided on-site fuel combustion. Less significant are the reduction in CH_4 emissions from avoided fuel combustion and avoided pipeline leakage. Other GHG impacts are also conceivable, but are likely to be small (black carbon and N_2O) and/or very difficult to estimate (e.g., materials use, life cycle, or market leakage).

Estimated GHG Reductions and Costs (or Cost Savings)

	Policy	Scenario/Element	Reductions		Cumulative Reductions 2007–2020 ($MMtCO_2e$)	NPV 2007–2020 ($ Millions)	Cost-Effective-ness ($/t$CO_2$)
			2010	2020			
RCII-13	Metering Technologies with Opportunity for Load Management and Choice	Policy Total	0.02	0.12	0.9	–$11	–$12
		Pilot Program	0.02	0.03	0.4	–$5	–$13
		Full Program	0.00	0.09	0.5	–$6	–$11

Data Sources: Experience with smart meters in other jurisdictions.[32]

Quantification Methods: Based on goals above, phase in smart meter use in Montana, apply meter cost and savings estimates below, and estimate GHG benefits and electricity avoided costs.

Key Assumptions:

- Average incremental installed cost per meter: $200.
- Average electricity use reduction per meter: 8%.

Key Uncertainties

None cited.

Additional Benefits and Costs

Benefits

None cited.

Costs

To the extent that low-income households may be covered by new metering and rate policies, low-income residents may be adversely affected, as they often live in substandard rental housing that uses a significant amount of energy, but they lack both the ability and the incentives to upgrade appliances, heating equipment, or the building envelope.

Feasibility Issues

None cited.

Status of Group Approval

Completed.

Level of Group Support

Unanimous consent.

Barriers to Consensus

None.

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[32] For example, *Smart Meters: Commercial, Policy and Regulatory Drivers*, by Gill Owen and Judith Ward, describes experience with smart meters in the UK and reports one to several percent net savings in electricity consumption from implementation of smart meters, as well as peak reduction impacts. Dated March 2006, published by Sustainability First, available at http://www.sustainabilityfirst.org.uk/docs/smart%20meters%20pdf%20version.pdf .

Annex 1 to Policy Options Descriptions: Survey of Carbon Tax Programs

Carbon Tax Programs in Other Cities, Countries, and Provinces

Jurisdiction	Status: Start Date	Tax Rate–Applicability	Where Tax Applied	Use of Revenue
Finland[1]	1990 Revised 1997 Revised 2002	1990 \$1.54/ton 1993 \$3.00/ton 1997–1998 Electricity: \$0.007/kWh Heating: \$22.53/ton CO_2 Natural gas: \$11.26/ton CO_2	1990 Fuels 1997 Electricity consumption not fuels reduced for industry Exemption for international aviation, shipping, and refineries	Reimbursement via lower payroll taxes
Norway[2]	1991 Revised 1999	Petrol: \$55.90/ton CO_2 Mineral oil: \$30.16/ton CO_2 Oil and gas in North Sea: \$52.05/ton CO_2	Producers and importers of oil products Exemption for foreign shipping, fishing, external aviation	Reduce other taxes
Sweden[3]	1991 Revised 2004	CO_2: \$100/ton 2004 increases: Gasoline: \$0.02/L Diesel: \$0.04/L Vehicle Tax Electricity: \$0.002/kWh (excludes industry)	Oil, coal, natural gas, liquefied petroleum gas, petrol, and domestic aviation fuel Reduced industrial rate Exemption for high-energy industries, i.e., horticulture, mining, manufacturing, and pulp/paper industry	Offset by income tax relief Estimated revenue \$523 million
Denmark[4]	1992 Revised 1999	Commercial: \$14.30/ton CO_2 Households: \$7.15/ton CO_2	Buildings	Reallocated as subsidies for energy efficiency activities and voluntary agreements

Jurisdiction	Status: Start Date	Tax Rate–Applicability	Where Tax Applied	Use of Revenue
Germany[5]	1999 Revised 2000	1999 Gasoline: $0.04/L Heating fuel: $0.03/L Natural gas: $0.02/kWh Electricity: $0.01/kWh 2000–2003 annual increases Gasoline: $0.04 per L Electricity: $0.003 per kWh	Electricity, heating fuel, natural gas, gasoline	Tax breaks for commuters Reduce labor costs via pension contributions
Japan[6]	2001	Green taxation Subsidies for high efficiency automobiles	Vehicles	
UK	2001–	Electricity: $0.0084 per kWh Coal and natural gas: $0.0029 per kWh Levy will rise with inflation annually beginning in 2007	Electricity generation includes nuclear Renewable exempt	Reduced national insurance rate Fund for energy efficiency initiatives
Netherlands	2005	Fossil electricity: $0.08 per kWh for small consumers Renewable exemption: $0.04 per kWh Rates indexed to inflation	Electricity and fuel consumption Renewable sources with green certificate exempt	Reduced income and corporate tax rates
City of Boulder, CO	Approved 2006 Start 2007 Expiration 2013	Electricity: (kWh) $0.0022 for residential $0.0004 for commercial $0.0002 for industrial use Max increases: $0.0049 for residential $0.0009 for commercial $0.0003 for industrial use	Electricity use	Funding for city's Climate Action Plan Programs to increase energy efficiency, renewable energy use, reduce motor vehicle emissions, and take further steps to meeting Kyoto protocol targets
Australia: State of West Australia[7]	Under current consideration	$19.58/ton CO_2		
Canada: Province of Quebec[8]	2006	To be determined by Quebec Energy Board $1 Billion estimated 6-year revenue	Non-renewable fossil fuels sold in bulk to retailers	Green Fund Public transportation, energy efficiency for buildings

[1] http://www.norden.org/pub/ebook/2001-566.pdf;

[2] http://ideas.repec.org/p/ssb/dispap/337.html

[3] http://pubs.acs.org/hotartcl/est/98/dec/hanish.html

[4] http://www.iea.org/Textbase/pm/?mode=cc&id=156&action=detail

[5] http://www.iea.org/textbase/publications/free_new_Desc.asp?PUBS_ID=1097

[6] http://www.iea.org/textbase/nppdf/free/2000/japan2003.pdf

[7] http://www.news.com.au/story/0,23599,21171914-2,00.html

[8] http://www.cbc.ca/news/background/kyoto/carbon-tax.html

Annex 2 to Policy Options Descriptions: Printouts of Selected Portions of Worksheets Used To Prepare Estimates of Costs and Benefits of Residential, Commercial, Institutional, and Industrial Mitigation Options

Printouts below reflect status of analyses of options as of June 26, 2007.

Estimate of Mitigation Option Costs and Benefits for Montans RCII GHG Analysis

GHG Emissions Totals for Montana RCII GHG Analysis

Date Last Modified:	6/26/2007	C. Lee/D. Von Hippel

Summary Results and Totals for RCII Mitigation Options

	Option Name	GHG Reductions ($MMtCO_2e$) 2010	2020	Cost-Eff ($\$/tCO_2e$)	NPV 2007-2020 ($million)	Cumulative Emissions Reductions (MMt CO_2e, 2007-2020)
RCII-1	Expand Energy Efficiency Funds	0.04	1.15	-$21	-$141	6.6
RCII-2	Market Transformation and Technology Development Programs	0.03	0.30	-$23	-$43	1.9
RCII-3	State Level Appliance Efficiency Standards and State Support for Improved Federal Standards	0.05	0.20	-$32	-$48	1.5
RCII-4	Building Energy Codes	0.03	0.25	-$10	-$15	1.6
RCII-5	"Beyond Code" Building Design Incentives and Mandatory Programs	0.07	0.52	-$5	-$17	3.4
RCII-6	Consumer Education Programs	Not Quantified				
RCII-7	Support for Implementation of Clean Combined Heat and Power	0.0	0.0			0.0
RCII-8	Support for Renewable Energy Applications	0.0	0.0			0.0
RCII-9	Carbon Tax	Not Quantified				
RCII-10	Industrial Energy Audits and Recommended Measure Implementation	0.07	0.56	-$26	-$93	3.6
RCII-11	Low income energy efficiency programs	0.05	0.75	-$9	-$41	4.7
RCII-12	State Lead by Example	0.03	0.33	-$6	-$11	2.0
RCII-13	Metering technologies with opportunity for load management and choice	0.03	0.12	-$12	-$11	0.9
	Total Gross Savings	0.41	4.18	-$16	-$421	26.2

Adjustment for Estimated Overlap Between RCI Options					
Overlap between RCI Options					
RCII-2, Overlap with RCII-1	0.02	0.20		-$29	1.2
RCII-3, Overlap with RCII-1 and RCII-2	0.00	0.00		$0	0.0
RCI-4, Overlap with RCII-1 through RCII-3	0.00	0.00		$0	0.0
RCI-5 Overlap with RCII-1 through RCII-4	0.03	0.23		-$12	1.5
RCII-7, Overlap with Other Quantified Policies	See Energy Supply Results				
RCII-8, Overlap with Other Quantified Policies	See Energy Supply Results				
RCII-9, Overlap with Other Quantified Policies	Not Quantified				
RCII-10 Overlap with Other Quantified Policies	0.04	0.28		-$47	1.8
RCII-11 Overlap with Other Quantified Policies	0.03	0.45		-$25	2.8
RCII-12 Overlap with Other Quantified Policies	0.00	0.03		-$1	0.2
RCII-13 Overlap with Other Quantified Policies	0.01	0.04		-$4	0.3
Total Estimated Overlap Among RCII Policies	0.13	1.23		-$117	7.8
Total Savings Net of Overlaps	0.28	2.95	-$17	-$304	18.4

Additional Emissions Savings from Recent Actions (not included in forecast or in policy options above)

	Option Name	GHG Reductions ($MMtCO_2e$) 2010	2020		Cumulative Emissions Reductions (MMt CO_2e, 2007-2020)
RCII-1	Expand Energy Efficiency Funds	0.30	0.79		6.5
RCII-11	Low income energy efficiency programs	0.02	0.05		0.4
	Total	0.32	0.83		7.0

Total Emissions Reductions Net of Overlaps (including recent actions)	0.59	3.79		25.3

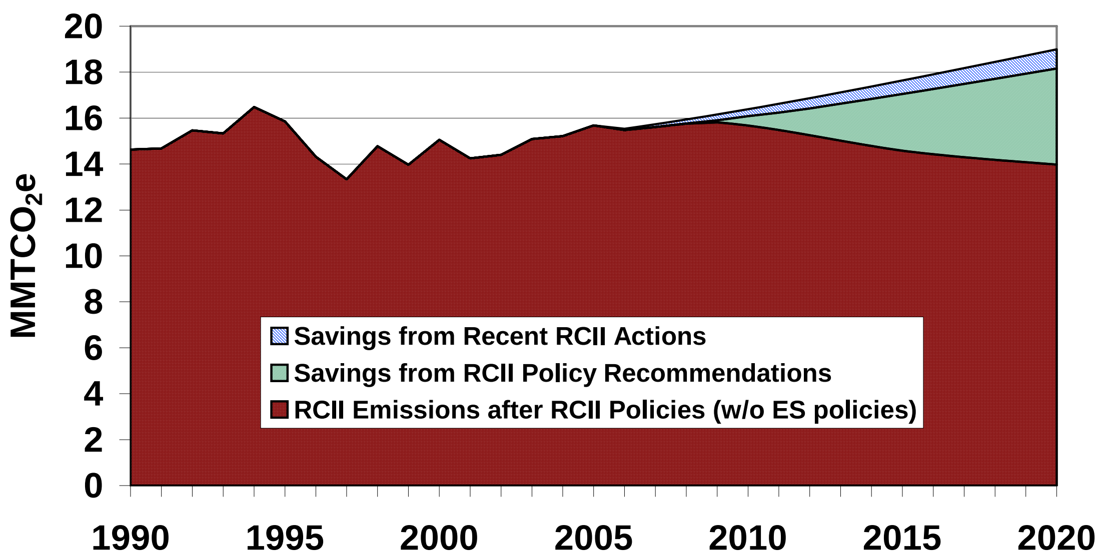
Note: Some totals in the tables above may differ from the sum of their component elements due to rounding.

TABLE BELOW SHOWS NET ADJUSTED SAVINGS BY OPTION

Summary Results and Totals for RCII Mitigation Options

	Option Name	GHG Reductions 2010	GHG Reductions 2020	Cost-Eff ($/t$CO_2$e)	NPV 2006-2020 ($million)	Cumulative Emissions Reductions (MMt CO_2e, 2006-2020)
RCII-1	Expand Energy Efficiency Funds	0.04	1.15	-$21	-$141	6.6
RCII-2	Market Transformation and Technology Development Programs	0.01	0.10	-$23	-$15	0.6
RCII-3	State Level Appliance Efficiency Standards and State Support for Improved Federal Standards	0.05	0.20	-$32	-$48	1.5
RCII-4	Building Energy Codes	0.03	0.25	-$10	-$15	1.6
RCII-5	"Beyond Code" Building Design Incentives and Mandatory Programs	0.04	0.29	-$3	-$5	1.9
RCII-6	Consumer Education Programs	Not Quantified				
RCII-7	Support for Implementation of Clean Combined Heat and Power	See Energy Supply Results				
RCII-8	Support for Renewable Energy Applications	See Energy Supply Results				
RCII-9	Carbon Tax	Not Quantified				
RCII-10	Industrial Energy Audits and Recommended Measure Implementation	0.04	0.28	-$26	-$47	1.8
RCII-11	Low income energy efficiency programs	0.0	0.3	-$9	-$16	1.9
RCII-12	State Lead by Example	0.0	0.3	-$5	-$10	1.9
RCII-13	Metering technologies with opportunity for load management and choice	0.0	0.1	-$12	-$7	0.6
	Total Savings	0.28	2.95	-$17	-$304	18.4

Note: Some totals in the table above may differ from the sum of their component elements due to rounding.



NOTES ON ESTIMATES OF OVERLAP BETWEEN POLICIES

Note 1:

The overlap between RCII-2 and RCII-1 is assumed to be approximately 66%
as RCII-1, which includes all cost-effective DSM potential, would be expected to cover many of the same measures as the market transformation programs in RCII-2.

Note 2:

RCII-3 and RCII-4 have no overlap with RCI-1 and RCII-2, since savings from appliance/equipment efficiency and buildings in RCII-1 and -2 would be over and above standards and codes.

Note 3:

RCII-5, "Beyond Code" building improvements, will not (by definition) overlap with RCII-3 or RCII-4, but will likely overlap with RCII-2 and especially RCII-1, which may be the source of incentives for many building improvements. The overlap between these options is assumed to be 50%
RCII-5 gross savings (and costs) except for the "green power" and customer-sited renewable energy components of RCII-5, which do not overlap with other options.

Note 4:

RCII-10, "Industrial Energy Audits", will likely overlap with RCII-1, which would be expected to provide some of the incentives for implementation of audit recommendations, and possibly (depending on design) overlap more modestly with RCII-2 through RCII-5. The overlap between RCII-10 and other options is assumed to be 50%
of RCII-10 gross savings (and costs).

Note 5:

RCII-11, "Low Income and Rental Unitl Energy Efficiency", will likely overlap with RCII-1, which would be expected to provide some of the incentives for implementation of weatherization and other measures, but not all, as RCII-11 includes measures beyond what are currently "cost-effective" (relative to electric avoided costs). There will also likely be some overlap between RCII-5 and RCII-11, though the two options may use different implementation mechanisms. The overlap between RCII-11 and other options is assumed to be 60% of RCII-11 gross savings (and costs).

Note 6:

For State Lead by Example, an overlap between RCI-12 and other options of 10% assumes relatively few government-sector improvements are subsidized by utility programs or energy efficiency funds. Overlap does not apply to the "green power" or renewable energy components of RCII-12.

