Colorado Climate Project

the ROCKY MOUNTAIN CLIMATE Organization

www.coloradoclimate.org

Residential, Commercial & Industrial Policy Work Group
Summary List of Draft Priorities for Analysis

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 ($M)	Cost-Effective-ness ($/t$CO_2$e)	Level of CAP Support
		2012	2020	Total 2007-2020			
Option #	**RESIDENTIAL, COMMERCIAL & INDUSTRIAL**						
RCI - 1	Expanded Demand Side Management	2.2	8.3	50.1	($1,617)	($32)	TBD
RCI - 2	Energy Efficiency in Buildings Owned by State and Local Governments	0.2	0.5	3.7	($~~138~~67)	($~~37~~18)	TBD
RCI - 3	Enforcement of Building Codes	N/A	N/A	N/A	N/A	N/A	TBD
RCI - 4	Planning and Design	1.0	2.4	20.4	$~~12~~1,550	$76~~1~~	TBD
RCI - 5	Inverted Block Rates to Fund Energy Efficiency	5.0~~4.9~~	18.3~~17.1~~	109.5~~102.5~~	($3,276)~~($2,916)~~	($30)~~($28)~~	TBD
RCI - 6	Retrofitting Existing Buildings for Energy Efficiency	0.5	1.8	11.7	($~~467~~300)	($~~40~~26)	TBD
RCI - 7	Pricing and Purchasing	2.0~~1.8~~	2.6~~2.3~~	25.4~~23.3~~	($844)~~($256)~~	($33)~~($11)~~	TBD
RCI - 8	Renewable Energy Systems on New and Existing Buildings	N/A	N/A	N/A	N/A	N/A	TBD
RCI - 9	Energy Delivery (CHP)	0.68~~0.9~~	2.74~~2.7~~	16.6~~18.2~~	($49)~~$67~~	($3)~~$4~~	TBD
RCI - 10	~~Targeting Small and Medium Enterprises~~Climate Wise Statewide	~~N/A~~0.6	~~N/A~~1.0	~~N/A~~4.5	~~N/A~~TBD	~~N/A~~TBD	TBD
	Sector Total After Adjusting For Overlaps	TBD~~6.6~~	TBD ~~21.9~~	TBD ~~137.9~~	TBD ~~(3427.0)~~	TBD ~~(24.85)~~	
	Reductions From Recent Actions (table to be added below)	TBD~~-~~	TBD~~-~~	TBD~~-~~	~~-~~TBD	TBD~~-~~	
	Sector Total Plus Recent Actions	TBD ~~6.6~~	TBD ~~21.9~~	TBD ~~137.9~~	TBD ~~(3427.0)~~	TBD ~~(24.85)~~	

RCI-1. Expanded Demand Side Management

Policy Description

This option focuses on improving energy efficiency through increased investment in demand-side management programs. Energy efficiency is the lowest cost resource for reductions in electricity and natural gas use by the residential, commercial and industrial sectors. There is a long track record of cost effective energy efficiency initiatives, typically called demand side management (DSM), at the local, state and regional levels in areas around the country. There is vast potential for improving the energy efficiency of homes, appliances, businesses and industry in Colorado.

Policy Design

Goals: 1%/year reduction in energy use in all sectors relative to a Business-As-Usual (BAU) forecast

Timing: Starting in 2008, through 2020 with four year ramp-in (full 1% by 2011)

Parties Involved: Entire state's gas and electric producers, suppliers and customers

Implementation Mechanisms

In order to implement expanded DSM programs for all utilities in Colorado, a number of mechanisms should be considered. This would involve revising existing statutes to enable utility investments in energy efficiency at the levels indicated above.

Investment in energy efficiency measures could be funded through systems (or public) benefit charges or by setting up appropriate rate treatment for efficiency. A performance-based incentive is a useful tool to encourage energy efficiency implementation. A revenue cap decoupling mechanism could be implemented to remove utilities' disincentive to implement efficiency measures. Alternatively, an independent, third-party program administrator(s) (e.g., Efficiency Vermont) could be created to deliver state-wide energy efficiency measures given that most of utilities in Colorado do not have experience in delivery of energy efficiency measures. In this case, revenue decoupling is not needed.

Related Policies/Programs in Place

Several investor owned utilities (IOUs), municipal utilities (muni's) and rural electric cooperatives have established DSM policies and programs in place. House Bill 07-1037 will facilitate and expand energy efficiency programs implemented by natural gas utilities (IOUs only) in Colorado. The bill would roughly double the energy and demand savings targets of IOUs from existing levels.

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided electricity production or on-site fuel combustion

Estimated GHG Savings and Costs per $MtCO_2e$

	GHG Reductions ($MMtCO_2e$)			Gross Cost (Million $)	Gross Cost per Unit of Energy Saved	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/t$CO_2e$)
	2012	2020	Total 2007-2020					
RCI – 1 Total	2.2	8.3	50.1	$871	~~/MMbtu~~ ~~/kWh~~	($2,489)	($1,617)	($32)
Electric DSM	1.61	5.98	36.1	$645	$16/MWh	($1,444)	($799)	($22)
Gas DSM	0.62	2.34	13.9	$226	$0.86/MMBtu	($1,044)	($818)	($59)

Data Sources, Methods and Assumptions

Data Sources:

Electricity

- *Estimated DSM potential:*
  - — KEMA 2006. Colorado DSM Market Potential Assessment, March 31, 2006, available at www.xcelenergy.com/XLWEB/CDA/0,3080,1-1-1_1875_15056_15473-13518-2_171_256-0,00.html
  - — The Southwest Energy Efficiency Project (SWEEP) 2002. THE NEW MOTHER LODE: The Potential for More Efficient Electricity Use in the Southwest, November, 2002, available at www.swenergy.org/nml/New_Mother_Lode.pdf
- *Cost of saved energy and other energy efficiency policy and program assumptions:* Western Governor's Association (WGA) 2006. The Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors Association, January, 2006, available at www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf
- *Electricity price forecast by sector:* KEMA 2006. Colorado DSM Market Potential Assessment, Appendix C and Chapter 3.

Gas

- *Cost of saved natural gas and benefit cost ratio for gas DSM programs:* SWEEP 2006. Natural Gas Demand-Side Management Programs: A National Survey, Southwest Energy Efficiency Project, available at www.swenergy.org;

- *Gas price forecast by sector:* projected gas prices for the Mountain region from EIA 2007, Annual Energy Outlook 2007 for Mountain region

Avoided Energy Cost

- KEMA 2006. Colorado DSM Market Potential Assessment

Historical and Planned DSM activities

- *Current spending on and savings through utility efficiency programs in Colorado:*
  - Howard Geller 2004. Utility Energy Efficiency Policies and Programs in the Southwest, September 17, 2004: SWEEP, available at www.aceee.org/conf/05ee/05eer_hgeller.pdf
  - Howard Geller 2005. "Energy Efficiency Policies and Programs in the Southwest" presentation at the Energy Efficiency Task Force Meeting at Santa Fe, NM March 22-23, 2005: SWEEP, available at www.aceee.org/conf/05ee/05eer_hgeller.pdf
  - Peter Narog 2005. "Xcel Energy Southwest DSM Update", a presentation on November 3, 2005: Xcel Energy, available at http://swenergy.org/workshops/2005/index.html

Quantification Methods:

Regional studies of gas and electricity efficiency potential and analyses/experience in other western US states (best practices) were used to estimate efficiency savings per $ spent on programs, which in turn were used to calculate the spending required to reach the energy use reduction target.

Key Assumptions

Parameter	Value	Notes
Avoided cost of natural gas	$6.3/ MMBtu	Based on AEO 2007 for Mountain region
Avoided cost of electricity	$56/MWh	Sales-weighted average based on Xcel's Colorado DSM Market Potential Assessment, March 2006 and including energy & capacity costs.~~Sales-weighted average, includes energy & capacity costs. Based on KEMA 2006.~~
Assumed average measure lifetime	13 years	Lifetime of an efficiency program varies significantly depending on the type of program, which could range from 8 to 30 years. Measures associated with building envelopes typically last longer, while appliances last shorter.
Real discount rate for levelized cost of natural gas savings	5.00%	Consistent with utility operation of program
Cost of Saved Electricity	2.5 cents/kWh (2005$ levelized)	• From WGA 2006. $25/MWh of saved energy is slightly higher than other estimates reviewed but is reasonable given the timeframe for this analysis. Other sources identified include: • NorthWestern Energy cited $21/MWh (nominal dollars, presumably 2005) in its filing before the MT PSC (Montana PSC Docket No.: D2005.5.88 07/12/06, available at

Parameter	Value	Notes
		http://psc.mt.gov/eDocs/DocketsAndOrders/D2005-5-88_6682d.pdf) • City of Fort Collins Utilities implements DSM at $11/MWh of saved energy (Phelan, John 2007. "City of Fort Collins Utilities Demand Side Management," available at www.marketdevelop.com/docs/wapa_power_to_save_012307.ppt) • Colorado Springs Utilities' DSM program costs at $17 per MWh of saved energy on average according to Simon Baker, Senior Conservation Specialist at Colorado Springs Utilities • SWEEP (2002) assumed $20/MWh
Electricity savings per $ of program investment	4.1 MWh per $1000 investment	Based on (1) levelized cost of $25/MWh, (2) a 13 year average program lifetime and, (3) 5 % real discount rate
Natural Gas Savings per $ of Program Investment	72,700 MCF/yr per $million	Based on the average cost of a number of gas DSM programs reported in SWEEP 2006. Natural Gas Demand-Side Management Programs: A National Survey, Southwest Energy Efficiency Project, www.swenergy.org.
Cost of Saved Gas	$1.35 per mmBtu	Based on (1) natural gas savings per program investment above, (2) a 13 year average program lifetime, (3) 5% real discount rate
Target electricity efficiency savings	1.0% total savings per year, except the first three years (0.2% in 2008, 0.4% in 2009, and 0.7% in 2010)	Based on the analysis of best practices and of other efficiency potential studies in the Western US (see WGA CDEAC EE , 2005), which found 0.8 to 1.0 percent total savings per year Other electric companies have achieved savings equal to 1% or more per year, including Efficiency Vermont and Sacramento Municipal Utility, and investor owned utilities in California, Connecticut, and Massachusetts.
Target gas efficiency savings	1.0% total savings per year, except the first three years (0.2% in 2008, 0.4% in 2009, and 0.7% in 2010)	Based on gas sales savings by leading gas utilities (see SWEEP 2006)
Other legislation	Effects of HB07-1037 not modeled	This legislation directs gas and electric investor owned utilities (IOUs) to implement additional or new energy efficiency programs. The bill requires electric companies to reduce a certain amount of energy consumption and peak demand by 2018. The energy and demand reduction for electric IOUs are set equal to 5 % of the energy consumption and peak in 2006. Also, the bill requires gas companies to spend 0.5 % of their annual revenue on energy

Parameter	Value	Notes
		efficiency programs. The bill is not being modeled because of when it was signed into law (not until May 22, 2007) and because the PUC's inquiry into the regulatory changes required by this law is ongoing. (HB07-1037 Jun 18 2007Fiscal Note, available at www.leg.state.co.us)
Emissions Factors	Electricity Near Term (2008-2011): 0.92 tCO2e/MWh Electricity Long Term (2012-2020): 0.79 tCO2/MWh	Based on the Inventory & Forecast
Timing of costs and benefits	N/A	• Energy savings are assumed to continue until 2020 with no decay of program effects, because the study period is less than the average lifetime of energy efficiency measures. • Annualized program costs (amortized over a period of 13 years or longer, consistent with the life of the asset) are included in the analysis through 2020.

Key Uncertainties

Impact of HB07-1037

Additional Benefits and Costs

- Reducing dependence on imported fuel sources
- Reducing vulnerability to energy price spikes
- Reducing peak demand and improving the utilization of the electricity system
- Reducing the risk of power shortages
- Supporting local businesses and stimulating economic development
- Enabling avoidance of the most controversial energy supply projects
- Reducing water consumption by power plants
- Reducing pollutant emissions by power plants and improving public health

Feasibility Issues

It may be difficult to implement 1% per year in the early years of the program, while infrastructure is being set up. This is especially likely to be the case for rural cooperatives or municipal utilities with no existing DSM programs.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-2. Energy Efficiency in Buildings Owned by State and Local Governments

Policy Description

Revolving loan funds are proven and effective tools for promoting energy efficiency in state and local government facilities. This policy would facilitate investment by public agencies in energy efficiency improvements by providing zero interest loans. Utility cost savings would provide cash flow for repaying principle, with the cost of program limited to interest payments and loan administration.

Policy Design

Goals: 20% reduction in energy use by buildings owned by state and local governments, including schools, through use of a revolving fund providing zero-interest loans

Timing: Reductions in individual facilities to be implemented in stages over a five-year period. Program would start in 2008 with a goal of reaching 50% of state buildings by 2015.

Coverage: All buildings owned by state and local governments are eligible to participate.

Implementation Mechanisms

The Governor's Office or State Legislature must establish low- or no-interest loans from revolving state energy efficiency fund for businesses.

Low- or no-interest loans will fund 1) program administration costs including marketing, education in the form of workshops, educational materials, and/or forums, salaries for program staff to run the programs and customer service professionals to take requests for assessments and set up appointments, 2) assessment costs including vendor fees for time spent conducting assessments and providing recommendations 3) implementation costs to install measures to reduce energy use (lighting, HVAC, insulation, weatherization, improved pumps and fans, etc.) and 4) measurement and verification including data collection, program monitoring, efficiency measure support and troubleshooting, and analysis and reporting of results. ~~TBD~~

Related Policies/Programs in Place

- Greening of State Government, Executive Order D-0011-07 (April 16, 2007), D-0012-07 (April 16, 2007), and D-005-05 (July 15, 2005)
- Greening of State Government Buildings, Senate Joint Resolution 06-032 (May 8, 2006)

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided electricity production or on-site fuel combustion

Estimated GHG Savings and Costs per $MtCO_2e$

	GHG Reductions ($MMtCO_2e$)			Gross Cost (Million $)	Gross Cost per Unit of Energy Saved	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/t$CO_2e$)
	2012	2020	Total 2007-2020					
RCI - 2	0.2	0.5	3.7	$119	$4.85/MMbtu ~~/kWh~~	($~~257~~186)	($~~138~~67)	($~~37~~18)

Data Sources, Methods and Assumptions

Data Sources:

- % Commercial floor space by building type (i.e., state and local government) and number of commercial buildings by building type in the Mountain Region: 2003 Commercial Buildings Energy Consumption Survey (CBECS), Detailed Tables, dated October 2006 and published by EIA, www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/alltables.pdf
- Commercial floor space projection for the Mountain Region: EIA AEO 2006
- Number of commercial buildings in the Mountain Region in 2003: 2003 Commercial Buildings Energy Consumption Survey (CBECS), Detailed Tables, dated October 2006 and published by EIA, www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/alltables.pdf
- Cost of saved electricity: Western Governor's Association (WGA) 2006. The Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors Association, January, 2006, available at www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf
- Cost of saved natural gas: Based on the average cost of a number of gas DSM programs reported in Natural Gas Demand-Side Management Programs: A National Survey, Southwest Energy Efficiency Project. January 2006. Available at: www.swenergy.org./pubs/Natural_Gas_DSM_Programs_A_National_Survey.pdf

Quantification Methods:

Benefits: Estimates of government floor space and electricity and natural gas consumption were used to determine average consumption levels per square foot. These consumption levels were then used to determine the amount of consumption savings that needed to be achieved per square foot. The consumption savings per square foot was multiplied by the number of buildings targeted and an assumed average square footage per commercial government building to arrive at the total required energy savings. Reductions from individual facilities were not modeled.

Costs: Studies of the cost of saved gas and electricity for commercial space were used to estimate $ spent on programs per unit of energy saved which in turn, was used to translate energy savings targets into required spending levels.

Key Assumptions

Parameter	Value	Notes
Ratio of Electricity and Natural Gas Consumption per Unit of Floor Area for State/State-funded Buildings Relative to Average of Commercial Buildings in Colorado	1.00	Placeholder assumption
Forecasted Number of Government Buildings	18,532	In 2015 Based on regional data, broken out into government and non-government using proportions from CBECS and scaled to Colorado based on population
Forecasted Floor Space of Government Buildings	417,877,767	
Number of Commercial Government Buildings Reached w/ Policy	9,266	
Avg. Consumption per Sq. Ft.	~~0.00007 billion~~70 M btu/sq. ft./yr	
Average Sq. Ft. per Government Building	22,691	Based on average between 2008 and 2020
Cost per unit of saved electricity for the public sector	4.74 cents/kWh	Levelized
Cost per unit of saved natural gas for the commercial sector	1.4$/MMBtu	Levelized
~~Loan interest~~	~~0%~~	
Timing of costs, benefits, and goal attainment	N/A	• Assumed an even ramp in to achieve goals in 2015 • Energy savings are assumed to continue until 2020 with no decay of program effects, because the study period is less than the average lifetime of energy efficiency measures. ~~Benefits continue at 2015 level through 2020 with no decay~~ • ~~Program cost terminated after 2015~~Annualized program costs (amortized over a period of 13 years or longer, consistent with the life of the asset) are included in the analysis through 2020, while the program itself ends in 2015.
Emissions Factors	Electricity All Times Near Term (2008-2011): 269	Based on the Inventory & Forecast

	tCO2e/billion BTU Electricity All Times Long Term (2012-2020): 231 tCO2e/billion BTU Natural Gas: 52.79 tCO2e/billion BTU	
Avoided Cost of Fuel	Avoided Cost of Commercial Electricity: $56/MWh Avoided Cost of Natural Gas: $6.3/MMBtu	–Electricity: Electricity avoided costs are based on Xcel's Colorado DSM Market Potential Assessment, March 2006 and include energy & capacity costs. Natural Gas: Based on AEO 2007 for Mountain region

Key Uncertainties

- Total government buildings and building space in Colorado (regional estimates used)
- Fraction of commercial buildings that are government-owned (proportion from 2003 for the Mountain Region used)

Additional Benefits and Costs

- Reducing dependence on imported fuel sources
- Reducing vulnerability to energy price spikes
- Reducing peak demand and improving the utilization of the electricity system
- Reducing the risk of power shortages
- Enabling avoidance of the most controversial energy supply projects
- Reducing water consumption by power plants
- Reducing pollutant emissions by power plants and improving public health

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI–3. Enforcement of Building Codes

Policy Description

Building energy codes can be an effective way to eliminate the least efficient energy approaches in new or renovated buildings. The International Energy Conservation Codes (IECC) have become a widely accepted standard. These codes are updated every three years through an exhaustive consensus process involving a large number of code officials and building experts. Many Colorado jurisdictions adopt the IECC. More will do so as a result of legislation (HB1146) recently signed by the Governor. Adoption of the IECC will do no good, however, if it is not enforced, and enforcement is questionable in many building jurisdictions. Building code jurisdictions need to be encouraged to enforce the IECC with training, technical support and education. Enforcement is a critical element in the success of any code, but it may be particularly important for the success of policies that must be undertaken during planning and construction, such as RCI-4.

~~Colorado is a home rule state – incentives to local governments are more acceptable than mandates. Incentives will take the form of training and technical support for the inspectors, plan reviewer and code officials as well as education for builders and contractors. This approach can have the added benefit of educating local governments and the contractors and builders about the programs that encourage "beyond code" construction.~~

Policy Design

Goals: Spend $1M/yr in training and resources to improve energy code enforcement

Timing: Begin funding in 2008

Coverage: Covers ~~the 20,000~~ new residential and commercial buildings~~homes per year in CO,~~ plus retrofits.

Implementation Mechanisms

Colorado is a home rule state – incentives to local governments are more acceptable than mandates. Incentives will take the form of training and technical support for the inspectors, plan reviewer and code officials as well as education for builders and contractors. This approach can have the added benefit of educating local governments and the contractors and builders about the programs that encourage beyond code construction.

~~TBD~~

Related Policies/Programs in Place

Some areas are already "beyond code".

HB 1146 requires county and municipal boards that have building codes to adopt standards at least as stringent as the 2003 International Energy Conservation Code (IECC). This bill has been passed by the legislature and signed by the governor.