Note 7:

For metering technologies, assume that 33% of reduction in consumption credited to the adoption of these technologies comes about as consumers are spurred to take advantage of incentives available thorugh RCII-1 and other options, with the remainder of the reductions coming about through changes in behavior and other modifications not related to other RCII options.

Estimate of Mitigation Option Costs and Benefits for Montana RCII GHG Analysis

Common Assumptions for Montana RCII GHG Analysis

Date Last Modified: 4/25/2007 C.Lee/D. Von Hippel

Common Assumptions

Real Discount Rate	**5%**	
Levelized, Avoided Costs (2006-2020, 2005$)		
Electricity - Sales-Weighted Average	**$ 49.13**	$/MWh

Estimate derived from contract data underlying the "the long-term, standard QF [Qualifying Facilities] tariff", "Option 1" ($49.90 per MWh, nominal cost average of quarterly contract costs from 2007 through 2014) as set by the Montana Public Services Commission, in an order covering DOCKET NO. D2003.7.86, ORDER NO. 6501f 2, DOCKET NO. D2004.6.96, ORDER NO. 6501f, and DOCKET NO. D2005.6.103, ORDER NO. 6501f, dated December 19, 2006. The $49.90 cost indicated is shown in paragraph 184 of the PSC document. Cost shown here extends the stream of nominal costs in the original NWE/PPL document by including values for 2015 to 2020 that increment the 2014 average value at the rate of inflation, levelizes the resulting 2007 to 2020 stream, and adjusts the levelized value to 2005 dollars. See "AvCost" worksheet in this workbook.

Electricity - Residential	**$49**	$/MWh
Electricity - Commercial	**$49**	$/MWh
Electricity - Industrial	**$49**	$/MWh

Levelized Costs not differentiated by sector for this analysis.

Natural Gas	**$6.5**	$/MMBtu

Note: In the absence (as of 3/26/07) of MT-specific avoided gas costs, we derive a placeholder estimate for MT avoided gas costs by starting with average 2005 NC citygate gas costs and escalating costs based on escalation in weighted-average regional AES2006 estimates for gas cost by sector. These values should be replaced by MT-specific costs when and if available.

Prices

Electricity Price - Sales-Weighted, Levelized	**$66**	$/MWh

Prices are based on DOE data for prices in 2005 http://www.eia.doe.gov/cneaf/electricity/esr/esr_sum.html. Changes from 2006 to 2020 are based on the relative changes in projected SERC reliability Corporation region prices in US DOE Annual Energy Outlook 2006 (same % changes). AEO 2006 projects prices to declining to below 2005 levels from 2008 onward.

Electricity - Residential Prices (Levelized, 2006-2020)	**$81**	$/MWh
Electricity - Commercial Prices (Levelized, 2006-2020)	**$69**	$/MWh
Electricity - Industrial Prices (Levelized, 2006-2020)	**$50**	$/MWh
Natural Gas (Delivered, RCII sales-weighted average)	**$9.5**	$/MMBtu
Natural gas prices are estimated as described for electricity above.		
Natural Gas - Residential Prices (Levelized, 2006-2020)	**$9.7**	$/MMBtu
Natural Gas - Commercial Prices (Levelized, 2006-2020)	**$9.2**	$/MMBtu
Natural Gas - IndustrialPrices (Levelized, 2006-2020)	**$7.5**	$/MMBtu
Biomass - All Users	**$3.2**	$/MMBtu

Estimate based on 1999 national study of state-by-state biomass resource resource assessments--see worksheet "Biomass_Data" in this workbook. Price equivalent of $51/dry ton at 16 MMBtu/dry ton. Replace with more MT-specific estimates (for example, from AF group when available).

Coal - Industrial Users	**$0.7**	$/MMBtu

average coal heat content of 26.75 MMBTU/ton, based on 2001 USDOE/EIA data. USDOE/EIA figures for 2005 "other industrial users" are withheld for MT. The MT average coal price of $11.63 per ton is given for "Electric Utility Plants". Based on a ratio of 1.55 ($25.89/$16.71) for the "Other Industrial Users" to "Electric Utility Plants" for the state of Wyoming. The MT "Other Industrial Users" coal price is estimated at $18.02. www.eia.doe.gov/cneaf/coal/page/acr/table34.html

Oil - Distillate/Diesel	**$12.5**	$/MMBtu

USDOE/EIA data are not available for MT or PADD IV. US average priced for heating oil of $gives NC average prices for heating oil of $2.34 per gallon in 2005/06 heating season. This cost does not include fuel taxes. An appendix to the 2006 Annual Energy Outlook by USDOE/EIA (see http://www.eia.doe.gov/oiaf/aeo/pdf/appendixes.pdf) lists an energy content for distillate oil of 5.799 MMBtu/bbl, or 0.138 MMBtu/gallon.

LPG	**$11.0**	$/MMBtu

USDOE/EIA data are not available for MT. The US average average prices given for propane are $1.01 per gallon in 2005/06 heating season. This cost does not include fuel taxes. Prices expressed on $/MMBtu basis a conversion factor of 0.09133 MMBtu/gallon (see "Fuel Data" woksheet)

Landfill Gas - All Users	**$5.0**	$/MMBtu
Placeholder Estimate		
Biogas Gas - All Users	**$5.0**	$/MMBtu
Placeholder Estimate		

Emission Rates, etc.	2010	2020	Units
Electricity T&D losses (fraction of total generation)	7.4%	7.0%	

Estimated based on US DOE Annual Energy Outlook figures for 2005 - 2025 for "total sales" and "total net energy for load" as reported in "Table 72. Electric Power Projections for EMM Region, Western Electricity Coordinating Council / Northwest Power Pool Area - 11", from http://www.eia.doe.gov/oiaf/aeo/supplement/sup_elec.xls.

	2010	2020	Units
Avoided electricity emissions rate	1.020	0.838	tCO_2/MWh

Assumes that reductions in electricity generation requirements through 2010 will come from the average emissions rate of then-existing fossil-fueled sources; by 2020 the predominant effect is assumed to be a reduction in reference case new more efficient coal builds during the 2010-2020 period.

Notes	2010	2020	Units

Multi-Gas Emission Factors

Except as noted, the following emission factors are calculated from values in the Montana Inventory and Forecast prepared for the CCAC, and reflect the average emissions over 2000 to 2020 per BTU and physical amount of fuel. They include combustion CH4 and N20 as well as CO2 emissions for consistency with the inventory.

	tCO_2e/billion BTU	
LPG - RCII	63.294	
Coal - RCII	93.714	
Natural Gas - RCII	52.921	
Biomass - RCII	2.500	
Oil - RCII	74.342	*Placeholder--assumed equal to CO_2 factor for misc pet prods from North Carolina (but used little in MT analysis)*
Landfill Gas - RCI	0.260	*Placeholder Value, from Steve Roe. Does not count benefit of capture of landfill gas.*
Biogas - RCII	5.000	*Placeholder Value-- May in fact be negative*

GDP Deflators (to 2005$)

Cost Year	Index
1997	1.18
1998	1.16
1999	1.15
2000	1.12
2001	1.09
2002	1.08
2003	1.05
2004	1.03
2005	1.00
2006	0.97
Implied annual average inflation, 1997 to 2006	2.1%

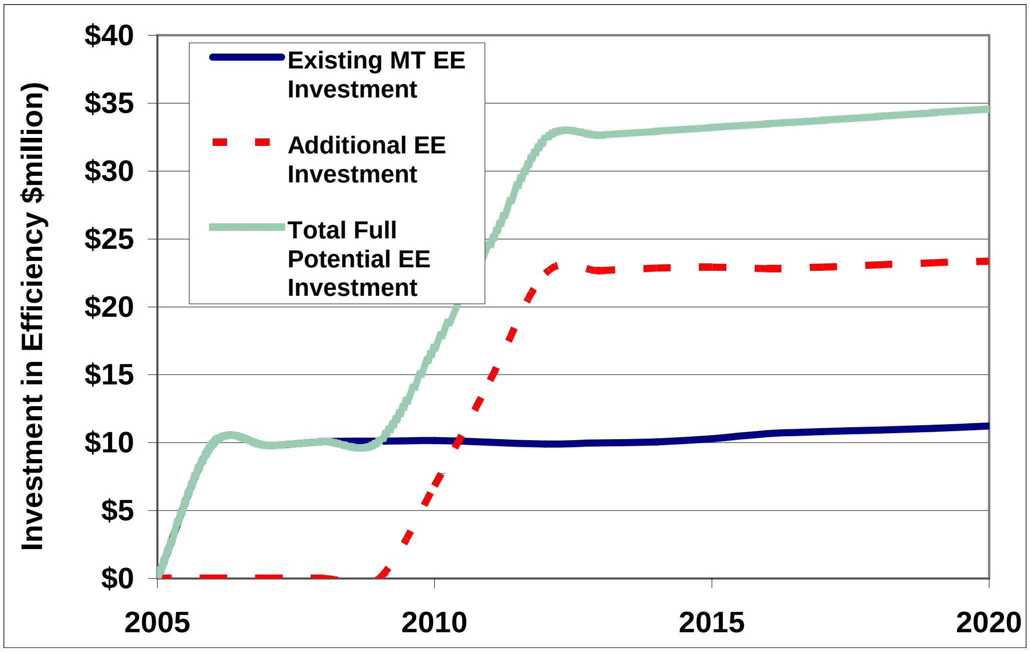
GDP Deflators indexed to 2000 dollars from
http://www.bea.gov/bea/dn/nipaweb/TableView.asp#Mid

2004	109.426
2005	112.737
2006	116.043

Natural Gas Conversion	1.03	million Btu/ thousand cf
Electricity Conversion	3413	MMBTU/ GWh

Other Data, Assumptions, Calculations		2010	2020/all	Units
Analysis				
RCII Electricity Sales	*(from inventory)*	14,283	15,684	GWh
Residential		4,245	4,329	GWh
Commercial		4,889	5,469	GWh
Industrial		5,150	5,885	GWh
Conversion Factor:GWh/Billion Btu			0.29306	
RCII Electricity Prices (statewide averages, real 2005 dollars)				
Residential		$78	$81	$/MWh
Commercial		$66	$70	$/MWh
Industrial		$49	$51	$/MWh
2005 electricity prices are from EIA (see "Retail_Prices_Elec" worksheet in this workbook). http://tonto.eia.doe.gov/dnav/ng/ Changes in sectoral electricity prices indexed to DOE EIA Annual Energy Outlook 2006 national forecast.				
Total Implied Electricity Revenues (RCII, statewide)		$906	$1,029	$million
Residential		$331	$350	$million
Commercial		$323	$380	$million
Industrial		$252	$299	$million
RCII Gas Sales	*(from inventory)*	60,107	63,216	Billion Btu
Residential		21,876	24,123	Billion Btu
Commercial		14,255	17,694	Billion Btu
Industrial		23,976	21,398	Billion Btu
Conversion Factor: Million Btu per Thousand Cubic feet			1.03	MMBtu/Mcf
RCII Gas Prices (statewide averages, real 2005 dollars)				
Residential		$9.12	$8.86	$/MMBtu
Commercial		$8.68	$8.08	$/MMBtu
Industrial		$7.01	$6.46	$/MMBtu
2005 gas prices are from EIA (see "NGPrices current" worksheet in this workbook). http://tonto.eia.doe.gov/dnav/ng/xls/ng_sum_lsum_dcu_SNC_a.xls. Changes in sectoral gas prices indexed to future gas prices from DOE EIA Annual Energy Outlook 2006 national forecast.				
Total Implied Gas Revenues (RCII, statewide)		$491	$495	$million
Residential		$199	$214	$million
Commercial		$124	$143	$million
Industrial		$168	$138	$million
Energy Efficiency Investment				
Recent Actions				
Fraction of Electricity Revenues Invested		0.8428%	0.8428%	
Efficiency Spending for Recent Actions (Electricity)		$7.6	$8.7	$million
Cumulative reduction in sales from existing investment		1.541%	4.463%	(Electric)
Fraction of Gas Revenues Invested		0.5132%	0.5132%	
Efficiency Spending for Recent Actions (Gas)		$2.5	$2.5	$million
Cumulative reduction in sales from existing investment		1.663%	4.536%	(Gas)
Full Potential Efficiency investment				
Target New Electricity Savings per Year		30.35	104.78	GWh
Fraction of Electricity Revenues Invested		0.6%	1.7%	
Implied Electricity Energy Efficiency investment per Year		$5.1	$17.5	$million
Target New Gas Savings per Year		131.76	442.06	Billion Btu
Fraction of Gas Revenues Invested		0.4%	1.2%	
Efficiency investment, New/Expanded (Gas)		$1.8	$5.9	$million

Additional Results	2010	2020	Units
Current/expected Energy Efficiency Investments			
Reduction in Electricity Use	220	700	GWh
as % of overall projected sales in that year	1.541%	4.463%	
Reduction in Generation Requirements	238	756	GWh
GHG Emission Savings from Electricity Use Reduction	**0.24**	**0.63**	$MMtCO_2e$
Reduction in Gas Use	999	2,868	Billion Btu
as % of overall projected sales in that year	1.663%	4.536%	
Reduction in Gas Consumption	999	2,868	Billion Btu
GHG Emission Savings from Gas Use Reduction	**0.05**	**0.15**	$MMtCO_2e$
Cumulative Emissions Reductions, Electricity (2007-2020)		**5.3**	
Cumulative Emissions Reductions, Gas (2007-2020)		**1.2**	
Cumulative Emissions Reductions, Electricity plus Gas (2007-2020)		**6.5**	
Full Cost-effective Potential Energy Efficiency Investments			
Reduction in Electricity Use from New/Expanded Investments	30	1,021	GWh
as % of overall projected sales	0.2%	6.5%	(Electric)
Incremental Reduction in Generation Requirements	33	1,102	GWh
GHG Emission Savings	**0.03**	**0.92**	$MMtCO_2e$
Reduction in Gas Use	132	4,315	Billion Btu
as % of overall projected sales in that year	0.2%	6.8%	
Reduction in Gas Consumption	132	4,315	Billion Btu
GHG Emission Savings from Gas Use Reduction	**0.01**	**0.23**	$MMtCO_2e$
Economic Analysis - New/Expanded Energy Efficiency Invesments			
Net Present Value, Electricity Savings (2007-2020)		**-$79**	$million
Cumulative Emissions Reductions, Electricity (2007-2020)		**5.4**	$MMtCO_2e$
Cost-Effectiveness, Electricity		**-$15**	$/tCO_2e$
Net Present Value, Gas Savings (2007-2020)		**-$61**	$million
Cumulative Emissions Reductions, Gas (2007-2020)		**1.2**	$MMtCO_2e$
Cost-Effectiveness, Gas		**-$49**	$/tCO_2e$
Incremental GHG Emission Savings, Electricity and Gas	**0.04**	**1.15**	$MMtCO_2e$
Net Present Value, Electricity Savings (2007-2020)		**-$141**	$million
Cumulative Emissions Reductions, Electricity plus Gas (2007-2020)		**6.6**	$MMtCO_2e$
Cost-Effectiveness, Electricity plus Gas		**-$21**	$/tCO_2e$



NOTES AND DATA FROM SOURCES

Note 1:

The Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors Association,
The Potential for More Efficient Electricity Use in the Western United States, January, 2006. This report is referred to here as the "WGA CDEAC EE report" and can be found at: http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf.