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided electricity production or on-site fuel combustion

Estimated GHG Savings and Costs per $MtCO_2e$

Not applicable.. Discussions with industry experts and literature review suggest that increased funding for enforcement could yield considerable energy and emissions savings, if additional training is provided and funding is sustained.

Data Sources, Methods, and Assumptions

Data Sources: City of Fort Collins. "Evaluation of New Home Energy Efficiency: An assessment of the 1996 Fort Collins residential energy code and benchmark study of design, construction and performance for homes built between 1994 and 1999: Summary Report" June 2002.

Quantification Methods: A literature review was conducted. Returns (emissions reductions) on investment in enforcement training and technical support for the inspectors, plan reviewer and code officials were not quantified. However, several costs that will factor into enhancing code enforcement were identified:

- Anecdotal evidence suggests that doing an insulation inspection would provide significant energy-reduction benefits. In many areas, inspecting insulation would require an additional trip to the site between the inspection of structural elements and inspection of finished work. In addition to the person-hours at the site, the additional trip would incur travel time and expense.
- Training: the cost of formal courses varies widely ($65/day per person from the CO Chapter of the International Code Council, to as much as $2000/day for code consultants). On-the-job training may be more effective than courses; however, the costs of mentoring (in terms of lowered productivity for the mentor) would vary depending on the situation.

Key Assumptions: Not applicable.

Key Uncertainties

Travel time figures prominently into the cost of making more inspections, which could be instrumental in improving insulation installation. The cost of adding an insulation inspection into the process will vary widely by the size of the jurisdiction and corresponding travel times.

On-the-job training may be more effective than courses; however, the costs of mentoring (in terms of lowered productivity for the mentor) could vary widely by jurisdiction.

Additional Benefits and Costs

- Reducing home heating and cooling costs
- Reducing dependence on imported fuel sources
- Reducing vulnerability to energy price spikes
- Reducing peak demand and improving the utilization of the electricity system
- Reducing the risk of power shortages
- Enabling avoidance of the most controversial energy supply projects
- Reducing water consumption by power plants
- Reducing pollutant emissions by power plants and improving public health

Feasibility Issues

Many building inspectors see energy codes as an additional obligation, one that has generally not come with an increase in department budget and that is secondary to what they perceive as the primary function of building inspection: maintaining health and safety, comfort and durability. There is resistance to changing enforcement processes among building inspectors. As a result of this and other market failures, changes in codes may achieve only a fraction of the intended benefits (e.g. Fort Collins' 1996 code revisions produced only about half of the anticipated natural gas savings). This inertia is being overcome in some jurisdictions, but only with dedicated leadership by head inspectors. Difficult-to-quantify organizational factors will be key in the success or failure of any program to enhance energy code enforcement.

Although additional staffing resources might help to step up enforcement efforts, code professionals have emphasized the importance of sustained funding.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-4. Planning and Design

Policy Description

This policy seeks to mandate building design to a very high efficiency standard for government-owned buildings and aggressively encourage voluntary efforts to design residential homes and nongovernment commercial buildings to very high efficiency standards. This policy will ensure that the next generation of buildings in Colorado produces much lower GHG emissions per unit of utility.

Since Colorado is a home rule state, mandates for buildings owned by home rule local governments will need to originate with their governing bodies.

Policy Design

Goals:

- Mandate that of all new construction and major renovations of government-owned buildings, including schools and publicly-owned hospitals, 30% reduce energy consumption 37% consistent with LEED™ Gold~~attain LEED™ certification; 30% must be certified to LEED™ Gold,~~ and the other 70% reduce energy consumption 30% consistent with~~to~~ LEED™ Silver.
- For residential: Voluntary efforts will result in attainment of a 15% reduction in energy consumption by 70% of new homes consistent with the EnergyStar ~~standard~~ "high performing" standard (see HPH100.org for definition)~~ by 70% of new homes~~.
- Commercial: Voluntary efforts will result in attainment of a 50% to 70% reduction in energy consumption by 70% of new buildings consistent with the Architecture 2030 standards which increase in stringency over time~~ by 70% of new buildings~~.

Timing:

- For Government buildings, applies to new structures and major renovations for which design begins after December 31, 2007
- For residential, 70% by 2015
- For commercial, 70% meet standards by 2015

Coverage: See above

Implementation Mechanisms

For government buildings, ~~TBD~~

~~D~~different approaches will be utilized to gain participation by state and local governments.

For residential, **100%** exemption of the assessed property value for construction of new, private residential units that achieve the EnergyStar "high performing" standard
For commercial: **100%** exemption of the assessed property value for construction of new, private commercial buildings that achieve Architecture 2030 standards. Residential units include new or rehabilitated apartment structures with four or more units but do not include detached residential structures.

- County property tax credit to any commercial building that achieves Architecture 2030 certification. The duration of the tax credit is for ten consecutive years.
- Full property state and county tax abatement for any building achieving LEED™ Gold certification for the first five years, then tapering off by 20% each year until the tenth year.

Related Policies/Programs in Place

- US Green Buildings Council's LEED™ New Construction (NC), LEED™ Existing Buildings (EB), LEED™ Core and Shell (C&S), and LEED™ Homes (H) (expected launch of LEED for Homes in Fall 2007)
- Colorado Homebuilders Association Built Green
- EPA Energy Star and HPH100
- Architecture 2030
- State of Colorado:
- Energy Performance Contracting to Improve State Facilities, Executive Order D-014-03 (July 16, 2003)
- State-Owned Facilities – Energy Conservation, Colorado Revised Statute 24-82, Part 6, Sections 601-602 – required energy performance goal (1982)
- Outdoor Lighting Fixtures, Colorado Revised Statute 24-82, Part 9, Sections 901-902 – standards (1982)
- Senate Bill 07-051 (impact not known)

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided electricity production or on-site fuel combustion

Estimated GHG Savings and Costs per $MtCO_2e$

	GHG Reductions ($MMtCO_2e$)			Gross Cost (Million $)	Gross Cost per Unit of Energy Saved	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/t$CO_2e$)
	2012	2020	Total 2007-2020					
RCI – 4 Total	1.0	2.4	20.4	$2,614	$18.45/MMbtu ~~/kWh~~	($1,~~572~~065)	$1,~~042~~550	$76~~51~~
Govt.	0.4	0.6	6.0	$654	$16.79/MMbtu	($307)	$348	$58
Com.	0.~~47~~5	1.4	11.2	$1,777	$24.21/MMbtu ~~/kWh~~	($~~771~~557)	$1~~,005~~.219	~~90~~$109
Res.	0.~~15~~2	0.4	3.2	$183	$6.25/MMbtu ~~/kWh~~	($~~376~~201)	($~~193~~17)	($5~~9~~)

Data Sources, Methods and Assumptions

Data Sources:

- For government (LEED):
  - — *% Commercial floor space by building type (i.e., state and local government) and number of commercial buildings by building type in the Mountain Region:* 2003 Commercial Buildings Energy Consumption Survey (CBECS), Detailed Tables, dated October 2006 and published by EIA, www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/alltables.pdf
  - — *Commercial floor space projection for the Mountain Regions:* EIA AEO 2006
  - — Enermodal Engineering, Inc. 2007. The Costs and Benefits of LEED-NC in Colorado, prepared for Colorado Governor's Energy Office, March 2007, available at www.colorado.gov/rebuildco/services/highperformance/leed_cost/index.htm
  - — Gregory H. Kats 2003. Green Building Costs and Financial Benefits: A Report to California's Sustainable Building Task Force, available at www.cap-e.com/ewebeditpro/items/O59F3481.pdf
- For commercial (Architecture 2030):

- — % Commercial floor space by building type (i.e., non- government) and number of commercial buildings by building type in the Mountain Region: 2003 Commercial Buildings Energy Consumption Survey (CBECS), Detailed Tables, dated October 2006 and published by EIA, www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/alltables.pdf
- — Commercial floor space projection for the Mountain Regions: EIA AEO 2006
- — Architecture 2030 website: www.architecture2030.org/

- For residential (EnergyStar "High Performing" Homes):
  - — Number of and average floor space projections of residential starts in the Mountain Region: EIA AEO 2006
  - — Total residential homes and survival rate of existing homes in 2001 in the Mountain Region: EIA AEO 2006
  - — % of Mountain Region population in Colorado: Census 2000
  - — Reduced energy consumption of new homes vs. older homes: Comparison of Newer and Older California Homes Energy Use (http://aceee.org/conf/06et/st2_friedmann.pdf) and Efficiency Measures Saturation and the California Statewide Residential Appliance Saturation Study (http://websafe.kemainc.com/RASSWEB/uploads/Volume%202,%20sections%201%20and%202.pdf)
  - — EnergyStar High Performing Homes website: www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_features

Quantification Methods:

Benefits: For policies affecting the commercial sector, energy savings were quantified based on estimated % energy reductions per sq. ft, reach, average square footage per building, and average consumption per square footage. For the residential sector, energy savings were quantified based on estimated % energy reductions per home, reach and average consumption per home.

Costs: Costs were quantified for all policies using an average cost per sq. ft. for new construction (i.e., this cost was applied to residential and commercial policies) for LEED. The cost premium for LEED was based on actual data. Cost premiums were extrapolated for Architecture 2030 and EnergyStar "High Performing" Homes based on the energy reductions and cost premiums for LEED. The incremental costs were calculated for the commercial policies using the amount of annual incremental square footage from 2008 forward and the cost premium per sq.ft. The incremental costs were calculated for the residential sector using the number of incremental homes built from 2008 forward and the cost premium per square foot, as well as an assumption about the average square footage per home in Colorado.

Cross-Sector Key Assumptions:

Parameter	Value	Notes
Timing of costs, benefits, and goal attainment	N/A	• Assumed an even ramp in to achieve goals in 2015 • Energy savings are assumed to continue until 2020 with no decay of program effects, because the study period is less than the

Parameter	Value	Notes
		average lifetime of energy efficiency measures. • Annualized program costs (amortized over a period of 13 years or longer, consistent with the life of the asset) are included in the analysis through 2020, while the program itself ends in 2015.~~Benefits continue at 2015 level through 2020 with no decay~~ • ~~Program cost terminated after 2015~~
Applicability	N/A	All units built in 2008 and after are assumed to be new.
Emissions Factors	Electricity All Times Near Term (2008-2011): 269 tCO_2e/billion BTU Electricity All Times Long Term (2012-2020): 231 tCO_2e/billion BTU Natural Gas: 52.79 tCO_2e/billion BTU	Based on the Inventory & Forecast

Government Sector Policy Key Assumptions:

Parameter	Value	Notes
Forecasted Number of New and Renovated Government Buildings (2008-2015)	7,347	Based on regional data, broken out into government and non-government using proportions from CBECS and scaled to Colorado based on population
Number of Commercial Government Buildings Reached w/ Policy	7,347	
Avg. Consumption per Sq. Ft.	~~0.00007 billion~~70 M btu/sq. ft./yr	
Average Sq. Ft. per Government Building	22,691	Based on average between 2008 and 2020
Ratio of Renovated Government Buildings to New Government Buildings	1.00	Placeholder assumption
Ratio of Electricity and Natural Gas Consumption per Unit Floor Area for State/State-funded Buildings Relative to Average Commercial Building in Colorado	1.00	Placeholder assumption
Energy Use Reductions due to Energy Efficiency in a LEED Gold Building	37%	Above standard code

Parameter	Value	Notes
Energy Use Reductions due to Energy Efficiency in a LEED Silver Building	30%	Above standard code
Standard New Construction Cost w/o LEED Implementation	$169/sq. ft.	Avg. across 11 CO projects; data from hospitals was not present in the sample from which this assumption was made
LEED requirements	N/A	Targeted buildings would be required to obtain points from the energy and atmosphere category in order to achieve the assumed average energy reductions for LEED Gold and LEED Silver. Credits from site, water efficiency, materials and resources, and indoor environmental quality can be obtained but would be incremental to energy requirements.
Other legislation	Effects of SB07-051 not modeled	Goals outlined in SB07-051 will overlap with the goals outlined in this policy.
Loan period	30 years	Consistent with life of asset
Real discount rate	5.0%	Consistent with government financing
LEED Construction Cost Premium	~~3.1~~6%	Study group member contribution based on a study by the Weidt Group on LEED conducted for the City of Henderson, NV; average of LEED Silver~~Avg. across 5 CO LEED Gold and Silver projects; data from hospitals was not present in the sample from which this assumption was made~~ and LEED Gold incremental costs
Avoided Cost of Fuel~~Avoided Cost of Fuel?~~	Avoided Cost of Commercial Electricity: $56/MWh Avoided Cost of Natural Gas: $6.3/MMBtu	Electricity: Electricity avoided costs are based on Xcel's Colorado DSM Market Potential Assessment, March 2006 and include energy & capacity costs. Natural Gas: Based on AEO 2007 for Mountain region

Commercial Sector Policy Key Assumptions:

Parameter	Value	Notes
Forecasted Number of New Commercial Buildings (2008-2015)	16.102	Based on regional data, broken out into government and non-government using proportions from CBECS and scaled to Colorado based on population
Number of Commercial Non-Government Buildings Reached w/ Policy	11,271	
Avg. Consumption per Sq. Ft.	~~0.00007 billion~~ 70 Mbtu/sq. ft./yr	
Average Sq. Ft. per Commercial Building	14,851	Based on average between 2008 and 2020

Parameter	Value	Notes
Architecture 2030 Reduction Consumption Targets	0.000021	In 2015 Adjusted to provide for some ramp in given that reductions were slated to begin in 2005 according to Architecture 2030
Loan period	30 years	Consistent with life of asset
Real discount rate	8.0%	Consistent with commercial financing
Construction Cost Premium	15~~9~~%	Study group member contribution based on a study by the Weidt Group on LEED conducted for the City of Henderson, NV; representative of the LEED Platinum incremental cost~~Mid-range assumption for very high efficiency buildings~~
Avoided Cost of Fuel~~Avoided Cost of Fuel~~	Avoided Cost of Commercial Electricity: $56/MWh Avoided Cost of Natural Gas: $6.3/MMBtu	Per the Common Factors

Residential Sector Policy Key Assumptions:

Parameter	Value	Notes
Forecasted Residential Starts (2008-2015)	395,729	Based on regional data and scaled to Colorado based on population
Number of New Residential Homes Reached w/ Policy	277,010	
Avg. Consumption per Sq. Ft.	50 M~~0.00005 billion~~ btu/sq. ft./yr	
% Energy Reduction to account for focus on New Homes vs. New/Existing Homes	15%	Based on a dataset comparing energy consumption of new vs. existing homes in California
% Energy Reduction Goal Beyond that for New Homes for EnergyStar "High Performing" Homes	15%	Stated goal
Avg. Sq. Ft. of a New Residential Home	1,973	Based on average between 2008 and 2020
Loan period	30 years	Consistent with life of asset
Real discount rate	7.0%	Consistent with residential financing
Construction Cost Premium	0.5%	Program estimate
Avoided Cost of Fuel~~Avoided Cost of Fuel~~	Avoided Cost of Residential Electricity: $68/MWh Avoided Cost of Natural Gas: $6.3/MMBtu	Per the Common Factors

Key Uncertainties

Most of the policy working group believes that it is unlikely that 70% of the commercial sector can achieve Architecture 2030 targets under a voluntary program; additional research is being conducted to determine if a more reasonable reach should be utilized.

The cost premium associated with Architecture 2030 is an estimate and will be replaced if/when reference data becomes available.

An estimated construction cost per square foot applicable to the residential sector would be much preferred over the commercial construction cost per square foot that is currently being used.

Additional Benefits and Costs

- Reducing dependence on imported fuel sources
- Reducing vulnerability to energy price spikes
- Reducing peak demand and improving the utilization of the electricity system
- Reducing the risk of power shortages
- Supporting local businesses and stimulating economic development
- Enabling avoidance of the most controversial energy supply projects
- Reducing water consumption by power plants
- Reducing pollutant emissions by power plants and improving public health

Feasibility Issues

Not all parties were able to agree that the aggressive and likely costly goal of 70% voluntary participation for the Commercial sector could be achieved.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-5. Inverted Block Rates to Fund Energy Efficiency

Policy Description

This option uses tiered, increasing surcharges to simultaneously provide a source of funding for energy efficiency and a financial incentive to adhere to high energy efficiency (low energy intensity) standards. Unlike a traditional public benefits charge, the surcharge grows with increasing use above target levels. High efficiency consumers will pay no surcharge.

Note: implementing this state wide would probably require legislation.

Policy Design

Goals: Standard rates up to Architecture 2030 targets, 2 cents per kWh surcharge for kwh above 2030 target up to two times the 2030 target, and 5 cents/kWh surcharge for all kwh in excess of two times the Architecture 2030 target. Proceeds to be used to fund energy efficiency programs in the Residential & Commercial sectors.

Timing: Starting in 2010

Coverage: Rates are applicable statewide, Residential & Commercial sectors.

Implementation Mechanisms

State Legislature must give the Public Utilities Commission authority to collect rates above cost-of-service and establish the fund for energy efficiency programs, to be run by load serving entities.

The Public Utilities Commission would provide oversight of implementation of inverted block rates and administration of energy efficiency programs.

Collected funds could be used by utilities or by an independent, third party efficiency administrator(s) to implement energy efficiency measures. A performance-based incentive is a useful tool to encourage energy efficiency implementation. A revenue cap decoupling mechanism could be implemented to remove utilities' disincentive to implement efficiency measures.

Related Policies/Programs in Place

Architecture 2030 (www.architecture2030.org/news/targets.html)

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided electricity production

Estimated GHG Savings and Costs per $MtCO_2e$

	GHG Reductions ($MMtCO_2e$)			Gross Cost (Million $)	Gross Cost per Unit of Energy Saved	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
	2012	2020	Total 2007-2020					
RCI - 5	5.0~~4.9~~	18.3~~17.1~~	109.5~~102.5~~	$1979	~~/MMbtu~~ $14/M~~k~~Wh	($5,255)	($3,276)~~($2,916)~~	($30)~~($28)~~

Data Sources, Methods and Assumptions

Data Sources:

- *Price elasticity of electricity:* EIA, Price Responsiveness in the AEO2003 NEMS Residential and Commercial Buildings Sector Models, available at www.eia.doe.gov/oiaf/analysispaper/elasticity/index.html and www.eia.doe.gov/oiaf/analysispaper/elasticity/table1.html
- *Electricity prices:* same sources as used for RCI-1.
- *Return on investment in efficiency measures:* same sources as used for RCI-1.
- *Architecture 2030 targets:* "The fossil fuel reduction standard for all new buildings shall be increased to:

  60% in 2010
  70% in 2015
  80% in 2020

Source: www.architecture2030.org/2030_challenge/index.html

Quantification Methods:

Identify the share of electricity consumption among energy sources by sector; estimate electricity consumption levels based on Architecture 2030 target. Project change in electricity consumption based on price elasticity and revenues available for energy efficiency programs. Estimate energy savings based on price elasticity as well as new energy efficiency programs funded by inverted block rates. (See the data sources, quantification methods, and assumptions for RCI-1 for an explanation of the analysis of RCI-5's enhanced energy efficiency benefits)

Key Assumptions

Parameter	Value		Notes
Price elasticity of electricity			
Residential	~~2008~~	~~2020~~	Source: Short-term price elasticity from EIA,