Estimate of Mitigation Option Costs and Benefits for Montana RCII GHG Analysis

RCII-2 Market Transformation and Technology Development Programs

Date Last Modified:	3/26/2007	D. Von Hippel/A Bailie/C. Lee

Key Data and Assumptions	2010	2020/all	Units
First Year Results Accrue		**2010**	
Savings from Alliance Programs			
Reduction in overall electricity use		**0.2%**	per year
Based on WGA (2005) - The Potential for More Efficient Electricity Use in the Western United States, Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors' Association. This study estimates that market transformation programs could achieve reductions in electricity consumption of about 0.2% per year, based on programs and experience similar to those of the Northwest Energy Efficiency Alliance. See NEEA 2004 Annual Report. www.nwalliance.org/resources/documents/A_2004AR.pdf. These savings are in addition to those achieved through building energy codes and utility DSM programs (no double counting). For Montana, a key implementation strategy could be support for and expansion of programs similar to NEEA's into areas of MT not now covered by those programs.			
Assumed Cost of Market Transformation Program Savings		**$12**	$/MWh
From WGA EE Task Force study (2005), which cites the Retrospective Analysis of the Northwest Energy Efficiency Alliance (Violette, Ozog, and Cooney, 2003).			
Avoided Electricity Cost		**$49**	$/MWh
See common assumptions.			

Other Data, Assumptions, Calculations	2010	2020/all	Units
Total Statewide Electricity Sales	**14,283**	**15,684**	**GWh**

Results	2010	2020	Units
Total Net GHG Emission Savings	**0.03**	**0.30**	$MMtCO_2e$
Net Present Value (2007-2020)		**-$43**	$million
Cumulative Emissions Reductions (2007-2020)		1.9	$MMtCO_2e$
Cost-Effectiveness		**-$23**	$\$/tCO_2e$
TOTAL Reduction in Electricity Sales	29	329	GWh (sales)
as share of projected sales	0.2%	2.1%	
Reduction in Generation Requirements	31	354	GWh (generation)

Estimate of Mitigation Option Costs and Benefits for Montana RCII GHG Analysis

RCII-3 **State Level Appliance Efficiency Standards and State Support for Improved Federal Standards**

Date Last Modified:	*3/26/2007*	*D. Von Hippel/A Bailie/C. Lee*

Key Data and Assumptions	2010	2020/all	Units
First Year Results Accrue		**2010**	
Projected Electricity Savings from 15 Proposed Standards (in 2020)		**184**	GWh
Projected Natural Gas Savings from 15 Proposed Standards (in 2020)		**553**	million ft^3
Projected NPV Savings (to 2030, $2005)		**$185**	million

The above findings are drawn from ASAP and ACEEE, 2006. "Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards", http://www.standardsasap.org/stateops.htm and http://www.standardsasap.org/a062_mt.pdf. The NPV results were derived using a 5% discount rate, and electricity prices of 8.7c/kWh ($13.6/thousand cubic ft gas) residential and 6.9c/kWh ($11.7/thousand cubic ft gas) commercial. The resulting NPV savings are thus slightly higher than would be obtained using our avoided delivered electricity and gas cost estimates.

Adjustment factor for NPV timespan		**0.527**	

This is the ratio of NPV values from 2007-2020 vs. 2005-2030 for a constant net benefit starting in 2012.

Adjustment factor for different electricity and gas avoided costs		**0.563**	

Simple adjustment assumes the benefits are largely on the electricity side, and equals the ratio of incremental cost savings per MWh using the following values (appliance standards cost from WGA 2005; ASAP/ACEEE assumes average of res and comm):

Average cost of efficiency improvements via standards		**$12**	$/MWh
Average cost of electricity in ASAP/ACEEE study		**$78**	$/MWh
Avoided cost of electricity used here (res/comm avg)		**$49**	$/MWh

Other Data, Assumptions, Calculations	2010	2020/all	Units
National Savings	14	52	TWh

ASAP/ACEEE, 2006. Assume here same ratio of 2010 to 2020 savings in MT for electricity. All gas-saving standards come into force in 2012, so no 2010 gas savings

Results	2010	2020	Units
Electricity			
Reduction in Electricity Sales	50	184	GWh (sales
Reduction in Generation Requirements	54	198	GWh (gene
GHG Emission Savings	**0.05**	**0.17**	$MMtCO_2e$
Cumulative Emissions Reductions (2007-2020)		1.3	$MMtCO_2e$
Natural Gas			
Reduction in Gas Use	0	570	Billion BTU
GHG Emission Savings	**0.00**	**0.03**	$MMtCO_2e$
Cumulative Emissions Reductions (2007-2020)		0.20	$MMtCO_2e$
Total for Policy (Natural gas and electricity)			
GHG Emission Savings	**0.05**	**0.20**	$MMtCO_2e$
Net Present Value (2007-2020)		**-$55**	$million
Cumulative Emissions Reductions (2007-2020)		1.5	$MMtCO_2e$
Cost-Effectiveness		**-$36**	$/tCO_2e$

Estimate of Mitigation Option Costs and Benefits for Montana RCII GHG Analysis

RCII-4 **Building Energy Codes**

Date Last Modified: *5/1/2007 D. Von Hippel/A Bailie*

Key Data and Assumptions	2010	2020/all	Units
First Year Results Accrue		**2008**	
Electricity	**2010**	**2020/all**	**Units**
Levelized Cost of Electricity Savings		**$37.2**	$/MWh
Based on 7 year payback as estimated in WGA CDEAC EE Report. (See Note 1, below.)			
Levelized Cost of Natural Gas Savings		**$4.7**	$/MMBtu
Based on 7 year payback as estimated in WGA CDEAC EE Report. (See Note 1, below.)			
Avoided Electricity Cost		**$49**	$/MWh
Weighted average over total 2007-2020 electricity savings for this policy in each sector. See common assumptions ("Common Factors" worksheet in this workbook).			
Avoided Natural Gas Cost		**$6.5**	$/MMBtu
See common assumptions ("Common Factors" worksheet in this workbook)			

Other Data, Assumptions, Calculations	2010	2020/all	Units
Adjustment for Inclusion of Rennovated Residential Space as Well as New Under New Code Requirements. *(Currently set at 1.0 so that no rennovated residential space is included--need to ask an MT building professional for an opinion on this value.)*		**1.00**	
Adjustment for Inclusion of Rennovated Commercial Space as Well as New Under New Code Requirements. *(Currently set at 1.5 so that about 1 unit of renovated space is included per unit of new space (initial assumption--see **Note 4**). It may be useful to get further information regarding this value.*		**1.50**	
Adjustment for Inclusion of New Industrial Space in Estimated Savings due to New Code Requirements (applied to total residential plus commercial savings) (See ***Note 3***)		**110.0%**	
Ratio of Electricity Savings to Gas Savings: Residential Sector	199	199	GWh/TBtu
Ratio of Electricity Savings to Gas Savings: Commercial Sector	316	316	GWh/TBtu
Estimated based on relative MT usage of electricity and gas by sector in 2004. Alternative factors could be derived from other sources to account for differeMTes in expected levels of electricity and natural gas savings.			

Results	2010	2020	Units
Electricity			
Recent Actions not included in forecast -- assume all recent savings are included in forecast			
Reduction in Electricity Sales: Residential	0	0	GWh (sales)
Red		0	GWh (sales)
Red		0	GWh (sales)
TOT		0	GWh (sales)
Reduction in Generation Requirements	0	0	GWh (generation)
GHG Emission Savings	**0.00**	**0.00**	$MMtCO_2e$

These rows are not used currently but are retained in case there is need to estimate savings from current activities

	2010	2020	Units
Savings due to Additional Effort in RCII-4			
Reduction in Electricity Sales: Residential	10	101	GWh (sales)
Reduction in Electricity Sales: Commercial	11	104	GWh (sales)
Reduction in Electricity Sales: Industrial	2	20	GWh (sales)
TOTAL Reduction in Electricity Sales	23	225	GWh (sales)
Reduction in Generation Requirements	25	242	GWh (generation)
GHG Emission Savings	**0.03**	**0.20**	$MMtCO_2e$

Economic Analysis (for Electricity Savings due to Additional Effort in RCII-4)		
Net Present Value (2007-2020)	**-$9.6**	$million
Cumulative Emissions Reductions (2007-2020)	1.3	$MMtCO_2e$
Cost-Effectiveness	**-$7.44**	$/tCO_2e$

Natural Gas

Recent Actions not included in forecast

These rows are not used currently but are retained in case there is need to estimate savings from current activities

Reduction in Gas Sales: Residential	0	0	Billion BTU
Reducti		0	Billion BTU
Reducti		0	Billion BTU
Reducti		0	Billion BTU
GHG Emission Savings	0	0.00	$MMtCO_2e$

Savings due to Additional Effort in RCII-4

Reduction in Gas Sales: Residential	50	509	Billion BTU
Reduction in Gas Sales: Commercial	36	328	Billion BTU
Reduction in Gas Sales: Industrial	7	65	Billion BTU
Reduction in Gas Use	92	902	Billion BTU
GHG Emission Savings	0.00	0.05	$MMtCO_2e$

Economic Analysis (for Savings due to Additional Effort in RCI-6)

Net Present Value (2007-2020)	**-$5.7**	$million
Cumulative Emissions Reductions (2007-2020)	0.3	$MMtCO_2e$
Cost-Effectiveness	**-$20.21**	$\$/tCO_2e$

Summary Results for RCII-4	2010	2020	Units
Recent Actions Not Included in Forecast (Current/planned building code changes)			
Electric GHG Emission Savings	**0.00**	**0.00**	$MMtCO_2e$
Gas GHG Emission Savings	**0.00**	**0.00**	$MMtCO_2e$
Total GHG Emission Savings	**0.00**	**0.00**	$MMtCO_2e$
Total for Option (Natural gas and electricity)			
GHG Emission Savings	**0.03**	**0.25**	$MMtCO_2e$
Net Present Value (2007-2020)		**-$15**	$million
Cumulative Emissions Reductions (2007-2020)		1.6	$MMtCO_2e$
Cost-Effectiveness		**-$9.73**	$\$/tCO_2e$

NOTES AND DATA FROM SOURCES

Note on Overall Approach to Analysis

The analysis for this option is based on structure used by the Building Codes Assistance Project (see http://www.bcap-energy.org). The analysis uses existing energy consumption and parameters to account for savings due to energy used for space conditioning in different climates and the estimated impact of building codes.

From Mitigation Option Description, the goals of the option are

• Increase standards such that the minimum performance of new and substantially-renovated buildings, both commercial and residential, is at least 15% higher by 2010 than that required by today's building codes (IECC 2003, though IECC 2006 codes are under consideration, see below), and 30% higher by 2020.

This analysis estimates the savings from full enforcement of the existing MT building code (according to energycodes.gov, "The MT Building Code CouMTil has adopted the 2003 IECC with MT amendments effective July 1, 2006. The amendments include adoption of ASHRAE 90.1-2004. Chapter 11 of the 2003 IRC has also been adopted and includes MT amendments; the effective date for the new 2006 MT Residential Code has been delayed until July 1, 2007.", but other suggests that IECC 2006 code adoption will be considered in summer, 2007.
IECC is the International Energy Conservation Code.

For 2008, this analysis assumes that the 2006 code (based on IECC 2003) achieves energy savings of

residential	3%	, eg standard practice is equivalent to about 1998 IECC levels
commercial	6%	, eg standard practice is equivalent to about ASHRAE 2001 levels

This assumption is based on notes provided by the Building Codes Assistance Project
(see notes on cells in column T and V in table below)

For enforcement rates, the analysis assumes:

50%	rate of energy code enforcement currently, before mitigation action (no source for this estimate, needs review by TWG)
95%	rate of energy code enforcement with this mitigation option in place

These are rough estimates and more appropriate values for Montana are welcomed.

For 2010, this analysis assumes that the current national building code will be approximately IECC 2003, or the equivalent of MT's 2006 code. Thus the options will achieve

15%	savings, relative to 2008 improvements, by 2010, and
30%	savings, relative to 2008 improvements, by 2020.

Annual energy savings are estimated using the table below are result in estimated savings of

2008 (code enforcement)

residential	0.001	TWh
Commercial	0.001	TWh

2010 (15% energy savings)

residential	0.007	TWh
Commercial	0.005	TWh

The above values are based on energy and households in 2005, these values are adjusted to provide future savings based on increased number of houses. See below

	RESIDENTIAL							
STATE	TOTAL HOUSING UNITS	NEW HOUSING UNITS AUTHORIZED BY PERMIT (PRIVATELY OWNED)		Ratio - new units / existing units	TOTAL ELECTRICITY ENERGY USE (TWh) 2005	Estimated Electric energy use, new residential units (TWh)	Electric space conditioning multiplier (see "HVAC and Fuel Mix" worksheet)	energy use for space conditioning - new res buildings (TWh)
full enforcement of 2003 IECC								
MT	433,454	5097		0.0118	4.2	0.05	16.1%	0.0080
15% improvement								
MT						0.0488		

COMMERCIAL						ENERGY SAVINGS POTENTIAL (TWh)					
Ratio - new/existing	TOTAL ELECTRICITY ENERGY USE (TWh) 2005	Energy Intensity Correction Factor by Climate Zone and Vintage	Percentage of electric energy for Heating, Cooling, and Lighting	Commercial electric energy use for Heating, Cooling, & Lighting for new buildings (TWh)	STATE	Residential Savings Multiplier reflecting change from 2006 state code to 2004/2006 IECC.	Energy Savings Potential Residential New Construction	Energy Savings Potential Replacement Window	Commercial Savings Multiplier reflecting change from 2006 state code to ASHRAE 90.1-2004.	Energy Savings Potential Commercial New Construction	STATE
0.0124	4.5	1.13	0.54	0.03	**MT**	0.030	0.001	0.000	0.060	0.001	**MT**
				0.03	**MT**	0.150	0.007	N/A	0.150	0.005	**MT**

Incremental annual energy savings		2007	2008	2009	2010	2011
Residential	TWh	0	0.0010	0.0010	0.008	0.007
Commercial	TWh	0	0.0010	0.0010	0.005	0.005
Growth factor, population based relative to population growth from 2005 (energy savings based on 2005 data)			1.14	1.15	1.16	0.98
Factor to increase 2010 savings to match 2020 goal			100%	100%	100%	110%

Montana	New housing units	5,097	2005

The following parameters are used to adjust the total electricity consumption in the residential sector to electricity use for space conditioning (data from the Residential Energy Consumption Survey (EIA)). A parameter for the commercial sector is used to adjust estimates of commercial electric energy use for Heating, Cooling, & Lighting for new buildings for climate.

July 2002-June 2003 State Heating Degree Days (HDD)

			Residential		Commercial
	HDD65	CDD65	RECS Climate Zone	% electric space conditioning	
MT	7525	252	1	16.1%	1.1309

Sources: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/hdd.200507-200607.pdf
http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/cdd.200501-200607.pdf

Energy Intensity Correction Factor by Climate Zone

All Buildings	1.1538
>7000 HDD	1.1309
5500-7000	1.2408
4000-5499	1.0297
<4000	1.1986
>2000 CDD & <4000 HDD	1.1953

Household Electricity End Use

	Climate Zone				
	<2000 CDD				>2000 CDD and <4000 HDD
	>7000 HDD	5500-7000 HDD	4000-5499 HDD	<4000 HDD	
	Quadrillion Btus				
Climate Category	**1**	**2**	**3**	**4**	**5**
Space-Heating	0.03	0.08	0.12	0.08	0.09
Electric AC (central & room)	0.02	0.08	0.11	0.11	0.30
Water Heating	0.04	0.06	0.08	0.07	0.11
Refrigerators	0.04	0.13	0.11	0.10	0.15
Other Appliance & Lighting	0.18	0.52	0.43	0.37	0.48
TOTAL	0.31	0.87	0.85	0.73	1.13
Percent Electric Space Conditioning	**16.1%**	**18.4%**	**27.1%**	**26.0%**	**34.5%**
Source: 2001 RECS (http://www.eia.doe.gov/emeu/recs/recs2001/detailcetbls.html#space)					

Additional Notes

Note 1:

From The Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors Association.
The Potential for More Efficient Electricity Use in the Western United States, January, 2006. This report is referred to here as the "WGA CDEAC EE report" and can be found at:
http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf.
The CDEAC report provides a cost of saved energy (electricity) based on an average 7-year payback for code improvements (page 42).