Parameter	Value	Notes
	-0.200 ~~-0.490~~	www.eia.doe.gov/oiaf/analysispaper/elasticity/table1.html
Commercial	-0.100 ~~-0.450~~	In reality, price elasticity differs widely among consumers. For simplicity, we assume that these price elasticity data used by EIA represent price elasticity for the entire residential sector and the entire commercial sector.
Architecture 2030 Challenge Site EUI Targets	60 % in 2010, 70% in 2015, and 80% in 2020	Architecture 2030 calls for reduction in fossil fuel energy use in all buildings by 60% by 2010, by 70% by 2015, and by 80% by 2020. For this policy option, these targets are used to set the base electric consumption level per capita for the residential sector and per square foot of a building for the commercial sector. The policy charges an extra 2 cents/kWh for consumption above the Architecture 2030 goals and an extra 5 cents/kWh for consumption above twice the Architecture 2030 goals.
Substitution effect for heating fuel (cross price elasticity)	0	This effect was not analyzed because it does not appear significant for the analysis. EIA reports that cross-price elasticity for electricity to natural gas for the residential sector is 0.01; for the commercial sector, it is 0.01. (AEO2003)
Assumed Cost of Implementation of Inverted-Block Tariffs	$0/MWh	In practice, there will be some costs associated with implementing inverted-block tariff structures, including program administration costs and changes to billing 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 & Commercial)	$61/MWh	Electricity avoided costs are based on Xcel's Colorado DSM Market Potential Assessment, March 2006 and include energy & capacity costs.
Levelized Cost of Electricity Savings	2.5 cents/kWh (2005$ levelized)	See notes under RCI-1.
Electricity Savings per $ of Program Investment (first year savings)	4.1 MWh/$1000 spent, or $247/MWh 1st yr savings	See notes under RCI-1.
Retail electric rates	9 cents/kWh for residential and 7.5 cents/kWh for commercial	Colorado average retail price in 2006 from EIA "Current and Historical Monthly Retail Sales, Revenues, and Average Retail Price by State and by Sector (Form EIA-826)" available at www.eia.doe.gov/cneaf/electricity/epa/epat7p

Parameter	Value	Notes
		4.html
Emissions Factors	Electricity Near Term (2008-2011): 0.92 tCO2e/MWh Electricity Long Term (2012-2020): 0.79 tCO2/MWh	
Timing of costs and benefits	N/A	• Energy savings are assumed to continue until 2020 with no decay of program effects, because the study period is less than the average lifetime of the program measures. • Annualized program costs (amortized over a period of 13 years or longer, consistent with the life of the asset) are included in the analysis through 2020.

Key Uncertainties

PUC, consumers, and utilities may be averse to adopting steep inclining block rates. Provisions for low income consumers may be required (e.g. PG&E has separate tiered rates for low income schedules.)

Additional Benefits and Costs

TBD

Feasibility Issues

For IOUs, this policy must go through a regulatory process. For utilities not under PUC authority, this policy may require legislation.

As constructed, this policy has received objections from some PWG members representing utilities. Cost recovery for energy supply could be difficult and complex under this policy where additional charges for higher consumption are used to fund energy efficiency, which in turn has the effect of reducing energy sales. An alternative policy construction that includes a cost-based inverted block rate consistent with ratemaking principles may find stronger support among the PWG.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-6. Retrofitting Existing Buildings for Energy Efficiency

Policy Description

This option is designed to improve the energy efficiency of existing privately owned (e.g., non-municipal) commercial and industrial buildings through a variety of energy-efficiency upgrades and improvements in day-to-day operations. Existing commercial and industrial buildings account for roughly 20% of GHG emissions. Because many buildings are extremely inefficient, small efficiency upgrades can result in dramatic reductions in GHG emissions and economic savings.

This proposal would provide short-term, low- or no-interest loans from the state (paid back by energy savings) to businesses to offset the initial costs and thus encourage energy-efficiency upgrades. It could also create low- or no-interest loans to energy service companies who contract with commercial and industrial clients to implement energy-savings measures.

Policy Design

Goals: By 2017, reach 5% per year of existing commercial non-government (including institutional) and industrial buildings with low interest loans from revolving fund – recipients to achieve 25% reduction in energy use on a per square foot basis over five years.

Timing: Begin in 2008, continuing for 5 years. Renewed every 5 years, based on satisfactory outcome.

Coverage: Commercial, industrial and institutional properties

Implementation Mechanisms

Governor's Office or State Legislature must establish low- or no-interest loans from revolving state energy efficiency fund for businesses.

Low- or no-interest loans will fund (1) assessments of historic and current energy use, (2) assessments of the efficacy of proposed energy efficiency measures, and (3) installation of efficiency measures, including improved lighting, control measures, efficient HVAC equipment, insulation, weatherization, and improved pumps and fans to reduce energy use in buildings without sacrificing performance over 10 years by 50% by businesses, including energy service companies. Educational materials, workshops, and forums can be instrumental in helping building owners and operators learn how energy efficiency measures, sometimes requiring small expenditures, can result in dramatic savings in utility costs.

Workshops, educational materials, and forums could also help raise awareness of tax credits, incentives, and loans that are available to assist in retrofit efforts.

~~TBD~~

Related Policies/Programs in Place

State Partners for Energy and the Environment program for inspectors to identify energy efficient potential during their regular inspections; Colorado Business Energy Partnership helps Colorado companies identify cost-effective strategies to boost energy efficiency; EPA's Energy Star program offers free tools to property owners to assess energy efficiency potential; Industrial Assessment Center/DOE offer free energy audits for small- and medium-sized businesses.

Colorado Bill 07-1037 was passed in May, 2007, and directs the Public Utilities Commission to adopt rules establishing funding and cost recovery mechanisms for natural gas distributors of to engage in conservation and energy efficiency programs, and directs distributors of natural gas and electric to develop and implement cost-effective energy efficiency programs once such rules are adopted.

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided electricity production or on-site fuel combustion

Estimated GHG Savings and Costs per $MtCO_2e$

	GHG Reductions ($MMtCO_2e$)			Gross Cost (Million $)	Gross Cost per Unit of Energy Saved	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
	2012	2020	Total 2007-2020					
RCI - 6	0.5	1.8	11.7	$218	$2.87~~4.85~~/MMbtu ~~/kWh~~	($~~685~~518)	($~~467~~300)	($26~~40~~)

Data Sources, Methods, and Assumptions

Data Sources:

- % Commercial floor space by building type (i.e., state and local government) and number of commercial buildings by building type in the Mountain Region: 2003 Commercial Buildings Energy Consumption Survey (CBECS), Detailed Tables, dated October 2006 and published by EIA, www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/alltables.pdf
- Commercial floor space projection for the Mountain Regions: EIA AEO 2006
- Industrial floor space and establishments in the US: EIA 2002 Manufacturing Energy Consumption Survey, www.eia.doe.gov/emeu/mecs/mecs2002/data02/pdf/table9.1_02.pdf

- Ratio between the number of industrial firms in Colorado vs. the US: 2003 US Census, www.statemaster.com/graph/ind_tot_num_of_ind_fir-industrial-firms-total-number-establishments
- Cost data: Colorado DSM Market Potential Assessment Final Report to Xcel Energy, Prepared by KEMA, Inc. with assistance from Quantum Consulting, March, 31, 2006. Found at: www.swenergy.org/news/Xcel_DSM_Potential_Study.pdf and http://swenergy.org/news/Xcel_DSM_Potential_Study_Appendices.pdf

Quantification Methods:

Benefits: The electricity and natural gas usage per square foot of commercial and industrial was reduced based upon how many years the building participants had been involved in the program. Participants involved in the program longer were tasked with generating greater energy usage reductions over the course of the 5 year period that they participated in the policy. This reduced usage was then multiplied by the number of buildings reached by this policy and the average estimated square footage of those buildings, to determine how much energy could be saved.

Costs: Cost assumptions per the energy savings achieved were developed. These were based on estimated program administration and participant implementation dollars spent and assumed that incentives would be provided that would fully cover the participant implementation cost.

Key Assumptions:

Parameter	Value	Notes
Existing Commercial Buildings	66,953	As of 2008 Commercial buildings were based on regional data, broken out into government and non-government using proportions from CBECS and scaled to Colorado based on population
Existing Industrial Buildings	4,833	As of 2008 Industrial buildings were based on national data and scaled to Colorado using an estimate of the percentage of industrial firms in Colorado
Number of Commercial Buildings Reached w/ Policy	33,477	
Number of Industrial Buildings Reached w/ Policy	2,417	
Avg. Consumption per Sq. Ft. for Commercial Buildings	0.00007 billion btu/sq. ft./yr	
Avg. Consumption per Sq. Ft. for Industrial Buildings	0.00004 billion btu/sq. ft./yr	
Average Sq. Ft. per Commercial Building	14,851	
Average Sq. Ft. per Industrial Building	86,458	
Satisfactory outcome	N/A	Assumed that this was achieved and that coverage continued

Timing of costs, benefits, and goal attainment	N/A	• Assumed an even ramp in to achieve goals in 2017 • Participants who began the program in 2014 or later continued to increase reduction goals annually to achieve the 25% goal; even if this goal was achieved after 2017 • Energy savings are assumed to continue until 2020 with no decay of program effects, because the study period is less than the average lifetime of energy efficiency measures. • ~~Benefits continue after goals are achieved with no decay~~ • Annualized program costs (amortized over a period of 13 years or longer, consistent with the life of the asset) are included in the analysis through 2020, while the program itself ends in 2018.~~Program cost decayed based on participation from 2018 on~~
Total Interest Cost	$~~123,436,602~~74,782,885	Financed at 8%
Total Capital Cost	$~~94,348,903~~143,002,620	
Loan period	13 years	Consistent with life of asset
Real discount rate	8.0%	Consistent with commercial financing
Emissions Factors	Electricity All Times Near Term (2008-2011): 269 tCO_2e/billion BTU Electricity All Times Long Term (2012-2020): 231 tCO_2e/billion BTU Natural Gas: 52.79 tCO_2e/billion BTU	Based on the Inventory & Forecast
Avoided Cost of Fuel	Avoided Cost of Commercial & Industrial Electricity: $48/MWh Avoided Cost of Natural Gas: $6.3/MMBtu	Electricity: Electricity avoided costs are based on Xcel's Colorado DSM Market Potential Assessment, March 2006 and include energy & capacity costs. Natural Gas: Based on AEO 2007 for Mountain region

Key Uncertainties

~~TBD~~A capital recovery factor based on an interest rate of 8% was initially assumed for the commercial and industrial sectors. However, after further consideration, an interest rate of 4.5% is recommended for state loans.

Additional Benefits and Costs

TBD

Feasibility Issues

Most if not all PWG members agreed that in order to attain its full potential, this policy should address the Residential sector as well as the Commercial and Industrial sectors.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-7. Pricing and Purchasing

Policy Description

Adopt smart metering, combined with time-of-use rate schedules and in-home displays, to enable electricity consumers to better manage energy use.

Initial expectation is to reduce electricity consumption 4 to 15%.

Policy Design

Goals: Implement time of use rates with smart meters and in-home displays of energy use, cost, and associated GHG emissions for 100% of electricity customers in Colorado (including customers of investor-owned utilities, cooperatives, and municipal utilities).

Timing: Start up in 2009, targeting 10% of industrial, commercial, and residential consumers, ramping up to 100% by 2013.

Parties Involved: All industrial, commercial, and residential electricity customers in Colorado.

Implementation Mechanisms

- A legislatively-prescribed Colorado Public Utilities Commission study of a mandatory investor-owned utility program combining advanced metering infrastructure, time-of-use electricity rates, and end-user energy displays. The study would weigh the energy cost savings, peak reduction benefits, and greenhouse gas benefits against the cost of the program. Costs would be considered from both the customer and the utility perspective. The study would use Colorado-specific assumptions to determine the most cost-effective technologies and programs to apply by customer class, and
- Based upon the results of the study, adoption of mandatory time-of-use rates for all commercial and industrial customers, as well as residential customers, and
- Installation of advanced metering infrastructure with two way communications (smart meters), and
- Installation of end-user energy displays with hourly usage, pricing, and greenhouse gas emissions display capabilities, and
- Allowing full recovery for the costs of the program through the utility ratemaking process if the program is proven cost-effective

Related Policies/Programs in Place

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided electricity production

Estimated GHG Savings and Costs per $MtCO_2e$

	GHG Reductions ($MMtCO_2e$)			Gross Cost (Million $)	Gross Cost per Unit of Energy Saved	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/t$CO_2e$)
	2012	2020	Total 2007-2020					
RCI - 7	2.0~~1.8~~	2.6~~2.3~~	25.4~~23.3~~	($347)	~~/MMbtu~~ $11/MWh~~kWh~~	($-1,191)	($844)~~($256)~~	($33)~~($11)~~

Data Sources, Methods, and Assumptions

Data Sources:

Impacts of Different Types of Smart Metering:

- “Smart Metering Study Summary” (smart-metering-append.pdf) compiled by CU Denver for the City & County of Denver
- Primen, Inc. 2004. California Information Display Pilot Technology Assessment, www.ucop.edu/ciee/dretd/documents/idp_tech_assess_final1221.pdf
- Summit Blue Consulting, Inc. 2006. Evaluation of the 2005 Energy-Smart Pricing PlanSM, prepared for Community Energy Cooperative, August 2006, available at www.energycooperative.org/pdf/ESPP-Evaluation-Executive-Summary-2005.pdf and www.energycooperative.org/energy-smart-pricing-plan.php

Cost of Metering

- Primen, Inc. 2004. California Information Display Pilot Technology Assessment, www.ucop.edu/ciee/dretd/documents/idp_tech_assess_final1221.pdf
- Idaho Power 2005. Phase One AMR Implementation Status Report under IPC-E-02-12, December 30, 2005
- CA PUC 2006. Advanced Metering Infrastructure (AMI) Update, available at www.cpuc.ca.gov/Static/hottopics/1energy/ami_update+june+2006.pdf

Quantification Methods: Cost will be based on costs of smart metering experienced by other states/localities. Economic savings in reduced energy use will also be estimated.

Key Assumptions:

Parameter	Value	Notes

Parameter	Value	Notes
Cost of Smart Meters and In-Home Displays	$250	The Cost of smart metering infrastructure appears to range from $200 to $300 per meter. This range is based on the following studies: • The Primen, Inc. 2004. California Information Display Pilot Technology Assessment, www.ucop.edu/ciee/dretd/documents/idp_tech_assess_final1221.pdf • Idaho Power 2005. Phase One AMR Implementation Status Report under IPC-E-02-12, December 30, 2005 • CA PUC 2006. Advanced Metering Infrastructure (AMI) Update, available at www.cpuc.ca.gov/Static/hottopics/1energy/ami_update+june+2006.pdf
Economic Life of Smart Meters and In-Home Displays	20 years	Assumes equipment lasts for 20 years.
Energy Reduction due to Real Time Pricing and In-Home Display	5%	Primen (2004) cites studies documenting that useful feedback can result in energy reduction by 4 to 15 percent. "Smart Metering Study Summary" (smart-metering-append.pdf) compiled by CU Denver for the City & County of Denver indicate that savings differ widely from 0% to 26%. Five percent savings is a conservative or reasonable estimate given that some of these studies might be only reporting peak energy use or demand reduction.
Real discount rate for levelized cost of natural gas savings	5.00%	Consistent with utility operation of program
Emissions Factors	Electricity Near Term (2008-2011): 0.92 tCO2e/MWh Electricity Long Term (2012-2020): 0.79 tCO2/MWh	
Timing of costs and benefits	N/A	• Energy savings are assumed to continue until 2020 with no decay of program effects, because the study period is less than the average lifetime of the program measures. • Annualized program costs (amortized over a period of 13 years or longer, consistent with the life of the asset) are included in the analysis through 2020.

Key Uncertainties

The level of energy savings is uncertain. Since 5 % savings is a conservative estimate, actual savings might be higher.

Technological progress in this field is very fast and cost-effectiveness (benefit-cost ratio) of each technology is uncertain. Thus stakeholders, utilities, and the public utility commission need to be careful about the choice of technology.

Additional Benefits and Costs

- Reducing peak demand and improving the utilization of the electricity system
- Electric utilities can save operating and maintenance expense through this measure. Examples include (1) reduced labor cost due to remote meter reading, (2) better outage management, and (3) more accurate meter reading and consumption forecasting.
- Consumers may be able to have more flexible retail choice under this program.
- Reducing the risk of power shortages
- Reducing vulnerability to energy price spikes
- ~~Reducing peak demand and improving the utilization of the electricity system~~
- Enabling avoidance of the most controversial energy supply projects
- Reducing water consumption by power plants
- Reducing pollutant emissions by power plants and improving public health

Feasibility Issues

Implementing meters and in-home displays for all electric customers will cost ratepayers significantly. Some consumer groups might oppose to this program.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-8. Renewable Energy Systems on New and Existing Buildings

Policy Description

This policy option will promote wider use of active and passive renewable energy systems on all buildings through education and financial incentives in the form of tax credits to businesses, homeowners and residential rental property owners who install proven and reliable renewable energy systems on property owned or operated by them.

Systems to be included in the mix of renewable energy technologies include passive solar heating, solar hot water, concentrated solar thermal, PV in areas not already covered by the RPS, and geothermal (ground-source heat pumps). (Other renewable energy systems that will qualify for the tax credit are under discussion.)

Proposed tax incentives will be awarded only to individuals and businesses that have significantly reduced energy consumption prior to or concurrent with system installation.

An educational campaign will be created to assist individuals and businesses in understanding the renewable energy options and requirements of the program. In addition, short-term, low-interest loans from the state and/or tax credits will be available to businesses, and tax credits will be available to homeowners and residential rental property owners, for energy-efficiency upgrades (to enlarge the pool of homeowners, residential property owners, and businesses eligible to take advantage of the renewable energy system tax credit).

Policy Design

Goals:

1. Expand the use of renewable energy by creating tax incentives to individuals and businesses who install proven and reliable renewable energy systems on property owned or operated by them. The incentive will be a 30% tax credit for passive solar heating, solar hot water, concentrated solar thermal, PV in areas not already covered by the RPS, and geothermal (ground source heat pumps), all of which have to meet the performance standard under (2), below, to qualify. (Other types of renewable energy systems that will qualify for the tax credit are under discussion.)
2. Create a complementary energy efficiency requirement that buildings related to the renewable energy system to be installed must reduce energy consumption by 20% prior to applying for renewable energy tax credits.

Timing: Start up in 2008, continuing for 5 years, with additional 5-year renewals based on success of program. Program should include periodic assessment of program performance with legislative policy adjustments, if required.

Parties Involved: (1) Homeowners, (2) Commercial Sector, (3) Industrial Facilities, and (4) Rental property owners in all sectors.

Other: Systems that qualify for tax incentives should significantly reduce energy use when combined with energy efficiency measures. Businesses will have short-term, low-interest loans from the state and/or tax credits available to them for energy efficiency upgrades; tax credits will be available to homeowners and residential rental property owners for energy efficiency upgrades.

Implementation Mechanisms

Establishment of a tax incentive program by the Colorado State Legislature as well as regulations regarding verification of efficiency measures and energy performance estimates by the installer.

~~TBD~~

Related Policies/Programs in Place

Amendment 37 requires major public utilities to provide rebates to residential and business customers of utility companies that install solar electric systems. HB 07-1281 has since doubled the Renewable Energy Standard, effectively doubling the set-aside for generation by customer-sited solar electric systems.

Federal incentives are available for individuals and businesses that apply energy conservation measures and install solar electric, and domestic solar hot water.

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided electricity production or on-site fuel combustion

Estimated GHG Savings and Costs per $MtCO_2e$

The benefits and costs of this policy were not analyzed.

Data Sources, Methods and Assumptions

Data Sources: Not applicable.

Quantification Methods:

As written, this policy option cannot be analyzed quantitatively. Benefits of providing financing for renewables may be amenable to quantification, although this would not be consistent with the option as defined by the PWG and approved by the CAP.

How many customers are willing to reduce 20% energy reduction? This must be addressed by building type. And among those meeting this requirement, how many are interested in installing the system?

Key Assumptions:

Key Uncertainties

TBD

Additional Benefits and Costs

- Reducing dependence on imported fuel sources
- Reducing vulnerability to energy price spikes
- Reducing peak demand and improving the utilization of the electricity system
- Reducing the risk of power shortages
- Supporting local businesses and stimulating economic development
- Enabling avoidance of the most controversial energy supply projects
- Reducing water consumption by power plants
- Reducing pollutant emissions by power plants and improving public health

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-9. Energy Delivery

Policy Description

Combined heat and power (CHP) refers to any system that simultaneously or sequentially generates electric energy and utilizes the thermal energy that is normally wasted. Western Governors Association analysis shows that CHP is an affordable, efficient, clean, and reliable piece of the puzzle for meeting the Western region's energy needs while substantially reducing carbon emissions. CHP is sometimes called "recycled energy" because the same energy is used twice. The recovered thermal energy can be used for space heating, hot water, steam, air conditioning, water cooling, product drying, or for nearly any other thermal energy need. The end result is significantly more efficient than generating electric and thermal energy separately. In fact, many CHP systems are capable an overall efficiency of over 80 percent – double that of conventional systems.