For Montana, the equivalent cost is estimated as follows for electricity and natural gas

Note 2:

Based on results from Table 5.8 of the 2002 Energy Consumptions by Manufacturers--Data Tables published by the US Department of Energy's Energy Information Administration, and available as http://www.eia.doe.gov/emeu/mecs/mecs2002/data02/pdf/table5.8_02.pdf, approximately 18% of industrial electricity use in the West Census region is used for HVAC, lighting, and "other facility support", with 6.7% of natural gas used for HVAC and "other facility support".

In Montana, as of 2005, total electricity use by sector was as follows (from Retail Sales of Electricity by State by Sector by Provider, downloaded from http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html (file sales_revenue.xls)

	MWh	Fraction of Total
Residential	4,221,448	31%
Commercial	4,473,394	33%
Industrial	4,783,996	35%
Total	13,478,838	100%

Thus industrial use of electricity for non-process uses in Montana may be roughly 10.0% of total Residential and Commercial electricity use. This figure is used as an initial rule of thumb in estimating the contribution of savings from this policy from industrial sector measures.

Note 3:

The estimate of one unit of renovated space per unit of new construction in the commercial sector is an initial estimate only.
It is clear, however, that the renovation market represents a substantial opportunity for improving energy efficiency through code changes. A study of the non-residential renovation market in California (Remodeling and Renovation of Nonresidential Buildings in California, by Donald R. Dohrmann, John H. Reed, Sylvia Bender, Catherine Chappell, and Pierre Landry, available as http://www.energy.ca.gov/papers/2002-08-18_aceee_presentations/PANEL-10_DOHRMANN.PDF) suggests that by 1999 the value of renovations and additions to non-residential space was similar to that in new non-residential space, based on building permit data. As a market with newer buildings, it is possible that Montana has less renovation per unit building activity than California.

Note 4:

Calculated based on July-2004 to July-2005 estimate of total housing units in Montana from http://www.census.gov/popest/housing/HU-EST2005.html (see "2005 Total Housing Units" worksheet in this workbook). Since this figure implicitly nets out demolitions, it may somewhat undercount new units. The source: http://www.census.gov/const/C40/Table2/t2yu200512.txt provides an estimate of 5,068 "New Privately Owned Housing Units Authorized", which may be somewhat of an over-estimate for total new housing units in Montana, as it would presumably include some permitted units not ultimately built. We use the former estimate at present as the basis for calculation of future growth in housing units.

Estimate of Mitigation Option Costs and Benefits for Montana RCII GHG Analysis

RCII-5 **"Beyond Code" Building Design Incentives and Mandatory Programs**

Local Building Materials and Advanced Construction

Date Last Modified: 6/6/2007 D. Von Hippel/A Bailie

Key Data and Assumptions	2010	2020/all	Units
First Year Results Accrue		2008	
Based on goal set in Mitigation Option Design for RCII-7 (version dated 10/27/06) that reads "Ramp up program starting in 2007 to full effectiveness by 2012, except where noted otherwise".			

Electricity	2010	2020/all	Units
Levelized Cost of Electricity Savings		$37.2	$/MWh
As estimated for RCII-4. Based on 7-year payback as estimated in WGA CDEAC EE Report. (See Note 1 in RCII-4.)			
Levelized Cost of Natural Gas Savings		$4.7	$/MMBtu
As estimated for RCII-4. Based on 7-year payback as estimated in WGA CDEAC EE Report. (See Note 1 in RCII-4.)			
Avoided Electricity Cost		$49	$/MWh
See "AvCost" and "Common Factors" worksheets in this workbook.			
Avoided Natural Gas Cost		$6.5	$/MMBtu
See "NG prices aeo2006" and "Common Factors" worksheets in this workbook.			

Other Data, Assumptions, Calculations	2010	2020/all	Units
Inputs to/Intermediate Results of Calculation of Electricity and Gas Savings			
Average Electricity and Gas Savings Beyond Code Levels (new commercial and residential buildings)	25%	50%	
The description for this option currently includes the following: "Reduce per-unit-floor-area consumption of grid electricity and natural gas by 20% by 2020 in existing buildings, and by 50% in new buildings by 2020. Up to 10% of the targeted reduction for new homes can come from use of off-site electricity generation from renewable energy . These requirements should be phased in over time...". This is interpreted to mean that participating buildings will be on average 25 percent more efficient than code in 2010, and an estimated average of 50 percent more efficient than code in 2020.			
Note in particular that the level of savings shown here is beyond that already included in Option RCII-4, and thus already includes an improvement in efficiency relative to average current practice.			
Total Commercial Floorspace in Montana (million square feet)	242	256	
Estimated (see "MT_Activities_Est" worksheet in this workbook) based on USDOE EIA CBECS (comercial survey) data for the Mountain region, extrapolated using projected Montana population as a driver.			
Est. area of new commercial space per year in MT (million square feet)	1.8	1.2	
Calculated based on annual floorspace estimates above.			
Total Residential Housing Units in Montana	444,698	469,553	
Assumes 2005 ratio of new homes to increase in population holds through 2020. Based on 2005 MT housing units as provided in U.S Census Bureau annual data, http://www.census.gov/popest/housing/HU-EST2005.html.			
Implied persons per housing units in Montana (for reference only)	2.18	2.18	
Estimated number of new residential units per year	3,317	2,154	
Calculated based on estimates above.			
Implied Average Electricity Consumption per Square Foot Commercial Space in Montana as of 2005 (see Note 2)		19.18	kWh/yr
Implied Average Natural Gas Consumption per Square Foot Commercial Space in Montana as of 2005 (see Note 2)		44.87	kBtu/yr
Implied Average Electricity Consumption per Housing Unit in Montana as of 2005 (see Note 2)		9.85	MWh/yr
Implied Average Natural Gas Consumption per Housing Unit in Montana as of 2005 (see Note 2)		47.69	MMBtu/yr

NEW BUILDINGS

Electricity Use per New/Renovated Commercial Sq. Ft. After RCII-4 Application *Reduces future per-unit electricity use based on savings from building code improvements (15 percent improvement by 2010, 30 percent by 2020) included in RCII-4.*	**16.2**	**13.2**	kWh/yr
Nat. Gas Use per New/Renovated Commercial Sq. Ft. After RCII-4 Application *Assumes the same pattern of code improvement as for electricity use, as described above.*	**35.4**	**25.9**	kBtu/yr
Implied Electricity Use per New/Renovated Commercial Square Foot After RCII-4 Application, Relative to Average in Montana as of 2005	**84.3%**	**68.7%**	
Implied Natural Gas Use per New/Renovated Commercial Square Foot After RCII-4 Application, Relative to Average in Montana as of 2005	**78.8%**	**57.6%**	
Electricity Use per New/Renovated Residential Unit After RCII-4 Application *Reduces future per-unit electricity use based on savings from building code improvements (15 percent improvement by 2010, 30 percent by 2020) included in RCII-4.*	**7.4**	**5.0**	MWh/yr
Natural Gas Use per New/Renovated Residential Unit After RCII-4 Application *Reduces future per-unit electricity use based on savings from building code improvements (20 percent improvement by 2010) included in RCII-4.*	**35.5**	**23.3**	kBtu/yr
Implied Electricity Use per New/Renovated Residential Unit After RCII-4 Application, Relative to Average in Montana as of 2005	**75.4%**	**50.8%**	
Implied Natural Gas Use per New/Renovated Residential Unit After RCII-4 Application, Relative to Average in Montana as of 2005	**74.5%**	**48.9%**	
Date program of improvement of new buildings fully "ramped up" *Placeholder estimate pending TWG review.*		2012	
Fraction of new commercial buildings participating in program at full program level		25%	/yr
Fraction of new residential buildings converted included under program by 2020		25%	/yr
Implied fraction of new commercial floorspace included in program *Note that government-sector floorspace is covered under RCI-12.*	**15.0%**	**25.0%**	/yr
Implied commercial floorspace included in program (million square feet)	**0.271**	**0.293**	/yr
Implied fraction of new residential units included in program	**15.0%**	**25.0%**	/yr
Implied new residential units included in program	**498**	**539**	/yr

EXISTING BUILDIINGS

Fraction of existing buildings (buildings existing as of 2005) upgraded under program		25%	
Date by which upgrading goal for existing buildings achieved *As included in goals for policy option.*		2020	
Date program of improvement of existing buildings fully "ramped up" *Assumed same as for new buildings.*		2012	
Fraction of existing buildings (buildings existing as of 2005) upgraded annually from 2012 on: *Adjust until the value at right ~ 0.25 (adjustment for lower penetration during ramp-in period)*	0.2497	2.27%	
Fraction of existing buildings (buildings existing as of 2005) upgraded annually:	**1.4%**	**2.3%**	
Electricity and Gas savings from upgrading existing commercial buildings *As included in goals for policy option.*		20%	
Electricity and Gas savings from upgrading existing residential buildings *As included in goals for policy option.*		20%	

CALCULATION OF SAVINGS

Required Elect/Gas Improvement in New Commercial and Residential Space After RCII-4 Policy Relative to Average in After Application of RCII-4 *Calculated based on inputs above.*	**25.0%**	**50.0%**	
Implied total electricity savings in new commercial buildings from RCII-5 *First-year savings--not cumulative.*	**1.10**	**1.93**	GWh/yr
Implied total gas savings in new commercial buildings from RCII-5 *First-year savings--not cumulative.*	**2.40**	**3.79**	GBtu/yr
Implied total electricity savings in new residential buildings from RCII-5 *First-year savings--not cumulative.*	**0.92**	**1.35**	GWh/yr
Implied total gas savings in new residential buildings from RCII-5 *First-year savings--not cumulative.*	**4.42**	**6.28**	GBtu/yr
Implied total electricity savings in existing commercial buildings from RCII-5 *First-year savings--not cumulative.*	**12**	**20**	GWh/yr
Implied total gas savings in existing commercial buildings from RCII-5 *First-year savings--not cumulative.*	**29**	**48**	GBtu/yr
Implied total electricity savings in existing residential buildings from RCII-5 *First-year savings--not cumulative.*	**11**	**19**	GWh/yr
Implied total gas savings in existing residential buildings from RCII-5 *First-year savings--not cumulative.*	**56**	**93**	GBtu/yr

Average Fraction of Improvement in Electric Energy Intensities from:

Energy Efficiency Improvement	83%	80%
Solar Thermal Energy (hot water/space heat/space cooling)	5%	7%
On-site Solar PV	1%	2%
On-site Biomass/Biogas/Landfill Gas Energy Use	1%	1%
Green Power Purchase (from off-site, beyond electricity supply RPS)	10%	10%

All "placeholder" assumptions, except on-site biomass/biogas/landfill gas energy use calculated so that values sum to 100%.

Average Fraction of Improvement in Gas Energy Intensities from:

Energy Efficiency Improvement	94%	91%
Solar Thermal Energy (hot water/space heat/space cooling)	5%	7%
On-site Solar PV	0%	0%
On-site Biomass/Biogas/Landfill Gas Energy Use	1%	2%
Green Power Purchase (from off-site, beyond electricity supply RPS)	0%	0%

All "placeholder" assumptions, except on-site biomass/biogas/landfill gas energy use calculated so that values sum to 100%.

Adjustment for Inclusion of Rennovated Commercial Space as Well as New Under Program. *Currently set at 1.5 so that about 0.5 unit of renovated space is included per unit of new space (initial assumption). See Note 4. It may be useful to get further MT-specfic information regarding this value.*		**1.50**
Adjustment of Energy Use per Unit Floor Area for Commercial Buildings in Program Relative to Average Commercial Building in Montana *Placeholder assumption.*	1.00	1.00

Adjustment for Inclusion of Rennovated Residential Units as Well as New Under Program.	1.00	

Currently set at 1.0 so that no renovated space is included per unit of new space (initial assumption). It may be useful to obtain further MT-specfic information regarding this value.

Implied Cumulative Impacts of Option, New Commercial Space (Electricity savings)			
Energy Efficiency Improvement	2.9	25.1	GWh
Solar Thermal Energy (hot water/space heat/space cooling)	0.2	1.8	GWh
On-site Solar PV	0.0	0.5	GWh
On-site Biomass/Biogas/Landfill Gas Energy Use	0.0	0.3	GWh
Green Power Purchase (from off-site, beyond electricity supply RPS)	0.4	3.1	GWh

Implied Cumulative Impacts of Option, New Commercial Space (Natural Gas savings)			
Energy Efficiency Improvement	7.4	59.7	GBtu/yr
Solar Thermal Energy (hot water/space heat/space cooling)	0.4	3.8	GBtu/yr
On-site Solar PV	-	-	GBtu/yr
On-site Biomass/Biogas/Landfill Gas Energy Use	0.1	1.0	GBtu/yr
Green Power Purchase (from off-site, beyond electricity supply RPS)	-	-	GBtu/yr

Implied Cumulative Impacts of Option, Existing Commercial Space (Electricity savings)			
Energy Efficiency Improvement	20.2	182.1	GWh
Solar Thermal Energy (hot water/space heat/space cooling)	1.2	13.4	GWh
On-site Solar PV	0.2	3.3	GWh
On-site Biomass/Biogas/Landfill Gas Energy Use	0.2	2.2	GWh
Green Power Purchase (from off-site, beyond electricity supply RPS)	2.4	22.3	GWh

Implied Cumulative Impacts of Option, Existing Commercial Space (Natural Gas savings)			
Energy Efficiency Improvement	53.6	483.5	GBtu/yr
Solar Thermal Energy (hot water/space heat/space cooling)	2.9	31.3	GBtu/yr
On-site Solar PV	-	-	GBtu/yr
On-site Biomass/Biogas/Landfill Gas Energy Use	0.6	7.8	GBtu/yr
Green Power Purchase (from off-site, beyond electricity supply RPS)	-	-	GBtu/yr

Implied Cumulative Impacts of Option, New Residential Space (Electricity savings)			
Energy Efficiency Improvement	0.9	12.3	GWh
Solar Thermal Energy (hot water/space heat/space cooling)	0.1	0.9	GWh
On-site Solar PV	0.0	0.2	GWh
On-site Biomass/Biogas/Landfill Gas Energy Use	0.0	0.2	GWh
Green Power Purchase (from off-site, beyond electricity supply RPS)	0.1	1.5	GWh

Implied Cumulative Impacts of Option, New Residential Space (Natural Gas savings)			
Energy Efficiency Improvement	5.0	66.0	GBtu/yr
Solar Thermal Energy (hot water/space heat/space cooling)	0.3	4.3	GBtu/yr
On-site Solar PV	-	-	GBtu/yr
On-site Biomass/Biogas/Landfill Gas Energy Use	0.1	1.1	GBtu/yr
Green Power Purchase (from off-site, beyond electricity supply RPS)	-	-	GBtu/yr

Implied Cumulative Impacts of Option, Existing Residential Space (Electricity savings)			
Energy Efficiency Improvement	19.1	171.8	GWh
Solar Thermal Energy (hot water/space heat/space cooling)	1.1	12.6	GWh
On-site Solar PV	0.2	3.2	GWh
On-site Biomass/Biogas/Landfill Gas Energy Use	0.2	2.1	GWh
Green Power Purchase (from off-site, beyond electricity supply RPS)	2.3	21.1	GWh

Implied Cumulative Impacts of Option, Existing Residential Space (Natural Gas savings)			
Energy Efficiency Improvement	104.6	943.8	GBtu/yr
Solar Thermal Energy (hot water/space heat/space cooling)	5.6	61.2	GBtu/yr
On-site Solar PV	-	-	GBtu/yr
On-site Biomass/Biogas/Landfill Gas Energy Use	1.1	15.3	GBtu/yr
Green Power Purchase (from off-site, beyond electricity supply RPS)	-	-	GBtu/yr

Additional Inputs to/Intermediate Results of Costs Analyses

Incremental Capital Cost of Solar Water Heater (relative to electric or gas unit) | **$3,500** | **$3,000**

Placeholder Assumption, assuming gradual decline in real costs of solar collectors. By way of example, ***source in Note 4*** *below notes a 2005 solar hot water heater cost in New Mexico of about $4,000.*

Factors for Annualizing Capital Costs (SWH and PV Systems)

Interest Rate (real)	8%	/yr
Economic Life of System	20	years
Implied Annualization Factor	10.19%	%/yr

Estimated Average Floorspace per Commercial Building (square feet) | **13,313**

Estimate,for the Mountain Region, see ***Note 5***

Water Heating

Estimate of total Commercial Delivered Energy Intensity (kBtu/square ft.-yr) | **118** | **119**

National average estimate, all fuels, all end-uses, see ***Note 5***

Estimated Fraction of Delivered Energy Used for Water Heating | **9.6%**

National average estimate, see ***Note 5***

Estimated Average Required kBtu/yr Delivered Water Heating Energy Per Commercial Building | **150,302** | **151,580**

Use of Electricity and Other (non-solar) Energy Sources per (non-solar) Household in Absence of Policy

Electricity | **5,030** | **4,790** | kWh

Placeholder value based on NM jurisdication. See ***Note 10***

Approximate Water Heating Capacity Required Relative to Residential Unit | **9** | **9**

Estimated annual levelized cost of solar hot water per unit output | **20.77** | **18.70** | $/MMBtu

Based on inputs to/results of solar hot water heating analysis above.

Adjustment to solar thermal costs for inclusion of space heat/cooling measures | 1.00 | 1.00

Placeholder assumption--Value of 1.0 implies that solar space heat and cooling will cost the same per unit output as solar water heating.

Implied Per Unit Cost Electricity Avoided by Solar WH/SH/Cooling	**65.91**	**59.32**	$/MWh
Implied Per Unit Cost Natural Gas Avoided by Solar WH/SH/Cooling	**14.54**	**13.09**	$/MMBtu

Assumes delivered solar WH/SH/Cooling replaces electric with EF of 0.93, gas with EF of 0.70 (and therefore one MMBtu of delivered solar heat is the equivalent of more than one MMBtu of each fuel).

Inputs to Cost Estimates for Residential Solar PV Systems (Data from Source in Note 6)

Average Capacity of Solar PV System Installed on New Homes (kW) | **2.00** | **2.00**

Assumption, consistent with capacity assumption used in Source in ***Note 6***

Capital Costs for PV Systems for New Homes

Module	**$ 3,345**	**$ 2,003**
BOS (Balance of System)	**$ 1,235**	**$ 739**
Installation	**$ 409**	**$ 143**
Total System - $/kW	**$ 4,989**	**$ 2,885**
Total System - $	**$ 9,978**	**$ 5,769**
Additional Cost Per Household for Solar-Ready Wiring/Meters/Roof Structures, Assuming 20% of BOS and Installation Costs	**$ 329**	**$ 176**

Average full-capacity-equivalent hours of operation for Solar PV Systems: | **1,643** | **1,643**

Placeholder value based on data for New Mexico from New Mexico Solar Energy Association--See ***Note 4****.* *This value may be somewhat high as an average for Montana.*

Commercial System Capital costs/kW Relative to New Residential *Rough assumption, but similar to values in literature--See* ***Note 7*** *.*	80%	80%	
Federal Solar Tax Credits: Commercial Sector--See ***Note 8***	10%	10%	
Reduce Captial Costs for Solar Tax Credits and Related Deductions?		**YES**	
Estimated annual levelized cost of on-site Solar PV *Based on solar PV cost assumptions described above. See also* ***Note 9*** *.*	**223**	**129**	$/MWh
Fuel Cost for On-site Biomass/Biogas/Landfill Gas Energy Use *Based on costs for Biomass fuel, which will likely dominate this category of fuel inputs. See "Common Assumptions" worksheet in this workbook. If significantly processed biomass fuels (such as pelletized fuels) are required, this cost may need to be increased.*		3.19	$/MMBtu
Relative Efficiency of On-site Biomass/Biogas/Landfill Gas displacing electricity *Placeholder assumption.*		0.75	
Factor to reflect probable higher costs of on-site Biomass/Biogas/Landfill Gas Equipment Relative to Electric Equipment *Placeholder assumption--In most cases, heating/water heating equipment designed to use biomass-derived fuels will be more expensive than equipment designed to use electricity. This factor loads these incremental capital costs into estimated fuel costs.*		2.00	
Implied Per Unit Cost Electricity Avoided by Biomass/Biogas/Landfill Gas	**28.95**	**28.95**	$/MWh
Incremental Cost for Green Power Purchase (from off-site, beyond supply RPS) *Placeholder assumption, but should be linked to assumptions for relevant ES options, if necessary.*	25.00	20.00	$/MWh

Results	**2010**	**2020**	**Units**
Electricity (Conventional)			
Reduction in Electricity Sales: Residential	24	226	GWh (sales)
Reduction in Electricity Sales: Commercial	28	254	GWh (sales)
TOTAL Reduction in Electricity Sales	52	480	GWh (sales)
Reduction in Generation Requirements	56	516	GWh (generation)
GHG Emission Savings	**0.06**	**0.43**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2007-2020)		**-$9**	$million
Cumulative Emissions Reductions (2007-2020)		2.8	$MMtCO_2e$
Cost-Effectiveness		**-$3.16**	$\$/tCO_2e$
Natural Gas			
Reduction in Gas Use, Residential Sector	117	1,092	Billion BTU
Reduction in Gas Use, Commercial Sector	65	587	Billion BTU
TOTAL Reduction in Gas Sales	182	1,679	Billion BTU
GHG Emission Savings	**0.01**	**0.09**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2007-2020)		**-$8**	$million
Cumulative Emissions Reductions (2007-2020)		0.54	$MMtCO_2e$
Cost-Effectiveness		**-$14.52**	$\$/tCO_2e$
Biomass/Biogas/Landfill Gas Fuel Use			
Biomass Fuels Use	**4.17**	**46.91**	GBtu/yr
Added GHG Emissions from Biomass Fuels Use	**0.00001**	**0.00012**	$MMtCO_2e$
Cumulative added Emissions from Biomass Fuels (2007-2020)		0.0007	$MMtCO_2e$

Summary Results for RCII-5	2010	2020	Units
Total for Option (Natural gas and Electricity less Biomass)			
GHG Emission Savings	**0.07**	**0.52**	$MMtCO_2e$
Net Present Value (2007-2020)		**-$16.8**	$million
Cumulative Emissions Reductions (2007-2020)		3.4	$MMtCO_2e$
Cost-Effectiveness		**-$4.98**	$/tCO_2e$

Additional Summary Results for RCII-5 for Reporting	2010	2020	Units
Total Green Power Purchased Under RCII-5	5	48	GWh (sales)
Total Green Power Generation to Serve RCII-5	6	52	GWh (generation)
GHG Emission Savings from Green Power Component	**0.01**	**0.04**	$MMtCO_2e$
Net Present Value (2007-2020) of Green Power component of RCII-5		**$3.9**	$million
Total Renewable Energy Under RCII-5	1	12	GWh (at consumer site)
Total Reduction in Conventional Generation due to Renewable Energy Under RCII-5	1	13	GWh (equivalent at central generator)
Net Present Value (2007-2020) of renewable energy component of RCII-5	**0.00**	**0.01**	$MMtCO_2e$
		$3.4	$million

NOTES AND DATA FROM SOURCES

Note 1:

From The Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors Association.
The Potential for More Efficient Electricity Use in the Western United States, January, 2006. This report is referred to here as the "WGA CDEAC EE report" and can be found at:
http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf.
See Note 1 in RCII-4 worksheet in this workbook.

Note 2:

Based on results from Table B.5 of the 2003 Commercial Buildings Energy Consumption Survey, Detailed Tables dated October 2006 and published by the US Department of Energy's Energy Information Administration, and available as http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/alltables.pdf, as described in "MT_Activities_Est" worksheet in this workbook.

Following data on electricity sales in Montana as of 2005 as described in "Utility_Sales" worksheet in this workbook.
Downloaded from http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html (file sales_revenue.xls)

	MWh	Fraction of Total
Residential	4,221,448	31%
Commercial	4,473,394	33%
Industrial	4,783,996	35%
Total	13,478,838	100%

For natural gas consumpation, consumption data from the USDOE EIA downloaded from http://www.eia.doe.gov/oil_gas/natural_gas/applications/eia176query.html are are follows:
(See "EIA_NG_Data" worksheet in this workbook for raw EIA data)

	Sales (Million Cubic Feet of Natural Gas)			
	Residential	Commercial	Industrial	Total
2005	19,834	10,162	398	30,394
Fraction of 2005 Total	65%	33%	1%	100%

Note 3:

The estimate of 0.5 unit of renovated space per unit of new construction in the commercial sector is a rough assumption.

It is likely that the ratio of commercial space undergoing major renovation to new commerial space will fluctuate year by year, and it may be necessary to get a more specific figure for this parameter. It is clear, however, that the renovation market represents a substantial opportunity for improving energy efficiency through code changes. A study of the non-residential renovation market in California (Remodeling and Renovation of Nonresidential Buildings in California, by Donald R. Dohrmann, John H. Reed, Sylvia Bender, Catherine Chappell, and Pierre Landry, available as http://www.energy.ca.gov/papers/2002-08-18_aceee_presentations/PANEL-10_DOHRMANN.PDF) suggests that by 1999 the value of renovations and additions to non-residential space was similar to that in new non-residential space, based on building permit data. As California includes a significant fraction of older buildings in its building stocks, renovations may be a smaller fraction of building activity in Montana.

Note 4:

Based on midpoint of "4 to 5 kilowatt-hours (kWh) of usable electrical energy per day in New Mexico on average". From http://www.nmsea.org/Downloads/System_Sizing_Cost.pdf, "Buying Solar Energy Systems", New Mexico Solar Energy Association.

Note 5:

Based on data in the 2003 Commercial Buildings Energy Consumption Survey Detailed Tables published by the US Department of Energy's Energy Information Administration, and available as http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/allbc.pdf, the average floorspace per building for all commercial buildings in the Mountain West (including malls) was 13,313 square feet (calculated from data in Tables A5 and A6).

The USDOE Office of Energy Efficiency and Renewable Energy's 2005 Building Energy Databook provides the following data, which were used to prepare a rough estimate of water heating requirements for commercial buildings in Montana. The table below is found on page 1-10 of the source document, which is available at http://buildingsdatabook.eren.doe.gov/docs/2005bedb-0805.pdf

1.3.3 2003 Commercial Energy End-Use Splits, by Fuel Type (quads)

	Natural Gas	Fuel Oil (1)	LPG	Other Fuel(2)	Renw. En.(3)	*Site* Electric	*Site* Total	*Site* Percent	Primary Electric (4)	Primary Total	Primary Percent
Lighting						1.34	1.34	16.1%	4.31	4.31	24.7%
Space Heating	1.36	0.30		0.12		0.21	1.98	23.9%	0.67	2.45	14.0%
Space Cooling	0.01					0.59	0.60	7.2%	1.89	1.90	10.9%
Water Heating	0.57	0.07			0.02	0.14	0.80	9.6%	0.45	1.11	6.3%
Refrigeration						0.34	0.34	4.1%	1.09	1.09	6.2%
Ventilation						0.31	0.31	3.8%	1.01	1.01	5.8%
Electronics						0.31	0.31	3.7%	1.00	1.00	5.7%
Computers						0.14	0.14	1.6%	0.44	0.44	2.5%
Cooking	0.26					0.03	0.29	3.5%	0.10	0.36	2.1%
Other (5)	0.30	0.03	0.10	0.04	0.09	0.32	0.86	10.4%	1.02	1.56	8.9%
Adjust to SEDS (6)	0.72	0.20				0.41	1.33	16.0%	1.32	2.25	12.8%
Total	3.22	0.59	0.10	0.16	0.11	4.13	8.31	100%	13.30	17.49	100%

Note(s): 1) Includes (0.52 quad) distillate fuel oil and (0.07 quad) residual fuel oil. 2) Kerosene (0.02 quad) and coal (0.10 quad) are assumed attributable to space heating. Motor gasoline (0.04 quad) assumed attributable to other end-uses. 3) Comprised of (0.10 quad) biomass, (0.02 quad) solar water heating, and (less than 0.01 quad) solar pv. 4)*Site* -to-source electricity conversion (due to generation and transmission losses) = 3.22. 5) Includes service station equipment, automated teller machines, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 6) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, AEO 2005, Feb. 2005, Tables A2, p. 140-142, Table A5, p. 147-148, and Table A17, p. 163 for 2002; EIA, AEO 1999, Dec. 1998, Table A5, p. 120 for 1996 refrigeration; EIA, National Energy Modeling System for AEO 2005, Feb. 2005; BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, p. 1-2 and 5-25 - 5-26; EIA, AEO 1998, Dec. 1997, Table A5, p. 108-109 for 1995 ventilation; BTP/Navigant Consulting, U.S. Lighting Market Characterization, Volume I, 1. Sept. 2002, Table 8-2, p. 63; and OBT/A.D. Little, Energy Savings Potential for Commercial Refrigeration Equipment, June 1996, Figure 1-1, p. 1-1.

1.3.4 Commercial *Delivered* and Primary Energy Consumption Intensities, by Year

		Floorspace (10^9 SF)	Percent Post-2000 Floorspace (1)	*Delivered* Energy Consumption Total (quads)	*Delivered* Energy Consumption Consumption per SF (10^3 Btu/SF)	Primary Energy Consumption Total (quads)	Primary Energy Consumption Consumption per SF (10^3 Btu/SF)
1980		50.9	N.A.	6.0	117.8	10.6	208.2
1990		64.3	N.A.	6.7	104.3	13.3	207.1
2000	(2)	68.5	N.A.	8.2	119.1	17.1	250.2
2003	**(2)**	**72.1**	**10%**	**8.3**	**115.2**	**17.5**	**242.4**
2005	(2)	74.7	16%	8.4	112.8	17.9	239.9
2010	(2)	81.2	28%	9.6	117.6	20.3	250.1
2020	(2)	96.2	50%	11.4	118.6	24.3	252.4
2025	(2)	104.8	59%	12.5	119.6	26.8	255.6

Note(s): 1) Percent built after Dec. 31, 2000. 2) Excludes parking garages and commercial buildings on multi-building manufacturing facilities.

Source(s): EIA, State Energy Data 2001, December 2004, Table 9, p. 19 for 1980-2000 energy consumption; DOE for 1980 floorspace; EIA, AEO 1994, Jan. 1994, Table A5, p. 62 for 1990 floorspace; EIA, AEO 2003, Jan. 2003, Table A5, p. 127 for 2000 floorspace; and EIA, AEO 2005, Feb. 2005, Table A2, p. 140-142, Table A5, p. 147-148, and Table A17, p.163 for 2003-2025.

Note 6:
Source: Worksheet "Solar Homes Summary table.xls", with calculations in support of the California Million Solar Homes Initiative, authored by XENERGY, Inc., and provided by M. Lazarus. Selected annual data provided.

Note 7:
Source: International Energy Agency (IEA), TRENDS IN PHOTOVOLTAIC APPLICATIONS Survey report of selected IEA countries between 1992 and 2004. Report #IEA-PVPS T1-14:2005.
Page 18.
"Indicative costs" in 2004 in USD per kWp (assumedly DC output) for on-grid PV systems in the US:

<10 kW	7000 to 10,000
>10 kW	6300 to 8500

In EIA Projections of Renewable Energy Costs, presented in "Forum on the Economic Impact Analysis of NJ's Proposed 20% RPS" by Chris Namovicz of the USDOE EIA (Energy Information Administration), dated February 22, 2005, and available as http://www.eia.doe.gov/oiaf/pdf/rec.pdf, a wind power average cost of

6000	dollars/kW is provided for a 25 kW Commercial system, or
8200	dollars/kW for a 2 kW Residential system, with

"Large potential for cost reduction".

Note 8:
A description of the new Federal Solar Tax Credits for businesses and residences as contained in the Energy Policy Act of 2005 (EPAct 2005) (see, for example, http://www.seia.org/getpdf.php?iid=21) provides for 30% (of system cost) tax credits for solar PV investments by businesses in 2006 and 2007, reverting to 10% thereafter. For residences, the credit in 2006 and 2007 is 30% with a "cap" of $2000, reverting to zero after 2007.   For the purpose of this analysis, we are modeling the federal tax credit at its long-term (10% business, 0% residential) level, as no systems are added in 2006 and 2007.

Note 9:
For simplicity, in this analysis, a single stream of annual solar PV costs per MWh have been used for both commercial and residential PV installations. In fact, these costs will differ by sector, with residential systems costing more per kW on a total cost basis due to their smaller scale, but costing many homeowners less per kW because they can constitute part of the purchase price of a home, or be purchased with home equity loans, making the interest on their capital cost deductable from federal income taxes.
These factors are assumed, for this analysis, to approximately offset.

Note 10:
Value for 2010 assumes 228 therms per HH using natural gas for water heat, based on value on p.
Natural Gas Energy Efficiency in the Service Territory of PNM, as prepared for PNM by GDS Associates, Inc, and dated May, 2005. Estimates for Electricity calculated based on average EF of .93 for Electricity, .7 for Natural Gas/LPG. Value in 2020 assumes 5% reduction in water heating energy use between 2010 and 2020 due to reduction in number of people per household plus naturally occuring energy efficiency improvements.

Estimate of Mitigation Option Costs and Benefits for Montana RCII GHG Analysis

RCII-10 **Industrial Energy Audits and Recommended Measure Implementation**

Date Last Modified: *4/25/2007 D. Von Hippel*

Key Data and Assumptions	2010	2020/all	Units
First Year Results Accrue		2009	
Levelized Cost of Electricity Savings from Technical Assistance Recommendations			
Industrial Sector		$15.1	$/MWh
Estimated based on assumptions below. Payback period is an average of the average payback range of 2.5 to 3 years cited by John Campbell of NorthWestern Energy as consistent with an industrial energy efficiency resource of 40 to 84 MW for Montana as a whole. The average measure lifetime shown below is a rough assumption for industrial-sector measures. The levelized cost is calculated as the annual payment required per MWh saved over the lifetime of the efficiency improvements, using a real discount rate of 5 percent/yr.			
Levelized Cost of Natural Gas and Other Fuels Savings			
Industrial Sector		$2.05	$/MMBtu
Calculated based on lifetime assumption and average first cost for industrial gas energy efficiency improvements shown below.			
Assumed ave. simple payback, Industrial Sector energy efficiency improvements		2.75	years
Assumed average lifetime for Industrial Sector energy efficiency improvements		12	years
Average estimated industrial electricity rates in MT, 2010 to 2020		$49	$/MWh
Average estimated industrial gas rates in MT, 2010 to 2020		$6.59	$/MMBtu
Implied average cost of industrial sector electric efficiency improvements		$134	$/(MWh/yr)
Investment per unit annual savings			
Implied average first cost of industrial sector gas efficiency improvements		$18.13	$/(MMBtu/yr)
Investment per unit annual savings			
Avoided Electricity Cost		$49	$/MWh
Levelized value--See "Common Factors" worksheet			
Avoided Natural Gas Cost		$6.5	$/MMBtu
Levelized value--See "Common Factors" worksheet			
Avoided LPG Cost		$11.0	$/MMBtu
Avoided Oil Cost		$12.5	$/MMBtu
Potential Cost-effective Energy Savings from Implementing Recommended Measures		10%	
Within the range of the industrial energy efficiency resource of 40 to 84 MW for Montana as a whole as estimated by John Campbell, assuming a load factor of about 80 percent and year 2005 Montana industrial electricity use. This value is assumed to be applicable for both electricity and natural gas measures.			
Fraction of Potential Energy Savings Achieved Annually Under Option		8%	
Program target.			
First Year in which Full Program Savings Achieved		2010	
Years between first year that program results accrue and first year in which full progam savings are achieved are years in which program effort is phased in.			
Annual Technical Assistance Visits: Residential Sector		-	
Annual Technical Assistance Visits: Commercial Sector		-	
Esimated Annual Audits: Industrial Sector	364	364	
For reference only, not an input. Calculated based on program assumptions.			
Total Technical Assistance Visits Over Life of Program		4,183	

Other Data, Assumptions, Calculations	2010	2020/all	Units

Inputs to/Intermediate Results of Calculation of Electricity and Gas Savings

Fraction of Potential Energy Savings Achieved Annually Under Option	8.0%	8.0%	

Industrial Sector

Estimated Industrial-sector (Electricity) Customers	4,547	4,547	
Average annual growth in customer numbers, 2005 to 2020		0.0%	

Initial estimate--USDOE EIA data on industrial customer count in Montana since 1990 seems to fluctuate significantly year to year, and is probably not a true reflection of the actual number of industrial customers in the state.

Estimated Total Industrial Sector Energy Use			
Electricity	5,150	5,886	GWh
Natural Gas	23,976	21,398	Billion Btu
LPG	1,170.3	1,159.4	Billion Btu
Oil (Distillate Oil)	13,104.3	12,982.6	Billion Btu

Average energy consumption per industrial (electricity) customer			
Electricity	1,132.7	1,294.4	MWh
Natural Gas	5,272.9	4,706.0	MMBtu
LPG	257.4	255.0	MMBtu
Oil (Kerosene and Distillate Oil)	2,882.0	2,855.2	MMBtu

Average Savings from Application of Measures from Technical Assistance Visits			
Electricity		10%	
Natural Gas and Other Fuels		10%	

As noted above.

Include LPG and Oil in analysis?		NO	

Estimated Savings From Application of Measures (first-year savings, not cumulative)			
Electricity	41.2	47.1	GWh
Natural Gas	191.8	171.2	Billion Btu
LPG	-	-	Billion Btu
Oil (Kerosene and Distillate Oil)	-	-	Billion Btu

Results	2010	2020	Units
Electricity Savings			
Reduction in Electricity Sales: Industrial	62	505	GWh (sales)
TOTAL Reduction in Electricity Sales	62	505	GWh (sales)
Reduction in Generation Requirements	66	543	GWh (generation)
GHG Emission Savings	**0.07**	**0.46**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2007-2020)		**-$63**	$million
Cumulative Emissions Reductions (2007-2020)		3.0	$MMtCO_2e$
Cost-Effectiveness		**-$21.18**	$\$/tCO_2e$
Natural Gas and Other Fuel Savings			
Reduction in Natural Gas Use: Industrial	94	1,917	Billion BTU
TOTAL Reduction in Natural Gas Sales	**94**	**1,917**	Billion BTU
Reduction in LPG Use: Industrial	0	0	Billion BTU
TOTAL Reduction in LPG Sales	**0**	**0**	Billion BTU
Reduction in Oil Use: Industrial	0	0	Billion BTU
TOTAL Reduction in Oil Sales	**0**	**0**	Billion BTU
GHG Emission Savings	**0.00**	**0.10**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2007-2020)		**-$30**	$million
Cumulative Emissions Reductions (2007-2020)		0.6	$MMtCO_2e$
Cost-Effectiveness		**-$49.86**	$\$/tCO_2e$

Summary Results for RCII-10	2010	2020	Units
Total for Policy (Electricity, Natural Gas and Other Fuels)			
GHG Emission Savings	**0.07**	**0.56**	$MMtCO_2e$
Net Present Value (2007-2020)		**-$93**	$million
Cumulative Emissions Reductions (2007-2020)		3.6	$MMtCO_2e$
Cost-Effectiveness		**-$25.93**	$\$/tCO_2e$

NOTES AND DATA FROM SOURCES

Note 1:

From The Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors Association.

The Potential for More Efficient Electricity Use in the Western United States, January, 2006. This report is referred to here as the "WGA CDEAC EE report" and can be found at: http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf.

Estimate of Mitigation Option Costs and Benefits for Montana RCII GHG Analysis

RCII-11 **Low income and rental housing energy efficiency programs**

Date Last Modified:	*6/6/2007 D. Von Hippel*

Key Data and Assumptions	2010	2020/all	Units
First Year Results Accrue		**2009**	
First Target: Achieve		**30%**	
Energy savings in		**50%**	
of eligible homes (household incomes less than 150 percent of Federal Poverty level) by the year		**2015**	
Ramp-up of First Target Program Complete by		**2011**	
Second Target: Achieve		**50%**	
Energy savings in		**75%**	
of eligible homes by the year		**2020**	
Start year for second target program		**2012**	
Ramp-up of Second Target Program Complete by		**2015**	
Average Cost per Home ($2005) to achieve first target		**$4,000**	
Rough estimate provided by Kane Quenemoen of MT Department of Public Health and Human Services (personal communication), based on an extrapolation of current program experience (an average of about 22 percent savings with an investment of $2700.			
Average Cost per Home ($2005) to achieve second target (directly)		**$6,500**	
Estimate provided as a starting point for analysis (range, $6000 - $7000) by Kane Quenemoen of MT Department of Public Health and Human Services (personal communication). Note that this value may change over time as homes with more severe energy-efficiency problems are weatherized, and the remaining pool of potential participants has more moderate energy use, on average, than those already treated. Future changes in technology could also, of course, affect future costs.			
Average Cost per Home ($2005) to "upgrade" from first to second target		**$2,500**	
Difference of costs above (but placeholder estimate).			
Of the above, average amount per Home ($2005) spent on health and safety measures with limited impact on energy efficiency		**$1,100**	
Estimate provided by Kane Quenemoen of MT Department of Public Health and Human Services (personal communication), based on current program experience.			
Average Lifetime of Efficiency Improvements		25	years
Assumption, but consistent with long-lived weatherization investments.			
Avoided Electricity Cost		**$49**	$/MWh
Levelized value--See "Common Factors" worksheet			
Avoided Natural Gas Cost		**$6.5**	$/MMBtu
Levelized value--See "Common Factors" worksheet			
Avoided Distillate Oil Cost		**$12.5**	$/MMBtu
Avoided LPG Cost		**$11.0**	$/MMBtu
Avoided Wood Cost		**$3.2**	$/MMBtu

Other Data, Assumptions, Calculations	2010	2020/all	Units
Total number of homes in Montana	444,698	469,553	

Uses 2005 number of housing units (from US Census data) as starting point, and with number of households assumed to grow at the same rate as population (See "MT_Activities" worksheet in this workbook)..

Fraction of Montana homes (total, not just "occupied") meeting income eligibility requirements in 2005		**20.33%**	
Fraction of Montana homes occupied by renters but with households NOT meeting income eligibility requirements in 2005		**14.63%**	
Annual average change in eligible fractions, 2006 to 2020		0.0%	
Implied fraction of households eligible for program	34.96%	34.96%	

Uses 2005 fraction of Montana residents below 150 percent of Federal powerty level. See ***Note 1****, below. (Also see "US Poverty Data" worksheet in this workbook. Data from U.S. Bureau of the Census,http://pubdb3.census.gov/macro/032006/pov/new46_135150_01.htm.)*

Implied number of households eligible for program net of those participating in existing program	146,959	138,648	

Makes the simplifying assumption that those housing units that have participated in existing MT Department of Public Health and Human Services low-income housing program from 2006 on are not eligible for the expanded program. See below for assumptons on the existing program.

Annual Average Energy Use per Household in (based on inventory estimates)			
Electricity	9.55	9.22	MWh
Natural Gas	49.78	51.98	MMBtu
Distillate Oil	2.27	2.19	MMBtu
LPG	7.79	7.52	MMBtu
Wood	3.74	3.10	MMBtu

Currently assumes that average energy use in low-income households is similar to the average energy use (for all fuels) in all households in MT. In fact, low income homes are likely to be both smaller (and thus require fewer energy services) then average homes, but are likely also less efficient--the data are not presently at hand to judge how these countervailing factors might balance (or not).

Fraction of eligible households meeting first target annually after start-up		8.3%	
Fraction of eligible households meeting first target annually	5.56%	0.00%	
Cumulative faction of eligible households meeting first target	8.33%	50.00%	
Number of households participating annually for first target	8,149	-	
Total number of households meeting first target by 2020		71,709	
Fraction of eligible households meeting second target annually after start-up		10.0%	
Fraction of eligible households meeting second target annually	0.00%	10.00%	
Cumulative faction of eligible households meeting second target	0.00%	75.00%	
Number of households participating annually for second target	-	13,249	
Total number of households meeting second target by 2020		103,986	
Assumed "cap" on total fraction of households participating:		75%	
Implied number of households "upgraded" from first to second target		32,278	
"Upgraded" households distributed over last 6	years of program		
Number of households "upgraded" annually from first to second target	-	5,380	
Number of households annually meeting second target directly (not upgraded)	-	7,870	

Annual Average Energy Savings per Household reaching first target			
Electricity	2.86	2.77	MWh
Natural Gas	14.93	15.60	MMBtu
Distillate Oil	0.68	0.66	MMBtu
LPG	2.34	2.25	MMBtu
Wood	1.12	0.93	MMBtu

Annual Average Energy Savings per Household upgrading to second target			
Electricity	1.91	1.84	MWh
Natural Gas	9.96	10.40	MMBtu
Distillate Oil	0.45	0.44	MMBtu
LPG	1.56	1.50	MMBtu
Wood	0.75	0.62	MMBtu
Annual Average Energy Savings per Household reaching second target directly			
Electricity	4.77	4.61	MWh
Natural Gas	24.89	25.99	MMBtu
Distillate Oil	1.14	1.10	MMBtu
LPG	3.90	3.76	MMBtu
Wood	1.87	1.55	MMBtu
First-year (not cumulative) Energy Savings for Households reaching first target			
Electricity	23.34	-	GWh
Natural Gas	121.69	-	Billion Btu
Distillate Oil	5.56	-	Billion Btu
LPG	19.05	-	Billion Btu
Wood	9.14	-	Billion Btu
First-year (not cumulative) Energy Savings for Households upgrading to second target			
Electricity	-	9.92	GWh
Natural Gas	-	55.93	Billion Btu
Distillate Oil	-	2.36	Billion Btu
LPG	-	8.09	Billion Btu
Wood	-	3.34	Billion Btu
First-year (not cumulative) Energy Savings for Households reaching second target directly			
Electricity	-	36.28	GWh
Natural Gas	-	204.55	Billion Btu
Distillate Oil	-	8.62	Billion Btu
LPG	-	29.58	Billion Btu
Wood	-	12.20	Billion Btu
Total Annual Investment Costs for all improvements	$ 32,598	$ 64,602	$ thousand
Includes health and safety-related measures with limited impact on energy use.			
Annual Investment Costs for energy-efficiency-related improvements	$ 23,633	$ 50,028	$ thousand
Net of health and safety-related measures with limited impact on energy use.			
Implied levelized cost of saved energy for households reaching first target			
Electricity	$ 72	$ 74	$/MWh
Calculated only for electricity, because the same investment also yields savings for other fuels.			
Implied levelized cost of saved energy for households upgrading to second target			
Electricity	$ 93	$ 96	$/MWh
Implied levelized cost of saved energy for households reaching second target directly			
Electricity	$ 80	$ 83	$/MWh
Implied first-year levelized cost of saved energy for households reaching first target in that year	$ 1,676,839	$ -	
Implied first-year levelized cost of saved energy for households upgrading to second target in that year	$ -	$ 954,239	
Implied first-year levelized cost of saved energy for households reaching second target directly in that year	$ -	$ 3,015,238	
Implied cumulative levelized cost of all participating households	$ 2,520	$ 47,955	$ thousand

Assumptions for Existing Low-income Weatherization Program (Recent Actions)

Number of homes weatherized per year	1700
Fractional energy savings in existing houses under current program	22%

Estimates based on recent MT Department of Public Health and Human Services program accomplishments provided by Kane Quenemoen of MT Department of Public Health and Human Services (personal communication).

Results	2010	2020	Units
Electricity Savings--Existing Program			
Reduction in Electricity Sales: Residential	18	53	GWh (sales)
TOTAL Reduction in Electricity Sales	18	53	GWh (sales)
Reduction in Generation Requirements	20	57	GWh (generation)
GHG Emission Savings	**0.02**	**0.05**	$MMtCO_2e$
Natural Gas and Other Fuel Savings--Existing Program			
Reduction in Natural Gas Use: Residential	92	283	Billion BTU
Reduction in Distillate Oil Use: Residential	4	13	Billion BTU
Reduction in LPG Use: Residential	15	43	Billion BTU
Reduction in Wood Use: Residential	7	20	Billion BTU
GHG Emission Savings from above	**0.01**	**0.02**	$MMtCO_2e$
Electricity Savings--Expanded Program			
Reduction in Electricity Sales: Residential	35	597	GWh (sales)
TOTAL Reduction in Electricity Sales	35	597	GWh (sales)
Reduction in Generation Requirements	38	643	GWh (generation)
GHG Emission Savings	**0.04**	**0.54**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2007-2020)		**$61**	$million
Cumulative Emissions Reductions (2007-2020)		3.4	$MMtCO_2e$
Cost-Effectiveness		**N/A**	$\$/tCO_2e$
Natural Gas and Other Fuel Savings--Expanded Program			
Reduction in Natural Gas Use: Residential	182	3,256	Billion BTU
Reduction in Distillate Oil Use: Residential	8	143	Billion BTU
Reduction in LPG Use: Residential	29	491	Billion BTU
Reduction in Wood Use: Residential	14	216	Billion BTU
GHG Emission Savings from above	**0.01**	**0.21**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2007-2020) (Avoided cost savings only)		**-$102**	$million
Cumulative Emissions Reductions (2007-2020)		1.3	$MMtCO_2e$
Cost-Effectiveness		**N/A**	$\$/tCO_2e$

Summary Results for RCII-11	2010	2020	Units
Total for Policy (Electricity, Natural Gas and Other Fuels)			
GHG Emission Savings	**0.05**	**0.75**	$MMtCO_2e$
Net Present Value (2007-2020)		**-$41**	$million
Cumulative Emissions Reductions (2007-2020)		4.7	$MMtCO_2e$
Cost-Effectiveness		**-$8.75**	$\$/tCO_2e$

NOTES AND DATA FROM SOURCES

Note 1

Montana demographics - by income level

Source: U.S. Census Bureau, Current Population Survey, 2006 Annual Social and Economic Supplement.

From: http://pubdb3.census.gov/macro/032006/pov/new46_100125_01.htm

and http://pubdb3.census.gov/macro/032006/pov/new46_135150_01.htm.

	All income levels	Below 100% of Poverty	Below 150% of Poverty
	(thousands of persons)		
Montana population (2005 data)	926	128	219
Percentage of population	100%	14%	23.7%

ratio of 150% poverty to 100% poverty:
1.711

Total Occupied Housing Units in MT, 2005:	368,268
Total Occupied Rental Housing Units in MT, 2005:	113,810

(From 2005 American Community Survey, downloaded from http://factfinder.census.gov; see "US Poverty Data" worksheet in this workbook).

Implied number of housing units occupied by households with income below 150% of poverty level in MT as of 2005: 87,096

Data Source for Poverty Status x Rental Status Estimates

Geographic Summary Level - State

Geographic Areas - State in [Montana]

Demographic Universe - Renter Occupied Housing Units

Demographic Characteristics - Person Poverty Status Recode (12) in [Less than 25%; 25.0% to 49.9%; 50.0% to 74.9%; 75.0% to 99.9%; 100.0% to 124.9%; 125.0% to 134.9%; 135.0% to 149.9%; 150.0% to 184.9%; 185.0% to 199.9%; 200.0% to 249.9%; 250.0% to 299.9%; 300.0% or more]

State	Person Poverty Status Recode (12)	Metrics Count	Cumulative totals, 2000
Montana	**Less than 25%**	6,023	Households
	25.0% to 49.9%	5,294	under
	50.0% to 74.9%	9,055	150% of
	75.0% to 99.9%	10,116	poverty level
	100.0% to 124.9%	9,872	
	125.0% to 134.9%	3,646	
	135.0% to 149.9%	5,875	49,881
	150.0% to 184.9%	11,750	Households
	185.0% to 199.9%	3,690	over
	200.0% to 249.9%	11,391	150% of
	250.0% to 299.9%	9,459	poverty level
	300.0% or more	24,796	61,086
	Total	110,967	
Total		110,967	

Source: U.S. Census Bureau, Census 2000 Sample Data File

Data users who create their own tabulations using data from the Census 2000 Sample Data File should cite the Census Bureau as the source of the original data only.

Individuals for whom poverty status is determined. Poverty status was determined for all people except institutionalized people, people in military group quarters, people in college dormitories, and unrelated individuals under 15 years old.

Above Sent by Pam Harris of the Census and Information Center, Montana Department of Commerce, attached to email to Greg Powell of Pembina/CCS on June 6, 2007 with subject "RE: Montana census data"

From above, year 2000 fraction of households in rental housing with income over 150 percent of poverty level: 55.0%

Assuming that this ratio holds for the year 2005 as well, the number of rental housing units in MT occupied by households with incomes above 150% of the poverty level is estimated at: 62,651

Estimate of Mitigation Option Costs and Benefits for Montana RCII GHG Analysis

RCII-12 **State Lead by Example**

Date Last Modified:	*6/26/2007 D. Von Hippel/A Bailie*	

Key Data and Assumptions	2010	2020/all	Units
First Year Results Accrue		2010	
Based on goal set in Policy Option Design for RCII-12 (version dated 5/1/07).			
Electricity			
Levelized Cost of Electricity Savings		$37.2	$/MWh
Based on estimate in WGA CDEAC EE Report. (See Note 1, below.) Although this estimate is based on building efficiency improvements driven by code changes, it is on the order of estimates for the costs of efficiency improvements for "beyond code" changes included in a recent report by the Southwest Energy Efficiency Project (SWEEP--see Note 2). Value here adjusted for NC prices based on 7-year payback estimated in WGA CDEAC EE Report. (See Note 1 in RCI-4.)			
Levelized Cost of Natural Gas Savings		$4.7	$/MMBtu
As estimated for RCII-4. Based on 7-year payback as estimated in WGA CDEAC EE Report. (See Note 1 in RCII-4.)			
Bulk Purchase Program:			
Fraction of State agency electricity demand addressed by bulk purchasing program		10%	
Target for Program.			
Fraction of all-sector (excluding government) electricity demand addressed by bulk purchasing program		0%	
Policy assumed to cover government demand only.			
Average lifetime of devices included in bulk purchasing program		10	years
Placeholder estimate--designed to be an average between longer-lived equipment such as water heaters and air conditioners, and shorter-lived devices such as computers.			
Fractional savings from bulk purchase program relative to standard-efficiency equipment, appliances, and other devices.		20%	
Placeholder estimate, but consistent with an average of fractional savings possible with many different types of higher-than-standard efficiency appliances, equipment, and other devices.			
Assumed Cost of Bulk Purchase Program Savings		$12	$/MWh
Pending receipt of more specific information, assumed to be similar to the cost of market transformation programs. Figure used is the same as used in RCII-2 worksheet in this workbook (From WGA EE Task Force study (2005), which cites the Retrospective Analysis of the Northwest Energy Efficiency Alliance (Violette, Ozog, and Cooney, 2003).)			
Target Year for Achieving Purchase Level		2020	
Target consistent with timing of building efficiency improvement element.			
Avoided Electricity Cost		$49	$/MWh
See "AvCost" and "Common Factors" worksheets in this workbook.			
Avoided Natural Gas Cost		$6.5	$/MMBtu
See "NG prices aeo2006" and "Common Factors" worksheets in this workbook.			

Other Data, Assumptions, Calculations	2010	2020/all	Units
Inputs to/Intermediate Results of Calculation of Electricity and Gas Savings from Beyond-code Building Improvements			
Average Electricity and Gas Savings Beyond Code Levels (new government buildings)	9%	9%	
The description for this option currently includes the following: "Reduce per-unit-floor-area consumption of grid electricity and natural gas by 20% by 2020 in existing buildings, and by 40% in new buildings by 2020. These requirements should be phased in over time." The values shown above for these parameters are initial assumptions.			
Note in particular that the level of savings shown here is beyond that already included in Option RCII-4, and thus already includes an improvement in efficiency relative to average current practice.			
Total Commercial Floorspace in Montana (million square feet)	242	256	
Estimated (see "MT_Activities_Est" worksheet in this workbook) based on USDOE EIA CBECS (commercial survey) data for the Mountain region, extrapolated using projected Montana population as a driver.			

Est. area of new commercial space per year (million square feet) *Calculated based on estimates above.*	**1.8**	**1.2**	
Implied Average Electricity Consumption per Square Foot Commercial Space in Montana as of 2005 (see ***Note 3***)		19.18	kWh/yr
Implied Average Natural Gas Consumption per Square Foot Commercial Space in Montana as of 2005 (see ***Note 3***)		44.87	kBtu/yr
Electricity Use per New/Renovated Commercial Sq. Ft. After RCII-4 Application *Based on application of RCI-4 (15-30% efficiency improvement)--see calculations and notes in "RCI-4" worksheet in this workbook. with ultimate savings of 15 percent relative to current building codes by 2010, and 30 percent by 2030.*	**16.2**	**13.2**	kWh/yr
Nat. Gas Use per New/Renovated Commercial Sq. Ft. After RCII-4 Application *Assumes the same pattern of code improvement as for electricity use, as described above.*	**35.4**	**25.9**	kBtu/yr
Implied Electricity Use per New/Renovated Commercial Square Foot After RCII-4 Application, Relative to Average in Montana as of 2005	**84.3%**	**68.7%**	
Implied Natural Gas Use per New/Renovated Commercial Square Foot After RCII-4 Application, Relative to Average in Montana as of 2005	**84.3%**	**68.7%**	
Required Net Elect/Gas Use per Square Foot New Government Space After RCII-4 Policy Relative to Average in Montana in 2005	First Year	**75%**	
	In 2020	**60%**	
Placeholder estimate, to be revised in consultation with TWG (based on pattern of improvement implied by meeting specifications in RCII-12 Option Design).			
Required Net Elect/Gas savings per Square Foot Existing Government Space After RCII-4 Policy Relative to Average in Montana in 2005 *Based on "20 percent improvement by 2020" as noted in RCII-12 Option Design.*	**1.8%**	**20.0%**	
Government floorspace (including leased) by year (million square feet)	**74**	**78**	
Implied total electricity savings in existing buildings from RCII-12	**25**	**297**	GWh/yr
Implied total gas savings in existing buildings from RCII-12	**60**	**695**	GBtu/yr

Average Fraction of Improvement in Electric Energy Intensities from:

Energy Efficiency Improvement	91%	80%
Solar Thermal Energy (hot water/space heat/space cooling)	3%	5%
On-site Solar PV	1%	3%
On-site Biomass/Biogas/Landfill Gas Energy Use	2%	4%
Green Power Purchase (from off-site, beyond electricity supply RPS)	3%	8%

All "placeholder" assumptions, but based on RCII-12 goal "Require 25% of energy use to be generated from renewable sources by 2025 in new and existing buildings. These goals may be met through any combination of on-site generation and "green power" purchases." On-site biomass/biogas/landfill gas energy use calculated so that values sum to 100%.

Average Fraction of Improvement in Gas Energy Intensities from:

Energy Efficiency Improvement	95%	80%
Solar Thermal Energy (hot water/space heat/space cooling)	5%	7%
On-site Solar PV	0%	0%
On-site Biomass/Biogas/Landfill Gas Energy Use	0%	13%
Green Power Purchase (from off-site, beyond electricity supply RPS)	0%	0%

All "placeholder" assumptions, based on goal cited above, except on-site biomass/biogas/landfill gas energy use calculated so that values sum to 100%.

Adjustment for Inclusion of Rennovated Commercial Space as Well as New Under New Code Requirements. *Currently set at 1.5 so that about 0.5 unit of renovated space is included per unit of new space (initial assumption). See Note 4. It may be useful to get further MT-specfic information regarding this value.*		**1.50**
Adjustment of Energy Use per Unit Floor Area for State/State-funded Buildings Relative to Average Commercial Building in Montana *Placeholder assumption.*	1.00	1.00

Fraction of New/Renovated Commercial Space in Government Buildings		25.4%

This estimate includes state-owned buildings plus local government buildings, including schools. Estimate is based on the fraction of commercial-sector floorspace in state and local-owned government buildings in the Mountain region, as described in CBECS 2003 data (see "MT_Activities_Est" worksheet in this workbook), pending receipt of MT-specific data.

Adjustment to Exclude Floor Area of New/Renovated State/State-funded buildings not included in option.	1.00	1.00

Placeholder assumption. Reduce below 1.0 if, for example, the option is designed to exclude small or special-use buildings.

Implied Annual Square Feet New Building Space Covered by Policy (million)	**0.83**	**0.54**

Implied Cumulative Impacts of Option, New Government Space (Electricity savings)

Energy Efficiency Improvement	**1.14**	**9.20**	GWh
Solar Thermal Energy (hot water/space heat/space cooling)	**0.04**	**0.41**	GWh
On-site Solar PV	**0.01**	**0.20**	GWh
On-site Biomass/Biogas/Landfill Gas Energy Use	**0.02**	**0.31**	GWh
Green Power Purchase (from off-site, beyond electricity supply RPS)	**0.04**	**0.55**	GWh

Implied Cumulative Impacts of Option, New Government Space (Natural Gas savings)

Energy Efficiency Improvement	**2.59**	**19.84**	GBtu/yr
Solar Thermal Energy (hot water/space heat/space cooling)	**0.14**	**1.31**	GBtu/yr
On-site Solar PV	-	-	GBtu/yr
On-site Biomass/Biogas/Landfill Gas Energy Use	**0.00**	**1.23**	GBtu/yr
Green Power Purchase (from off-site, beyond electricity supply RPS)	-	-	GBtu/yr

Implied Cumulative Impacts of Option, Existing Government Space (Electricity savings)

Energy Efficiency Improvement	**23.17**	**237.64**	GWh
Solar Thermal Energy (hot water/space heat/space cooling)	**0.76**	**14.85**	GWh
On-site Solar PV	**0.25**	**8.91**	GWh
On-site Biomass/Biogas/Landfill Gas Energy Use	**0.51**	**11.88**	GWh
Green Power Purchase (from off-site, beyond electricity supply RPS)	**0.76**	**23.76**	GWh

Implied Cumulative Impacts of Option, Existing Government Space (Natural Gas savings)

Energy Efficiency Improvement	**56.60**	**556.02**	GBtu/yr
Solar Thermal Energy (hot water/space heat/space cooling)	**2.98**	**48.65**	GBtu/yr
On-site Solar PV	-	-	GBtu/yr
On-site Biomass/Biogas/Landfill Gas Energy Use	**0.00**	**90.35**	GBtu/yr
Green Power Purchase (from off-site, beyond electricity supply RPS)	-	-	GBtu/yr

Additional Inputs to/Intermediate Results of Costs Analysis for Building Improvements

Estimated annual levelized cost of solar hot water per unit output	**20.77**	**18.70**	$/MMBtu

Based on inputs to/results of solar hot water heating included in RCII-5.

Adjustment to solar thermal costs for inclusion of space heat/cooling measures	1.00	1.00

Placeholder assumption--Value of 1.0 implies that solar space heat and cooling will cost the same per unit output as solar water heating.

Implied Per Unit Cost Electricity Avoided by Solar WH/SH/Cooling	**65.91**	**59.32**	$/MWh
Implied Per Unit Cost Natural Gas Avoided by Solar WH/SH/Cooling	**14.54**	**13.09**	$/MMBtu

Assumes delivered solar WH/SH/Cooling replaces electric with EF of 0.93, gas with EF of 0.70 (and therefore one MMBtu of delivered solar heat is the equivalent of more than one MMBtu of each fuel).

Estimated annual levelized cost of on-site Solar PV	**223**	**129**	$/MWh

Based on inputs to/results of solar PV analysis included in RCI-5.

Fuel Cost for On-site Biomass/Biogas/Landfill Gas Energy Use		**3.19**	$/MMBtu

Based on costs for Biomass fuel, which will likely dominate this category of fuel inputs. See "Common Assumptions" worksheet in this workbook. If significantly processed biomass fuels (such as pelletized fuels) are required, this cost may need to be increased.

Relative Efficiency of On-site Biomass/Biogas/Landfill Gas displacing electricity		0.75	
Placeholder assumption.			
Factor to reflect probable higher costs of on-site Biomass/Biogas/Landfill Gas Equipment Relative to Electric Equipment		2.00	
Placeholder assumption--In most cases, heating/water heating equipment designed to use biomass-derived fuels will be more expensive than equipment designed to use electricity. This factor loads these incremental capital costs into estimated fuel costs.			
Implied Per Unit Cost Electricity Avoided by Biomass/Biogas/Landfill Gas	**28.95**	**28.95**	$/MWh
Incremental Cost for Green Power Purchase (from off-site, beyond supply RPS)	25.00	15.00	$/MWh
Placeholder assumptions.			
Implied use of biomass/biogas/landfill gas by year	**2.42**	**146.83**	Billion Btu

Inputs to/Intermediate Results of Analysis of Bulk Purchase Element

Government Building Electricity Use	1,390	1,188	GWh
Net of efficiency measures from other programs and options. Does not currently include local government electricity use.			
Fractional implementation of Bulk Purchase Program targets	9.1%	100.0%	
Annual Savings from Bulk Purchase Program (not cumulative)			
State Agency Program	0.3	2.4	GWh
All-sectors (non-State) Program [not included in this policy]	0.0	0.0	GWh

Results	2010	2020	Units
Electricity (Conventional), Building Improvement Elements/Green Power Purchase			
Reduction in Electricity Sales: Residential (not included here)	0	0	GWh (sales)
Reduction in Electricity Sales: Commercial (government)	27	308	GWh (sales)
TOTAL Reduction in Electricity Sales	27	308	GWh (sales)
Reduction in Generation Requirements	29	331	GWh (generation)
GHG Emission Savings	**0.03**	**0.28**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2007-2020)		**-$7**	$million
Cumulative Emissions Reductions (2007-2020)		1.8	$MMtCO_2e$
Cost-Effectiveness		**-$3.72**	$/tCO_2e$
Electricity Savings Through Bulk Purchase Program			
Reduction in Electricity Sales: Residential (not included here)	0	0	GWh (sales)
Reduction in Electricity Sales: Commercial (government)	0	15	GWh (sales)
TOTAL Reduction in Electricity Sales	0	15	GWh (sales)
Reduction in Generation Requirements	0	16	GWh (generation)
GHG Emission Savings	**0.00**	**0.01**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2007-2020)		**-$1.4**	$million
Cumulative Emissions Reductions (2007-2020)		0.06	$MMtCO_2e$
Cost-Effectiveness		**-$22.47**	$/tCO_2e$
Natural Gas			
Reduction in Gas Use	62	717	Billion BTU
GHG Emission Savings	**0.00**	**0.04**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2007-2020)		**-$3**	$million
Cumulative Emissions Reductions (2007-2020)		0.2	$MMtCO_2e$
Cost-Effectiveness		**-$15.17**	$/tCO_2e$
Biomass/Biogas/Landfill Gas Fuel Use			
Biomass Fuels Use	**2.42**	**146.83**	Billion BTU
Added GHG Emissions from Biomass Fuels Use	**0.00001**	**0.00037**	$MMtCO_2e$
Cumulative added Emissions from Biomass Fuels (2007-2020)		0.0016	$MMtCO_2e$

Summary Results for RCI-12	2010	2020	Units
Total for Policy (Natural gas and electricity less biomass)			
GHG Emission Savings	**0.03**	**0.33**	$MMtCO_2e$
Net Present Value (2007-2020)		**-$11.4**	$million
Cumulative Emissions Reductions (2007-2020)		2.0	$MMtCO_2e$
Cost-Effectiveness		**-$5.55**	$\$/tCO_2e$
Total for Policy Less Bulk Purchase Program			
GHG Emission Savings	**0.03**	**0.31**	$MMtCO_2e$
Net Present Value (2007-2020)		**-$9.9**	$million
Cumulative Emissions Reductions (2007-2020)		2.0	$MMtCO_2e$
Cost-Effectiveness		**-$5.00**	$\$/tCO_2e$

Additional Summary Results for RCII-12 for Reporting	2010	2020	Units
Total Green Power Purchased Under RCII-12	1	24	GWh (sales)
Total Green Power Generation to Serve RCII-12	1	26	GWh (generation)
GHG Emission Savings from Green Power Component	**0.00**	**0.02**	$MMtCO_2e$
Net Present Value (2007-2020) of Green Power component of RCII-12		**$1.2**	$million
Total Renewable Energy Under RCII-12	2	37	GWh (at consumer site)
Total Reduction in Conventional Generation due to Renewable Energy Under RCII-12	2	39	GWh (equivalent at
Net Present Value (2007-2020) of renewable energy component of RCII-12	**0.00**	**0.03**	$MMtCO_2e$
		$2.4	$million

NOTES AND DATA FROM SOURCES

Note 1:

From The Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors Association.
The Potential for More Efficient Electricity Use in the Western United States, January, 2006. This report is referred to here as the "WGA CDEAC EE report" and can be found at:
http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf.

In the WGA CDEAC EE report, Building Code improvements were effectively modeled in two steps.
The first, assumed to be effectively a baseline action, in the context of this study,
but called the "Current Activities" case, brought codes up to recent IIEC levels as follows:

"In particular, we assume adoption of a recent version of the IECC leads to 5% electricity savings on average in states in colder or moderate climates, and 13% savings in homes in very hot climates (AZ, TX, and NV). Regarding commercial buildings, we assume adoption of the code leads to 10% electricity savings in moderate and colder states, and 15% savings in very hot states (Kinney, Geller, and Ruzzin 2003). For California, we used estimates of the electricity savings from building code upgrades adopted in 2001 and 2005 (Mahone, et al. 2005). These savings levels are prior to the adjustment for savings realization mentioned in Table V.1" [Quote from footnote, page 40]

The second increase, to the CDEAC "Best Practices" Scenario, included the following improvements:

"This [Best Practices] scenario assumes that the International Energy Conservation Code, 2004 version, is adopted in 2007 in all states except California, as California has its own more stringent standard. It is assumed that state and/or local building energy codes are upgraded in 2011 (3% improvement) and in 2015 (additional 6% improvement). This scenario also assumes that compliance and enforcement are improved and that a 90% savings realization rate is achieved. Finally, we assume that California's current building energy codes will be upgraded in 2009 (3%), 2013 (6%) and 2017 (3%)." [Quote from page 41]

The CDEAC report provides a cost of saved energy (electricity) of 4.74 cents/kWh,
in 2005 dollars, based on an average 7-year payback for code improvements (page 42).

Note 2:

The Southwest Energy Efficiency Project's (SWEEP) Report
Increasing Energy Efficiency in New Buildings in the Southwest: Energy Codes and Best Practices
includes state-by-state estimates of the potential savings from two scenarios of building code and "beyond code" efficiency improvements.

Note 3:

Based on results from Table B.5 of the 2003 Commercial Buildings Energy Consumption Survey, Detailed Tables dated October 2006 and published by the US Department of Energy's Energy Information Administration, and available as http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/alltables.pdf, as described in "MT_Activities_Est" worksheet in this workbook.

Following data on electricity sales in Montana as of 2005 as described in "Utility_Sales" worksheet in this workbook. Downloaded from http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html (file sales_revenue.xls)

	MWh	Fraction of Total
Residential	4,221,448	31%
Commercial	4,473,394	33%
Industrial	4,783,996	35%
Total	13,478,838	100%

For natural gas consumption data from the USDOE EIA downloaded from http://www.eia.doe.gov/oil_gas/natural_gas/applications/eia176query.html are are follows: (See "EIA_NG_Data" worksheet in this workbook for raw EIA data)

	Sales (Million Cubic Feet of Natural Gas)			
	Residential	Commercial	Industrial	Total
2005	19,834	10,162	398	30,394
Fraction of 2005 Total	65%	33%	1%	100%

Note 4:

The estimate of 0.5 unit of renovated space per unit of new construction in the commercial sector is a rough assumption.

It is likely that the ratio of commercial space undergoing major renovation to new commerial space will fluctuate year by year, and it may be necessary to get a more specific figure for this parameter. It is clear, however, that the renovation market represents a substantial opportunity for improving energy efficiency through code changes. A study of the non-residential renovation market in California (Remodeling and Renovation of Nonresidential Buildings in California, by Donald R. Dohrmann, John H. Reed, Sylvia Bender, Catherine Chappell, and Pierre Landry, available as http://www.energy.ca.gov/papers/2002-08-18_aceee_presentations/PANEL-10_DOHRMANN.PDF) suggests that by 1999 the value of renovations and additions to non-residential space was similar to that in new non-residential space, based on building permit data. As California includes a significant fraction of older buildings in its building stocks, renovations may be a smaller fraction of building activity in Montana.

Estimate of Mitigation Option Costs and Benefits for Montana RCII GHG Analysis

RCII-13 **Metering Technologies with opportunity for load management and choice**

Date Last Modified: *5/21/2007 D. Von Hippel/Michael Lazarus*

Key Data and Assumptions	2010	2020/all	Units
The following calculation estimates GHG emissions reduction from only one element of RCII-13, inverted block tariff structures. Other elements of provide GHG emissions reductions largely through supporting other policies in the RCII and Energy Supply sectors.			
First Year Results Accrue		2009	
Savings from Smart Meters and related rate structures for Residential Consumers			
Reduction in Residential Electricity Use		8%	
TWG members familiar with this technology suggest potential savings of 8 to 10 percent of consumption. A review of smart metering-related studies and pilot installations (Smart meters: commercial, regulatory and policy drivers, by Gill Owen and Judith Ward of Sustainability First, dated March 2006, Appendicies document "Appendix 2 – Smart metering experience and studies", p. 19 to 34 in document available as http://www.sustainabilityfirst.org.uk/docs/smartmeterspdfappendices.pdf) suggests potential savings in a similar range.			
Cost of Smart Meters per Meter		$200	
Assumed Cost of Implementation of Tariffs for Smart Meters		$0	$/MWh
In practice, there are likely to be some costs associated with smart meter tariff structures, including program costs, changes to billing systems, and possibly (in some cases) changes to metering or meter-reading systems. These costs are not explicitly accounted for in this analysis, but are likely to be quite small relative to the electricity cost savings achieved through the policy.			
Avoided Electricity Cost (Residential)		$49	$/MWh
See common assumptions.			
Target Number of Smart Meters Installed Under Pilot Program		45,000	
End Date of Pilot Program		2011	
Target Fraction Additional Residential Consumers Using Smart Meters, Full Program		30%	
Placeholder Assumption.			
Start Date of Full Program		2012	
Full Phase-in Date of Full Program		2020	

Other Data, Assumptions, Calculations	2010	2020/all	Units
Residential Electricity Sales	4,245	4,329	GWh
Residential Customers	456,073	481,564	
Implied Consumption per Customer	9.31	8.99	MWh
Cumulative Number of Installed Meters Under Pilot Program	30,000	45,000	
Cumulative Number of Installed Meters Under Full Program	-	144,469	
Factors for Annualizing Capital Costs (Residential Smart Meters)			
Interest Rate (real)		7%	/yr
Economic Life of Meter *(Rough estimate)*		15	years
Implied Annualization Factor		10.98%	%/yr
Implied Annualized Cost of Meters		$ 21.96	/meter-yr
Intermediate Cost Results, Pilot Program			
Total up-front meter costs for meters installed in each year	$ 3,000	$ -	thousand
Annualized Meter Costs	$ 659	$ 988	thousand
Intermediate Cost Results, Pilot Program			
Total up-front meter costs for meters installed in each year	$ -	$ 3,328	thousand
Annualized Meter Costs	$ -	$ 3,172	thousand

Results	2010	2020	Units
Electricity			
TOTAL Reduction in Electricity Sales, Pilot Program	23	33	GWh (sales)
Reduction in Generation Requirements, Pilot Program	25	36	GWh (generation)
TOTAL Reduction in Electricity Sales, Full Program	0	104	GWh (sales)
Reduction in Generation Requirements, Full Program	0	112	GWh (generation)
Totals for Pilot Program			
Total Net GHG Emission Savings, Pilot Program	**0.03**	**0.03**	$MMtCO_2e$
Net Present Value (2007-2020), Pilot Program		**-$5**	$million
Cumulative Emissions Reductions (2007-2020), Pilot Program		0.4	$MMtCO_2e$
Cost-Effectiveness, Pilot Program		**-$13**	$\$/tCO_2e$
Totals for Full Program			
Total Net GHG Emission Savings, Full Program	**0.00**	**0.09**	$MMtCO_2e$
Net Present Value (2007-2020), Full Program		**-$6**	$million
Cumulative Emissions Reductions (2007-2020), Full Program		0.5	$MMtCO_2e$
Cost-Effectiveness, Full Program		**-$12**	$\$/tCO_2e$
Totals for Policy (Pilot plus Full Programs)			
Total Net GHG Emission Savings	**0.03**	**0.12**	$MMtCO_2e$
Net Present Value (2007-2020)		**-$11**	$million
Cumulative Emissions Reductions (2007-2020)		0.9	$MMtCO_2e$
Cost-Effectiveness		**-$12**	$\$/tCO_2e$