In addition to tremendous efficiency gain, increased adoption of CHP in the West would save literally billions in new capital investment, reduce power costs, reduce security vulnerabilities, improve reliability and power quality, avoid transmission losses, reduce water used by power plants, cut fossil fuel use, cut greenhouse gas emissions, and cut other pollutants. Combined heat and power, using proven and affordable technologies, significantly improves every key outcome from power generation.

Policy Design

Goals and Timing: 500 MW of CHP statewide by 2015

Coverage: Statewide

Implementation Mechanisms

Implement WGA's recommendations to states to promote CHP implementation:

1. PUC undertakes a thorough review of policies affecting CHP.
2. Adopt recently enacted FERC standards for interconnection agreements.
3. Give fair credit for CHP emissions reductions by adopting output-based emission standards and greenhouse gas market trading networks.
4. Seek CHP solutions to T&D-constrained areas.
5. Undertake a review of electricity rates, including standby rates, to make sure they are not discriminatory toward CHP. Incorporate policies that will appropriately promote CHP in state utility Least Cost Planning and Integrated Resources Plans.
6. Consider adding CHP to Demand Side Management and other energy efficiency programs.

7. Decouple utility revenues from throughput. Enact a state equivalent of the Federal Section 45 Production Tax Credit including CHP, wind, geothermal, and biomass technologies.
8. Adopt simplified, streamlined, and consistent permitting for CHP systems. Offer state-funded training and technical assistance programs for local code officials.
9. Ensure that renewable portfolio standards, environmental portfolio standards, advanced energy portfolio standards, and other renewable energy laws include the full range of renewable CHP options, including waste heat recovery and spent pulping liquor.
10. Call on CHP Regional Application Centers (DOE) for help in policy, programs, and analysis.
11. Wherever possible, adopt consistent, region-wide policies. (WGA 2006)

~~TBD~~

Related Policies/Programs in Place

TBD

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided electricity production or on-site fuel combustion, reduction in transmission losses, improvements in overall energy use efficiency

Estimated GHG Savings and Costs per $MtCO_2e$

	GHG Reductions ($MMtCO_2e$)			Gross Cost (Million $)	Gross Cost per Unit of Energy Saved	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
	2012	2020	Total 2007-2020					
RCI - 9	0.7~~9~~	2.7	~~18.2~~1 6.6	($1,458)	$30.46/MMbtu ~~/kWh~~	($1,507)	($49)~~$67~~	($3)~~$4~~

Data Sources, Methods and Assumptions

Data Sources:

CHP Technical Potential:

- WGA 2006. Combined Heat and Power White Paper to the Clean and Diversified Energy Initiative of the Western Governors Association, January 2006, available at www.westgov.org/wga/initiatives/cdeac/CHP-full.pdf.
- Energy and Environmental Analysis, Inc. 2003. Market Potential for Advanced Thermally Activated BCHP in Five National Account Sectors.

- Resource Dynamics Corporation 2004. Combined Heat and Power Market Penetration for Opportunity Fuels, August 2004, prepared for U.S. DOE

CHP Economic Potential:

- Energy and Environmental Analysis, Inc., EPRI Solutions, Inc., and Energy and Environmental Economics, Inc. 2005. Assessment of California CHP Market and Policy Options for Increased Penetration. July 2005, prepared for Electric Power Research Institute and California Energy Commission's Public Interest Energy Research Program
- EEA 2004. Assessment of Large Combined Heat and Power Market. April 2004, submitted to Oak Ridge National Laboratory.
- EEA 2004. Combined Heat and Power in the Pacific Northwest: Market Assessment: Task 1 - Final Report, submitted to Oak Ridge National Laboratory, August 2004
- EEA 2003. Natural Gas Impacts of Increased CHP, submitted to U.S. Combined Heat and Power Association, October 2003
- Institute for Sustainable Energy at Eastern Connecticut State University 2004. Distributed Generation Market Potential: 2004 Update/ Connecticut and Southwest Connecticut

Cost and Performance of CHP and DG:

- WGA 2006. Combined Heat and Power White Paper to the Clean and Diversified Energy Initiative of the Western Governors Association, January 2006, available at www.westgov.org/wga/initiatives/cdeac/CHP-full.pdf.
- Navigant Consulting 2006. "Energy Cost Savings Module for customer-sited DG" prepared for the Massachusetts DG Collaborative, available at http://masstech.org/renewableenergy/public_policy/DG/EnergyCostSavingsModule-Jan202006.zip
- GRI and NREL 2003, Gas-Fired Distributed Energy Resource Technology Characterizations – Bringing you a prosperous *future where energy is clean, abundant, reliable, and affordable*, available at www.eea-inc.com/dgchp_reports/TechCharNREL.pdf.

Quantification Methods: Emissions benefit of increased overall energy use efficiency of CHP will be multiplied by target penetration rate. Cost of CHP investments and economic potential for CHP to be determined from public sources. Energy cost savings associated with greater efficiency to be estimated based on forecast energy prices in Colorado.

Key Assumptions:

Parameter	Value	Notes
CHP technical potential in Colorado	1,578 MW	WGA 2006

Parameter	**Value**	**Notes**
CHP economic potential	30% of the technical CHP potential (473 MW in 2003)	It is assumed that roughly 30% of the CHP technical potential is the CHP economic potential that takes into account many factors influencing economics and feasibility of CHP. This sometimes involves a scenario analysis that includes a business as usual scenario that assume the current policies continue and another scenario with favorable policies for CHP implementation. ~~can be achieved under certain policy conditions favorable for CHP. There are~~ Factors involved in the analysis of the economic potential are~~many factors influencing the economic potential of CHP including~~ customer payback period, electric price, natural gas price, standby rates, customer awareness and interest in CHP, availability of streamlined permitting process, capital availability, and natural gas availability.
Annual growth in CHP potential	2.3% per year	Based on growth in electricity use in the commercial and industrial sectors.
Policy goal	Pushed out attainment date to 2020 rather than 2015	This means that the policy goal is to achieve the maximum economic potential by 2020. The economic potential adjusted upward for electric consumption growth in the commercial and industrial sectors reaches 700 MW by 2020.
Annual CHP implementation plan~~Fraction of New CHP Capacity~~	30 MW from 2008 to 2009, 40MW from 2010 to 2012, 60 MW from 2013 to 2016, and 70 MW from 2017 to 2020.~~Natural gas - 90%~~ ~~Biomass - 10%~~ ~~Coal - 0%~~	We assumed a smooth ramp-in. ~~By 2020, Biomass is assumed to increase to 15% of new capacity.~~
Fraction of New CHP Capacity	Natural gas - 90% Biomass - 10% Coal - 0%	By 2020, Biomass is assumed to increase to 15% of new capacity.
Avoided cost of electricity	$56/MWh	Sales-weighted average~~, includes energy & capacity costs.~~ based on Xcel's Colorado DSM Market Potential Assessment, March 2006 and including energy & capacity costs.~~Based on KEMA 2006. Xcel's Colorado DSM Market Potential Assessment, March 2006.~~

Parameter	Value			Notes
Avoided cost of natural gas	$7.42/mmBtu			The simple average of commercial and industrial natural gas prices for Mountain region in AEO2007 The industrial sector uses more natural gas than the commercial sector. However, because more CHP potential exists in the commercial sector, we use the simple average of fuel prices for CHP applications.
Avoided cost of coal	$1.9/mmBtu			AEO 2007 forecast for Industrial users in the Mountain region.
Avoided cost of fuel oil	$12.5~~11.2~~/MMBtu			The simple average of commercial and industrial distillate oil prices. AEO 2007 forecast for Electric generation in the Mountain region.~~Placeholder, pending data on commercial and industrial fuel oil. From AEO 2007 forecast for Electric generation in the Mountain region.~~
Real discount rate for levelized cost of natural gas savings	5.00%			Consistent with utility operation of program
Interest rate	8%			Interest rate for commercial and industrial customers
Economic life of CHP and DG measures	20 years			
Capital costs for CHP ($/kW~~w~~)		2010	2020	Capital costs for CHP are incremental to the cost of regular space and water heating systems because CHP systems are assumed to replace space or water heating systems or both. The costs of regular space and water heating systems are assumed to be around $1500. Incremental costs for natural gas systems are assumed to be $1300 and to decrease to $1040 by 2020, and the incremental costs for biomass DG systems (including wood and biomass) is assumed to be $2000 and decrease to $1400 by 2020. The cost reduction the study period is around 20% based on EIA's DG cost projection in AEO2007. The capital costs in 2010 are close to the weighted average capital cost of equivalent DG systems in "Self-Generation Incentive Program Data" by the San Diego Regional Energy Office.
	Natural Gas	1300	1040	
	Biomass	2000	1400	
Average Net Heat Rate by Fuel (Btu Fuel Input/kWh	Natural Gas	10,000		~~Rough~~ Placeholder estimates. Heat rates vary by the type of generator.

Parameter	Value			Notes
Electricity Output)	Biomass	13,000		
Fraction of CHP Heat Output Displacing Thermal Energy by Fuel	Natural Gas	80%		Based on (1) EIA, AEO2007 National Energy Modeling System run AEO2007.D112106A, obtained from Erin Boedecker at the Commercial Energy Demand Division at EIA and (2) EIA 2002 Energy Consumption by Manufacturers. Table 5.8 - By Region with Total Consumption of Electricity (trillion Btu), available at www.eia.doe.gov/emeu/mecs/mecs2002/data02/shelltables.html
	Biomass	0%		
	Coal	4%		
	Electricity	10%		
	Oil	6%		
~~Fraction of Fuel Usage~~				~~Based on fuel consumption for commercial space and water heating, and fraction of industrial fuel use for process heat and HVAC (below)~~
~~Fuel Consumption for Commercial Space and Water Heating (trillion Btu) for Mountain Region (average between 2005 and 2020)~~		~~Consumption~~	~~Share~~	~~Based on the table for EIA, AEO2007 National Energy Modeling System run AEO2007.D112106A. The original data was obtained from Erin Boedecker at the Commercial Energy Demand Division at EIA~~
	~~Electricity~~	~~14~~	~~6%~~	
	~~Natural Gas~~	~~196~~	~~89%~~	
	~~Fuel Oil~~	~~9~~	~~4%~~	
	~~Total~~	~~219~~	~~100%~~	
Usable Cogenerated Heat Output as a Fraction of Fuel Energy Input ~~Fraction of Industrial Fuel Use for Process Heat and HVAC for West Census Region~~	Natural Gas CHP: 40% Biomass CHP: 40% ~~Electricity 13%~~ ~~Fuel Oil 1%~~ ~~Natural Gas 71%~~ ~~LPG 1%~~ ~~Coal 13%~~			Placeholder assumption~~Source: EIA 2002 Energy Consumption by Manufacturers. Table 5.8 - By Region with Total Consumption of Electricity (trillion Btu), available at www.eia.doe.gov/emeu/mecs/mecs2002/data02/shelltables.html~~
Fraction of Usable Heat Output Replacing Space/Water/Process Heat Use	90%			
Net Efficiency of Displaced Boiler/Heater Thermal Energy by Fuel	Natural Gas	85%		~~Rough assumption~~Placeholder assumption
	Biomass	80%		
	Coal	80%		

Parameter	Value		Notes
	Electricity	92%	
	Oil	80%	
Estimated Average Non-fuel Operating and Maintenance Costs by System Type ($/MWh)	Natural Gas	$10.00	Source: ~~Rough Estimates of O&M costs:~~ O&M costs for natural gas systems are based on GRI and NREL 2004. Gas-Fired Distributed Energy Resource Technology Characterizations. O&M for other fuels are assumed to be higher than natural gas. $20/MWh for biomass is a placeholder assumption.
	Biomass	$20.00	
Emissions Factors	Electricity Near Term (2008-2011): 0.92 tCO2e/MWh Electricity Long Term (2012-2020): 0.79 tCO2/MWh, Natural gas: 52.79 tCO2e/billion BTU Biomass: 6.79 tCO2/MWh, Coal: 92.65 tCO2e/billion BTU, Oil: 71.58 tCO2e/billion BTU		From Inventory and Forecast

Key Uncertainties

TBD

Additional Benefits and Costs

- Reducing vulnerability to energy price spikes
- Reducing peak demand and improving the utilization of the electricity system
- Reducing the risk of power shortages
- Enabling avoidance of the most controversial energy supply projects
- Reducing water consumption by power plants
- Reducing pollutant emissions by power plants and improving public health

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-10. ~~Targeting Small and Medium Enterprises (SMEs)Climate Wise Statewide~~Implementing Climate Wise Statewide

Policy Description

This option builds on the success of Fort Collins' "Climate Wise" program, a voluntary program for reducing energy use in small businesses, by expanding this concept to the entire state of Colorado.

Policy Design

Goal: Ramp up to 1 million tons CO_2/yr reduction in emissions by 2015 by replicating the Fort Collins program statewide, with free on-site technical assistance.

Timing: Begin in 2008, and ramp up to 1 million tons annual avoided emissions by 2015.

Parties Involved: ~~Small and Medium-sized e~~Enterprises throughout the state

Implementation Mechanisms

~~TBD~~Set up a fund for free, on-site technical assistance.

Assign responsibility to XX for administration of the program.

Related Policies/Programs in Place

~~TBD~~Fort Collins Climate Wise Program

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) will be from avoided electricity production and on-site fuel combustion (via energy efficiency and renewable energy), avoided transportation (VMT), and waste-related emissions (CO_2 and methane). The program will have GHG-reduction benefits from water conservation, but the benefits have been such a small contribution to the total ~~Ft. Collins~~Fort Collins program to date that they were not analyzed.

Estimated GHG Savings and Costs per $MtCO_2e$

	GHG Reductions ($MMtCO_2e$)			Gross Cost (Million $)	Gross Cost per Unit of Energy Saved	Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
	2012	2020	Total 2007-2020					
RCI - 10	0.6	1.0	4.5	~~$54~~TBD	~~$0.88/MMbtu~~ TBD ~~/kWh~~	($486)	TBD	TBD

~~The benefits and costs of this policy were not analyzed.~~

Data Sources, Methods, and Assumptions

Data Sources: Information provided by Fort Collins program staff.

Quantification Methods: ~~Not applicable.~~GHG emission goals and average reductions achieved by businesses participating in the Fort Collins program were used to back out the average number of companies that would need to participate in the program to reach the emission reduction goal.

Key Assumptions: ~~Not applicable.~~

Parameter	Value	Notes
Estimated Average CO2 Reduction per New Partner per Year	1,474 tCO2e	Based on data from the Fort Collins Climate Wise Program
% MMtCO2e Saved by Activity Type	Energy Efficiency: 16.9% Renewable Energy: 21.6% Solid Waste Diversion: 61.2% Transportation: 0.3%	Based on data from the Fort Collins Climate Wise Program
# of Participants Needed	678 companies	Estimated based on emissions goals and estimated average CO2 reduction per new partner per year
Breakout of Small/Medium/Large Companies	48% small (1-99 employees), 26% medium (100-499 employees), 26% large (500+ employees)	Based on data from the Fort Collins Climate Wise Program
Annual Program Administration Costs per New Partner	TBD	Based on data from the Fort Collins Climate Wise Program
Annual Participant Costs per New Partner	TBD	Based on data from the Fort Collins Climate Wise Program
Loan period	13 years	Consistent with life of asset

Parameter	Value	Notes
Real discount rate	8.0%	Consistent with commercial financing
Emissions Factors	Electricity All Times Near Term (2008-2011): 269 tCO2e/billion BTU Electricity All Times Long Term (2012-2020): 231 tCO2e/billion BTU Natural Gas: 52.79 tCO2e/billion BTU	Based on the Inventory & Forecast
Avoided Cost of Fuel	Avoided Cost of Commercial Electricity: $56/MWh Avoided Cost of Natural Gas: $6.3/MMBtu	Electricity: Electricity avoided costs are based on Xcel's Colorado DSM Market Potential Assessment, March 2006 and include energy & capacity costs. Natural Gas: Based on AEO 2007 for Mountain region

Key Uncertainties

Costs:

- Cost results continued to look suspicious after quantification and raised a number of new questions. These questions were emailed to Climate Wise and we are currently awaiting a response. The responses we receive may or may not enable us to quantify the costs of expanding this program statewide.

Impact of AFW-9:

- This analysis could not be completed as the analysis of AFW-9, dealing with solid waste diversion which is the largest part of RCI – 10, was not complete as of the posting date. Assumptions from AFW-9 will need to be leveraged once they are available. The loan period assumption, among other assumptions, may need to be revised at that time. Overlap with AFW-9 will need to be assessed once both analyses are complete.

Implementation:

~~The Fort Collins Climate Wise program has seen remarkable success in the years since its inception. However, there are a number of issues with extrapolating statewide performance from the Fort Collins experience, including:~~

- The Fort Collins program is ~~too~~ quite small ~~scale~~ at this time ~~to be used to extrapolate statewide performance with accuracy.~~ For example, it is unknown what the appropriate staff level would be for a larger program. In Fort Collins, a staff of 1.5 employees managed 48 partners as of 2006 and 70+ partners in 2007. A larger program could experience greater efficiencies due to staff specialization. However, the statewide program may require additional administrative staff to support the participation of a larger number of smaller companies.

- The data do suggest that the statewide program would need to be far more aggressive than the Fort Collins program was in the early years of implementation in order to achieve 1 million tons CO_2/yr reduction in emissions by 2015. The voluntary nature of this program will make it even harder to attract participants with resources available to fund efficiency measures with high emissions reduction potential.
- A major benefit of this type of program is the public relations benefit to participants. If businesses perceive that consumers will respond positively to Climate Wise "branding," they will be more likely to invest their time and money in voluntary measures. Community buy-in and word-of-mouth promotion will greatly facilitate the success of the program. However, culture and economic characteristics of Fort Collins may not be representative of the rest of the state. Participation rates are likely to vary in other areas.

Data Quality:

Performance data are generally less reliable during the first few years following program start-up. In Fort Collins' case, little to no performance reporting was available from the first 3 years (2000-2002). Until 2006, participants did not consistently report data on the reductions achieved in each of the program areas (energy efficiency, renewable energy, transportation, waste, and water use). Participant costs have not been uniformly reported throughout.

~~The data do suggest that the statewide program would need to be far more aggressive than the Fort Collins program was in the early years of implementation in order to achieve 1 million tons CO_2/yr reduction in emissions by 2015. The data also suggests that 1 million tons CO_2/yr reduction in emissions by 2015 is an extremely aggressive goal overall and that small- and medium-sized businesses may not be able to provide reductions that are high enough to reach this goal. The voluntary nature of this program will make it even harder to attract participants with resources available to fund efficiency measures with high emissions reduction potential.~~

- ~~Data from the Fort Collins program in 2006 suggests that the statewide program would need to be over 30 times larger than the Fort Collins program was after it was up and running for 7 years in order to accomplish the emission reduction goal. This takes into account a discrepancy between the sizes of targeted businesses in the Fort Collins program versus the statewide program. The Fort Collins program invites participation by businesses of any size, whereas the statewide program is targeted towards small- and medium-sized businesses only.~~

Additional Benefits and Costs

- Supporting local businesses and stimulating economic development
- Reducing water consumption by businesses and power plants
- Reducing dependence on imported fuel sources
- Reducing vulnerability to energy price spikes
- Reducing peak demand and improving the utilization of the electricity system
- Reducing the risk of power shortages

- Enabling avoidance of the most controversial energy supply projects
- Reducing pollutant emissions by power plants and improving public health

Feasibility Issues

~~The Ft. Collins program benefits from roughly 26% participation by large businesses. As the statewide program was designed to engage small and medium businesses, it will require a greater number of participants per ton of CO_2e reduced, as compared to the Ft. Collins program. Furthermore, given the constrained cash flows of smaller businesses, it is difficult to know whether the participation levels required to meet the emissions reduction goal can be achieved in the absence of any subsidies to help offset initial participant implementation costs~~TBD~~.~~

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD