Appendix E
Residential, Commercial, and Industrial Sectors Policy Recommendations

Summary List of Policy Recommendations

	Policy Recommendation	GHG Reductions ($MMtCO_2e$)			Costs (Savings) 2007-2020 (Million $)	Cost-Effectiveness ($/tCO_2e$)	Climate Action Panel Action
		2012	2020	Total 2007-2020			
RCI-1	Expand demand side management programs of all electric and gas utilities, ramped up to reduce energy use by 1% per year by 2013.	0.6	5.2	24	–$853	–$32/ton	Unanimous Consent (Several qualified approvals)
RCI-2	Revolving loans to reduce energy use in state and local government buildings.	0.2	0.5	3.7	–$67	–$18/ton	Super Majority (1 objection)
RCI-3	Upgrade the state's energy requirements for local building codes every 3 years, and improve enforcement of building codes.	0.3	2.7	13.0	N/A	N/A	Unanimous Consent
RCI-4 (total)	Targets and programs for beyond-code reductions in energy use in new government, residential, and commercial buildings.	1.0	2.4	20.4	$1,550	$76/ton	Unanimous Consent
	Government subtotal:	*0.4*	*0.6*	*6.0*	*$348*	*$58/ton*	
	Commercial subtotal:	*0.5*	*1.4*	*11.2*	*$1,219*	*$109/ton*	
	Residential subtotal:	*0.2*	*0.4*	*3.2*	*–$17*	*–$5/ton*	
RCI-5	Inverted electricity block rates for all residential and commercial consumers to fund utility energy efficiency programs.	1.6	6.7	38.2	–$1,135	–$30/ton	Majority (7 objections)
RCI-6	Low interest loans to fund energy efficiency retrofits for commercial and industrial buildings.	0.5	1.8	11.7	–$334	–$28/ton	Unanimous Consent (2 qualified approvals)
RCI-7	Electricity smart metering with time-of-use rates and in-home or in-office displays for all residential, commercial, and industrial consumers.	2.0	2.6	25.4	–$844	–$33/ton	Unanimous Consent
RCI-8	Tax credits for renewable energy systems in new and existing residential, commercial, and industrial buildings.	N/A	N/A	N/A	N/A	N/A	Unanimous Consent
RCI-9	Promote commercial and industrial combined heat and power (CHP) systems.	0.3	1.4	8.3	–$25	–$3/ton	Unanimous Consent
RCI-10	Statewide program for voluntary GHG reductions by businesses.	0.6	1.0	4.5	N/A	N/A	Unanimous Consent
RCI-11	Inverted electricity block rates for all residential and commercial consumers, recovering only cost of service.	N/A	N/A	N/A	N/A	N/A	Unanimous Consent
	Sector GHG reduction total of **9 analyzed policies** after adjusting for overlaps among policies	3.7	15	86	N/A	N/A	
	Sector cost-effectiveness total of **7 analyzed policies with cost analysis** after adjusting for overlaps among policies				–$153	–$2 /ton	

Negative numbers indicate cost savings.

The cost (savings) shown are calculated as in terms of net present value in constant 2005 dollars using a 5% annual real discount rate for the period 2008 through 2020. Capital investments are represented in terms of levelized or amortized costs through 2020.

RCI-1. Expanded Energy Efficiency and Demand Side Management

Policy Description

This policy recommendation 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.

A number of DSM efforts are already underway or mandated in Colorado, including those of two significant recent actions: HB 07-1037, a new state law enacted this year, and a recent settlement agreement mandate for Xcel Energy. The goal of this policy is to bring the *total* demand reduction of those two recent actions plus new, additional DSM activities in the state to a 1% reduction per year by 2013, and continuing at that rate through the end of the study period. These reductions are cumulative, i.e., demand reductions in the second year are incremental to the reductions in the first year.

Policy Design

Goals: Increase DSM activity in the state beyond two recent DSM actions (House Bill 07-1037, enacted in 2007, and a commitment to additional DSM action by Xcel Energy as part of a legal settlement) so that the combined effects of these two recent actions and the new actions contemplated by this recommendation *achieve a 1% per year reduction in electricity and natural gas use by the residential, commercial, and industrial sectors*, compared to a Business-As-Usual (BAU) forecast that does not incorporate these two recent actions.

Timing: Starting in 2008, through 2020 with 5-year ramp-in (full 1% per year by 2013)

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

Implementation Mechanisms

Both electric and natural gas DSM programs are designed to be consistent with the implementation mechanisms established by HB 07-1037. However, because roughly 40 percent of natural gas customers are purchasing gas on wholesale markets, this policy option would require new legislation that requires wholesale gas customers to fund their own gas efficiency measure.

Municipal utilities and cooperatives would have the option of participating in a System Benefits Charge (SBC).

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.

HB 07-1037 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 efficiency programs.

In pursuit of a "settlement agreement" between Colorado stakeholders and the Colorado PUC, Xcel Energy is committed to achieve 100 GWH/yr of energy savings during the years 2006–2013. This level of savings is equal to about 3 to 3.5% of its projected sales.

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 impacts of HB 07-1037 and Xcel's DSM commitment were not incorporated in the business-as-usual (or BAU) forecast used for this analysis, but instead were modeled separately as "recent actions."

The first row of the table below shows the combined effects of those two recent actions plus the additional DSM actions needed to achieve a 1%/year reduction compared to that baseline. The second and third rows show the benefits and costs of RCI-1 plus recent actions, broken out by gas and electric programs. The combined effects of HB07-1037 and Xcel's DSM commitments are addressed in the fourth row. The actual net benefits and costs of RCI-1 (last row) are equal to the total impacts of the first row less the combined impacts of the recent actions.

Length of ramp-in (years)	GHG Reductions ($MMtCO_2e$)			Gross Costs (Million $)	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/t$CO_2e$)
	2012	2020	Total 2007-2020				
RCI–1 plus recent actions	1.43	7.53	41.4	$711	–$2,030	–$1,320	–$32
Electric DSM	1.03	5.41	29.8	$526	–$1,177	–$651	–$22
Gas DSM	0.40	2.12	11.6	$185	–$853	–$668	–$58
Combined recent actions	0.9	2.4	17.5	$354	–$821	–$467	–$27
Net RCI-1 only	0.6	5.2	23.9	$357	–$1,210	–$853	–$36

The length of the ramp-in period (years until the goal of 1%/yr energy reductions is reached) was a controversial aspect of the policy. During the course of analysis, the PWG considered a few different ramp-in periods. As shown below, the results vary dramatically depending on the length of the ramp-in period. Again, these values include the two recent DSM activities.

Length of ramp-in (years)	GHG Reductions ($MMtCO_2e$)			Gross Costs (Million $)	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/t$CO_2$e)
	2012	2020	Total 2007-2020				
7	1.0	6.8	34.7	$591	–$1,690	–$1,098	–$32
5	1.4	7.5	41.4	$711	–$2,030	–$1,320	–$32
3	2.2	8.3	50.1	$871	–$2,489	–$1,617	–$32
1	2.8	8.9	56.3	$987	–$2,819	–$1,831	–$33

Members of other PWGs questioned the overall consumption reduction goal as being too low. For comparison purposes, results based on a goal of 15% cumulative reduction in consumption by 2020 (assuming a six-year ramp-in to 1.5% per year) is presented below:

Goal	GHG Reductions ($MMtCO_2e$)			Gross Costs (Million $)	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/t$CO_2$e)
	2012	2020	Total 2007-2020				
15% by 2020	2.2	11.2	62.1	$1,068	–$3,050	–$1,982	–$32

Note that the costs associated with a 15% reduction goal are very rough, given the lack of examples of utilities sustaining reductions of 1.5% per year for more than a few years.

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 dollar spent on programs, which in turn were used to calculate the spending required to reach the energy use reduction target.

Total reductions and costs for achieving the overall goal of 1%/yr savings were calculated using the assumptions below. The combined impacts of HB07-1037 and the Xcel settlement were then subtracted from the total to yield the emissions reductions and costs associated solely with this policy option.

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 and capacity costs
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%	Consistent with utility operation of program

Parameter	Value	Notes
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 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 and natural gas efficiency savings	2008: 0.1% 2009: 0.2% 2010: 0.4% 2011: 0.6% 2012: 0.8% 2013–2020: 1%	Smooth 5 year ramp-in rates from 2008 to 2012 before reaching 1% of energy sales savings in 2013 as proposed by the working group. The 1% target is 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. Leading natural gas companies are achieving 1% per year energy savings (see SWEEP 2006)
Electricity emissions factors	Near-term (<2012): 0.92 tCO_2e/MWh Long-term (>2012): 0.79 tCO_2/MWh	Based on the Inventory and Forecast

- 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

The impact of HB07-1037, an existing law that mandates certain levels of DSM in Colorado, is a key uncertainty. This has been accommodated as a “recent action” in the summary table at the top of this document.

Additional Benefits and Costs

- Reducing dependence on imported fuel sources
- Reducing energy price increases and volatility
- 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 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. (This was the basis of the ramp-in period discussed above.)

Status of Group Approval

Unanimous consent of those CAP members present and voting.

Level of Group Support

Several CAP members qualified their votes of approval based on a range of concerns such as the mandatory structure of this policy, the attainability of the goal, and the goal not being ambitious enough.

Barriers to Consensus

None identified.

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 would establish low- or no-interest loans from revolving state energy efficiency fund for businesses.

Low- or no-interest loans will fund implementation of measures to reduce energy use (lighting, HVAC, insulation, weatherization, improved pumps and fans, etc.). Subject to implementation of these measures, low- or no-interest loans may also cover 1) assessment costs including vendor fees for time spent conducting assessments and providing recommendations; 2) measurement and verification costs including data collection, program monitoring, efficiency measure support and troubleshooting; and 3) analysis and reporting of results.

Work conducted by performance contractors would be eligible for loans. The program would be subject to third party oversight.

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 Costs (Million $)	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/tCO_2e$)
	2012	2020	Total 2007-2020				
RCI-2	0.2	0.5	3.7	$119	–$186	–$67	–$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	PWG assumption
Number of government buildings in 2015	18,532	Based on regional data, broken out into government and nongovernment using proportions from CBECS and scaled to Colorado based on population
Total floor space of government buildings in 2015	417,877,767	
Number of commercial government buildings reached w/ policy	9,266	
Average annual consumption	70 MBtu/sq. ft	
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
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 and 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 and capacity costs. Natural Gas: Based on AEO 2007 for Mountain region

- 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.
- 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.

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)

- Some of the savings, costs and benefits of this policy may overlap with savings, costs and benefits anticipated from Xcel's current DSM efforts and from implementing HB07-1037. Actual benefits and costs of RCI-2 may be lower, depending on the details (e.g., specific measures and populations targeted) of how RCI-2, HB07-1037, and the Xcel DSM programs are implemented.

Additional Benefits and Costs

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

Feasibility Issues

Contingent upon state approval and financing of the loans.

Status of Group Approval

Approved by those CAP members present and voting with one objection.

Level of Group Support

The objection was to the policy design of replacement in 5 years, rather than replacement on as-needed basis.

Barriers to Consensus

None Identified.

RCI-3. Strengthening and Enforcement of Building Codes

Policy Description

Stronger 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 have adopted the 2003 IECC standard, and more will do so as a result of legislation (HB07-1146) recently signed by the Governor. The IECC must be enforced, however, and enforcement can be spotty 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.

This policy assumes a gradually increasing energy efficiency code for new construction in Colorado following the progress of the IECC, backed up by strong, consistent enforcement measures.

Policy Design

Goals: Adhere to the periodic upgrades of the IECC standards, as described under "key assumptions." Spend $1 million per year in training and technical support to improve energy code enforcement.

Timing: First energy code upgrade to occur in 2010. Begin funding in 2008.

Coverage: Covers new residential and commercial buildings plus retrofits in the 70% of Colorado that is subject to building energy codes.

Implementation Mechanisms

HB 1146 includes a provision for the Governor's Energy Office to apply the periodic IECC upgrades as the standards that municipalities and counties with building codes must adopt. Enforcement incentives will take the form of state-sponsored training and technical support for the inspectors, plan reviewers, 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.

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).

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 table below shows the emissions reduction benefits from updating codes.

	GHG Reductions ($MMtCO_2e$)			Gross Costs (Million $)	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
	2012	2020	Total 2007-2020				
RCI-3	0.3	2.7	13	N/A	N/A	N/A	N/A

Discussions with industry experts and literature review suggest that increased and sustained funding for training and enforcement will be critical to achieving the energy and emissions savings indicated above.

Data Sources, Methods, and Assumptions

Data Sources:

- # of households: RECS 2001 Households by Census Division (including single family, multi family and mobile home units). March 2006. Found at: http://www.eia.doe.gov/oiaf/archive/aeo06/assumption/pdf/residential_tables.pdf
- New housing stock: AEO2006 from a spreadsheet entitled EIA-RES-SF-2007-07-02.xls from John Cymbalsky at EIA
- % 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
- 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
- Commercial floor space projection for the Mountain Region: EIA AEO 2006

Quantification Methods:

Compare total commercial and residential energy use in the state under stronger building codes vs. reference case.

Key Assumptions:

Parameter	Value	Notes
Share of new buildings affected by new energy codes	40% between 2008 and 2009; 70% between 2010 and 2020	Building Code Assistance Project (BCAP) estimates that 40% of new construction in CO will be affected by the code upgrade mandated by HB07-1146. The other 60% will not be affected by the law because some cities and counties (about 35 counties ~30% of the state) have already adopted building codes equal to or exceeding IECC 2003 standards, and some jurisdictions (~30%) have no pre-existing codes and are exempt from the law. The share of new construction affected by new codes will increase to 70% starting in 2010 because those cities or counties that have voluntarily adopted IECC 2003 will have to upgrade their code for new buildings to the stronger energy code (i.e., IECC 2006).
Colorado specific energy savings based on HB-1146 baseline (IECC 2003)	5% for residential buildings; 15% for commercial buildings	Assumptions from BCAP. The percentages are relative to respective prevailing energy consumption.
Energy savings between IECC 2003 and IECC 2006	2% for residential buildings; 8% for commercial buildings. IECC 2006 to be adopted in 2010.	Assumptions from BCAP. The percentages are relative to IECC 2003.
Energy savings for future building codes (e.g., IECC 2009)	5% decrease in energy use every three years for both residential and commercial buildings	The Southwest Energy Efficiency Project (SWEEP)
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 and Forecast

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 energy price increases and volatility
- Reducing peak demand and improving the utilization of the electricity system
- Reducing the risk of power shortages
- Enabling avoidance of 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

Unanimous consent of those CAP members present and voting.

Level of Group Support

No objections.

Barriers to Consensus

None identified.

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 and the other 70% reduce energy consumption 30% consistent with 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 "high performing" standard (see HPH100.org for definition).
- 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.

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

For residential: full property tax credit based on the assessed property value of new, private residential units that achieve the Energy Star "high performing" standard; capped at 1 year. Residential units include new or rehabilitated apartment structures with four or more units but do not include detached residential structures.

For commercial: partial county property tax credit based on the incremental construction cost for new, private commercial buildings that achieve Architecture 2030 standards; capped at 10 years.

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 Costs (Million $)	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
	2012	2020	Total 2007-2020				
RCI–4 Total	1.0	2.4	20.4	$2,614	–$1,065	$1,550	$76
Government	0.4	0.6	6.0	$654	–$307	$348	$58
Commercial	0.5	1.4	11.2	$1,777	–$557	$1,219	$109
Residential	0.2	0.4	3.2	$183	–$201	–$17	–$5

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 percent 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 percent energy reductions per home, reach and average consumption per home.

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.

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

Energy Star "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:

- 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.
- 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.
- All units built in 2008 and after are assumed to be new.

Based on the Inventory and Forecast, the emissions factors for displaced energy are as follows:

- 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

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 nongovernment using proportions from CBECS and scaled to Colorado based on population
Number of commercial government buildings reached w/ policy	7,347	
Average annual consumption	70 MBtu/sq. ft	
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	PWG 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	PWG assumption
Energy use reductions due to energy efficiency in a LEED gold building	37%	Above standard code
Energy use reductions due to energy efficiency in a LEED silver	30%	Above standard code

Parameter	Value	Notes
building		
Standard new construction cost w/o LEED implementation	$169/sq. ft.	Average across 11 CO projects; data from hospitals was not present in the sample from which this assumption was made
Loan period	30 years	Consistent with life of asset
Real discount rate	5.0%	Consistent with government financing
LEED construction cost premium	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 and LEED Gold incremental costs
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 and 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 nongovernment using proportions from CBECS and scaled to Colorado based on population
Number of commercial nongovernment buildings reached w/ policy	11,271	
Average annual consumption	70 MBtu/sq. ft	
Average sq. ft. per commercial building	14,851	Based on average during forecast period
Architecture 2030 Annual Consumption Target (2015)	21,000 Btu/sq. ft	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%	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
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	
Average annual consumption	50 MBtu/sq. ft	
% 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 Energy Star "high performing" homes	15%	Stated goal
Average 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 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; it is unclear whether 70% of the commercial sector would be reached with the implementation mechanism proposed.
- A construction cost per square foot that is specific to the residential sector could be different than the commercial construction cost per square foot that is currently being used.
- Some policy working group and CAP members believe that the savings from reduced energy use relative to construction costs may be much higher than is reflected in the commercial and government building analyses, and that cost savings would be a more likely outcome.
- Some of the savings, costs and benefits of this policy may overlap with savings, costs and benefits anticipated from Xcel's current DSM efforts and from implementing HB07-1037. Actual benefits and costs of RCI-4 may be lower, depending on the details (e.g., specific measures and populations targeted) of how RCI-4, HB07-1037, and the Xcel DSM programs are implemented.

Additional Benefits and Costs

- Reducing dependence on imported fuel sources
- Reducing energy price increases and volatility
- 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 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

Unanimous consent of those CAP members present and voting.

Level of Group Support

No objections. However, some CAP members believe the result of positive costs for energy efficiency measures is counter-intuitive. The overall positive cost reflects the 15% cost premium for application of LEED platinum standards in the commercial sector. The residential sector shows negative costs for achieving the policy goals.

Barriers to Consensus

None identified.

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.

Policy Design

Goals: Standard rates up to the first threshold (set at 50% of the Architecture 2030 energy consumption reduction targets), 2 cents/kWh surcharge for kWh above the first threshold up to the second threshold (set at twice the first threshold), and 5 cents/kWh surcharge for all kWh in excess of the second threshold. Proceeds are to be used to fund energy efficiency programs in the Residential and Commercial sectors.

These thresholds are based on recent investor owned utility (IOU) experience with inverted block rates in California.

Timing: Starting in 2010.

Coverage: Rates are applicable statewide for the Residential and Commercial sectors.

Implementation Mechanisms

Implementation to be consistent with the implementation mechanisms established by HB07-1037. Municipal utilities and cooperatives would have the option of participating in a System Benefits Charge (SBC).

Related Policies/Programs in Place

Inverted block rates in California as documented in: SCE. Residential Baseline Allocation, available at http://www.sce.com/NR/rdonlyres/DF137120-E263-459E-96F4-0B4F4BA60520/0/597R0906ResidentialBaseline.pdf

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 Costs (Million $)	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/t$CO_2e$)
	2012	2020	Total 2007-2020				
RCI-5	1.6	6.7	38.2	$690	–$1,825	–$1,135	–$30

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.

The California Public Utilities Commission requires IOUs to establish inverted block rates for residential customers. In this rate structure, the baseline consumption or threshold that covers basic needs of residential customers are set higher than those originally set for RCI-5 based on Architecture 2030. The baseline consumption allocation typically covers 60-70% of the average residential energy use in each region.[1]

Quantification Methods:

Estimate base electricity consumption levels that are not subject to surcharges based on 50% of Architecture 2030 energy consumption reduction targets (first threshold). Per capita annual electric consumption for residential and per square foot annual electric consumption are used to estimate the base consumption levels. Estimate electricity consumption levels that are equal to twice the first consumption threshold (second threshold). Allocate projected total electricity consumption by residential and commercial sectors among (1) base consumption (less than or equal to the first threshold); (2) above the first threshold but less than or equal to the second threshold; and (3) greater than the second threshold. 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)

The Architecture 2030 energy consumption reduction targets are defined as 60% of the Year 2003 regional or national average electricity consumption during the period between 2010 and 2014, 70% of the Year 2003 average consumption between 2015 and 2019, and 80% of the Year 2003 consumption in 2020. Thus, 50% of the Architecture 2030 energy consumption reduction

[1] SCE. Residential Baseline Allocation, available at http://www.sce.com/NR/rdonlyres/DF137120-E263-459E-96F4-0B4F4BA60520/0/597R0906ResidentialBaseline.pdf

targets equals 30% of the Year 2003 regional or national average electricity consumption between 2010 and 2014, and 35% between 2015 and 2019, and 40% in 2020.

Key Assumptions:

Parameter	Value	Notes
Price elasticity of electricity:	–0.2 Residential, –0.1 Commercial	Source: Short-term price elasticity from EIA, www.eia.doe.gov/oiaf/analysispaper/elasticity/table1.html. 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.
50% of Architecture 2030 Challenge Site EUI energy consumption reduction targets	30% in 2010, 35% in 2015, 40% 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, base electric consumption is set at twice these targets (half the reduction) on a per capita basis for residential and per square foot basis for commercial use for the first threshold. The second threshold is twice the first.
Substitution effect for heating fuel (cross price elasticity)	none	This effect was not considered for this 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 and commercial)	$61/MWh	Electricity avoided costs are based on Xcel's Colorado DSM Market Potential Assessment, March 2006 and include energy and capacity costs.
Levelized cost of electricity savings	2.5 cents/kWh (2005$ 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/epat7p4.html
Electricity emissions factors	Near-term (<2012): 0.92 tCO_2e/MWh Long -term (>2012): 0.79 tCO_2/MWh	

- 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

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

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.

This policy is mutually exclusive to RCI-7 and RCI-11.

Status of Group Approval

Approved by those CAP members present and voting, with seven objections.

Level of Group Support

Objections concerned feasibility issues on the one hand, and concerns that the policy is insufficiently aggressive with the given targets on the other. One CAP member objected on the basis that the policy is essentially structured as an electricity use tax.

Barriers to Consensus

Utility representatives do not support a rate structure that is designed to recover more than the cost of service. Proponents of the policy support it as an effective price signal to consumers.

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 nongovernment (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

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

Low- or no-interest loans will fund implementation of measures to reduce energy use (e.g., lighting, HVAC, insulation, weatherization, improved pumps and fans). Subject to implementation of these measures, low- or no-interest loans may also cover 1) assessment costs including vendor fees for time spent conducting assessments and providing recommendations; 2) measurement and verification costs including data collection, program monitoring, efficiency measure support and troubleshooting; and 3) analysis and reporting of results.

Work conducted by performance contractors would be eligible for loans. The program would be subject to third-party oversight.

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 to engage in conservation and energy efficiency programs, and directs distributors of natural gas and electricity 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 Costs (Million $)	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	$184	–$518	–$334	–$28

Data Sources, Methods, and Assumptions

Data Sources:

- Percent of 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 in state	66,953	As of 2008 Commercial buildings were based on regional data, broken out into government and nongovernment 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	
Average annual consumption: commercial buildings	70,000 Btu/sq. ft	
Average annual consumption: industrial buildings	40,000 Btu/sq. ft	
Average sq. ft. per commercial building	14,851	
Average sq. ft. per industrial building	86,458	
Total interest cost	$40,722,163	Financed at 4.5%
Total capital cost	$143,002,620	
Loan period	13 years	Consistent with life of asset
Real discount rate	4.5%	To reflect state financing
All-hours emissions factor for electricity	Near-term (<2012) 269 tCO_2e/ BBtu Long-term (>2012) 231 tCO_2e/ BBtu	Based on the Inventory and Forecast
Emission factor for gas	52.79 tCO_2e/BBtu	
Avoided cost of electricity	$48/MWh	Electricity avoided costs are based on Xcel's Colorado DSM Market Potential Assessment, March 2006 and include energy and capacity costs.
Avoided cost of gas	$6.3/MMBtu	Based on AEO 2007 for Mountain region

- 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.
- 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.

Key Uncertainties

Some of the savings, costs and benefits of this policy may overlap with savings, costs and benefits anticipated from Xcel's current DSM efforts and from implementing HB07-1037. Actual benefits and costs of RCI-6 may be lower, depending on the details (e.g., specific measures and populations targeted) of how RCI-6, HB07-1037, and the Xcel DSM programs are implemented.

Additional Benefits and Costs

- Reducing dependence on imported fuel sources
- Reducing energy price increases and volatility
- Reducing peak demand and improving the utilization of the electricity system
- Reducing the risk of power shortages
- Enabling avoidance of energy supply projects
- Reducing water consumption by power plants
- Reducing pollutant emissions by power plants and improving public health
- Improves profitability of participating facilities

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.
- Contingent upon state approval and financing of the loans

Status of Group Approval

Unanimous consent of those CAP members present and voting.

Level of Group Support

Two CAP members qualified their votes of approval because of reservations about the policy's viability for commercial buildings.

Barriers to Consensus

None identified.

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

Xcel’s Critical Peak Pricing pilot and Saver’s Switch program

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 Costs (Million $)	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/t$CO_2e$)
	2012	2020	Total 2007-2020				
RCI-7	2.0	2.6	25.4	$347	–$1,191	–$844	–$33

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 and 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
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

Parameter	Value	Notes
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%. "Smart Metering Study Summary" (smart-metering-append.pdf) compiled by CU Denver for the City and 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%	Consistent with utility operation of program
Emissions factors	Electricity near-term (2008–2011): 0.92 tCO_2e/MWh Electricity long-term (2012–2020): 0.79 tCO_2/MWh	

- 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.

Time-of-Use rates tend to encourage consumers to shift electricity usage to off-peak times. A policy that moves consumption from peak to off-peak times may or may not decrease GHG emissions, depending on whether the generation avoided during times of reduced consumption has lower emissions than the generation that is dispatched when consumption is increased.

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 energy price increases and volatility
- Enabling avoidance of 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 this program.

This policy is mutually exclusive to RCI-5 and RCI-11.

Status of Group Approval

Unanimous consent of those CAP members present and voting.

Level of Group Support

No objections.

Barriers to Consensus

None identified.

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, photo-voltaic solar (PV) on buildings not already covered by the existing renewable portfolio standards (RPS), and geothermal (ground-source heat pumps), and possibly other emerging technologies. 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 on buildings not already covered by the existing RPS, geothermal (ground source heat pumps), and possibly other emerging technologies, all of which have to meet the performance standard under (2), below, to qualify.
2. Create a complementary energy efficiency requirement that prior to applying for renewable energy tax credits, building owners must demonstrate a 20% reduction in energy consumption following installation of the renewable energy system. .

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.

Successful operation of the renewable energy system (metered separately) must be demonstrated over a period of time to get the tax credit.

The Governor's Energy Office would set up an audit program (audits are to be outsourced).

Wisconsin's performance based system may serve as a model for implementation of this policy.

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 Amendment 37's renewable portfolio 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.

Key Assumptions:

Key Uncertainties

How many customers (by building type) are willing to reduce energy consumption by 20%? Among those meeting this requirement, how many would be interested in installing the system?

Additional Benefits and Costs

- Reducing dependence on imported fuel sources
- Reducing energy price increases and volatility
- 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 energy supply projects
- Reducing water consumption by power plants
- Reducing pollutant emissions by power plants and improving public health

Feasibility Issues

Costs could be very high for monitoring and verification.

Contingent upon state approval and appropriation of funding for this effort

Status of Group Approval

Unanimous consent of those CAP members present and voting.

Level of Group Support

No objections.

Barriers to Consensus

None identified.

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: 50% of the economic potential of CHP (defined below), interpreted as 350 MW of CHP statewide by 2020

Coverage: Statewide

Implementation Mechanisms

Further study should be conducted by the Governor's Energy Office on in-state CHP potential.

Implement WGA's recommendations (modified) 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. Seek CHP solutions to T&D-constrained areas.

4. 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.

5. Consider adding CHP to Demand Side Management and other energy efficiency programs.

6. Consider mechanisms to remove utility disincentives for CHP.

7. Adopt simplified, streamlined, and consistent permitting for CHP systems. Offer state-funded training and technical assistance programs for local code officials.

8. 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.

9. Call on CHP Regional Application Centers (DOE) for help in policy, programs, and analysis.

10. Wherever possible, adopt consistent, region-wide policies. (WGA 2006)

Related Policies/Programs in Place

Xcel's existing interconnection standards, net metering tariff, and standby rates

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 Costs (Million $)	Gross Benefits (Million $)	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/t$CO_2e$)
	2012	2020	Total 2007-2020				
RCI-9	0.34	1.37	8.3	$729	–$754	–$25	–$3

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 were 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
CHP economic potential under an advanced scenario (not a BAUscenario)	30% of the technical CHP potential (473 MW in 2003)	It is assumed that CHP economic potential is roughly 30% of the CHP technical potential. This takes into account many factors influencing economics and feasibility of CHP, including customer payback period, electricity price, natural gas price, standby rates, customer awareness and interest in CHP, availability of streamlined permitting process, capital availability, and natural gas availability. CHP economic potential studies often conduct scenario analysis which includes a business as usual scenario and another scenario (advanced scenario) with favorable policies for CHP implementation. The 30% figure is based on CHP studies for advanced scenarios.
Annual growth in CHP potential	2.3%	Based on growth in electricity use in the commercial and industrial sectors.

Parameter	Value	Notes
Policy goal	50% of the economic potential of CHP by 2020 (350 MW)	The economic potential adjusted upward for electric consumption growth in the commercial and industrial sectors reaches 700 MW by 2020. Half of this potential, 350MW is the CHP target for Colorado by 2020.
Cumulative new CHP Installation	Year — Cumulative Capacity 2008 — 15 MW 2009 — 30 MW 2010 — 50 MW 2011 — 70 MW 2012 — 90 MW 2013 — 120 MW 2014 — 150 MW 2015 — 180 MW 2016 — 210 MW 2017 — 245 MW 2018 — 280 MW 2019 — 315 MW 2020 — 350 MW	Smoothed ramp-in
Technology of new CHP capacity	Natural gas – 85%–90% Biomass – 10%–15% Coal – 0%	By 2020, Biomass is assumed to increase to 15% of new capacity
Avoided cost of electricity	$56/MWh	Sales-weighted average based on Xcel's Colorado DSM Market Potential Assessment, March 2006 and including energy and capacity costs.
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/MMBtu	The simple average of commercial and industrial distillate oil prices. AEO 2007 forecast for Electric generation in the Mountain region.
Real discount rate for levelized cost of natural gas savings	5%	Consistent with utility operation of program
Interest rate	8%	Interest rate for commercial and industrial customers
Economic life of CHP and	20 years	

Parameter	Value			Notes
DG measures				
Capital costs for CHP ($/kW)	**Source**	**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 $1400 by 2020. The cost reduction the study period is around 20% based on EIA's DG cost projection in AEO2007. The capital costs in 2010 are close to the weighted average capital cost of equivalent DG systems in "Self-Generation Incentive Program Data" by the San Diego Regional Energy Office.
	Natural gas	1300	1040	
	Biomass	2000	1400	
Average net heat rate by fuel (Btu fuel input/kWh electricity output)	Natural gas	10,000		Placeholder estimates. Heat rates vary by the type of generator.
	Biomass	13,000		
Fraction of CHP heat output displacing thermal energy by fuel	Natural gas	80%		Based on (1) EIA, AEO2007 National Energy Modeling System run AEO2007.D112106A, obtained from Erin Boedecker at the Commercial Energy Demand Division at EIA and (2) EIA 2002 Energy Consumption by Manufacturers. Table 5.8 - By Region with Total Consumption of Electricity (trillion Btu), available at www.eia.doe.gov/emeu/mecs/mecs2002/data02/shelltables.html
	Biomass	0%		
	Coal	4%		
	Electricity	10%		
	Oil	6%		
Usable cogenerated heat output as a fraction of fuel energy input	Natural gas CHP: 40% Biomass CHP: 40%			Placeholder assumption
Fraction of usable heat output replacing space/water/process heat use	90%			
Net efficiency of displaced boiler/heater thermal energy by fuel	Natural gas	85%		Placeholder assumption
	Biomass	80%		
	Coal	80%		
	Electricity	92%		
	Oil	80%		
Estimated average non-fuel operating and maintenance costs by system type ($/MWh)	Natural gas	$10.00		Source: 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		

Parameter	Value	Notes
Emissions factors	Electricity near-term (2008-2011): 0.92 tCO_2e/MWh Electricity long-term (2012-2020): 0.79 tCO_2/MWh, Natural gas: 52.79 tCO_2e/billion Btu Biomass: 6.79 tCO_2/MWh, Coal: 92.65 tCO_2e/billion Btu, Oil: 71.58 tCO_2e/billion Btu	From Inventory and Forecast

Key Uncertainties

- Economic potential of CHP in Colorado
- How load growth would affect emissions reductions from policy

Additional Benefits and Costs

- Reducing energy price increases and volatility.
- Reducing peak demand and improving the utilization of the electricity system.
- Reducing the risk of power shortages.
- Enabling avoidance of energy supply projects.
- Reducing water consumption by power plants.
- Reducing pollutant emissions by power plants and improving public health.

Feasibility Issues

Permitting of new CHP plants under existing air emissions rules.

Status of Group Approval

Unanimous consent of those CAP members present and voting.

Level of Group Support

No objections.

Barriers to Consensus

None identified.

RCI-10. Implementing Climate Wise Statewide

Policy Description

This option builds on the success of Fort Collins' "Climate Wise" program, a voluntary business program featuring free technical assistance and continuous support as a means for reducing carbon emissions through reductions in energy, water, transportation, and solid waste, by expanding this concept to the entire state of Colorado.

This option complements many of the energy efficiency options listed in this document and would implement a state-wide clearinghouse to provide support for start-up of similar outreach, technical assistance, and recognition programs as requested by cities, counties, or agencies state-wide.

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: Enterprises throughout the state

Implementation Mechanisms

The Fort Collins Climate Wise program has dedicated staff performing outreach, education, administration, evaluation and facility assessment tasks. The statewide program would mimic this effort by providing technical assistance to promote voluntary GHG reduction programs with a focus on energy, water, solid waste, and transportation. This program may ultimately be linked to existing and future efforts managed by the Governor's Energy Office.

Related Policies/Programs in Place

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 Fort Collins program to date that they were not analyzed.

Estimated GHG Savings and Costs per $MtCO_2e$

	GHG Reductions ($MMtCO_2e$)			Gross Costs (Million $)	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	N/A	N/A	N/A	N/A

Total costs cannot be pinpointed with accuracy. At a minimum, costs would include salaries and office space for coordinating staff and technical experts.

Data Sources, Methods, and Assumptions

Data Sources: Information provided by Fort Collins program staff.

Quantification Methods: 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:

Parameter	Value	Notes
Estimated Average CO_2e Reduction per New Partner per Year	1,474 tCO_2e	Based on data from the Fort Collins Climate Wise Program
% $MMtCO_2e$ 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	678 companies	Estimated based on emissions goals and estimated average CO_2 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

Key Uncertainties

Costs:

- Costs to Fort Collins participants are not necessarily reflective of costs to participants in other areas of the state, especially since participants in other areas may be interested in implementing different measures. This level of flexibility and customization is an asset of the program. However, it prevented the quantification of participant or incentive costs.

Data Quality:

- Performance data are generally less reliable during the first few years following program start-up due to lack of program structure (which will be crucial in planning a state-wide effort) and limited staff resources. In Fort Collins' case, little to no performance reporting was available from the first 3 years (2000-2002). Until 2006 when new tools, resources, and a new structure were implemented, 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). While cost data reporting increased recently (88% between 2006 and the present), a complete set of participant costs across all measure categories are not available at this time.

Overlap with AFW-9:

- Due to the fact that 60% of current reductions are coming from solid waste diversion, the reductions from this policy will likely overlap with reductions achieved by AFW-9.

Other:

- The Fort Collins program is quite small for a thorough state-wide analysis at this time. 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 and an implemented budget which finances support from existing trained consultants state-wide.
- The voluntary nature of this program may present a challenge in attracting participants with resources available to fund efficiency measures with high emissions reduction potential.
- Major benefits of this type of program for participants are associated with reputation and networking. Businesses that perceive that consumers will respond positively to Climate Wise “branding” 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. Participation rates are likely to vary across the state.

Additional Benefits and Costs

- Supporting local businesses and stimulating economic development.
- Reducing water consumption by businesses and power plants.
- Reducing waste and landfill diversion rates.
- Reducing dependence on imported fuel sources.
- Reducing energy price increases and volatility.
- Reducing vehicle miles traveled and road congestion.
- Reducing peak demand and improving the utilization of the electricity system.
- Reducing the risk of power shortages.
- Enabling avoidance of energy supply projects.
- Reducing pollutant emissions by power plants and improving public health.
- Climate Wise at the state level could help build participation in other programs, thus resulting in additional indirect emissions reductions.

Feasibility Issues

Contingent upon state approval and appropriation of funding for this effort.

Status of Group Approval

Unanimous consent of those CAP members present and voting.

Level of Group Support

No objections.

Barriers to Consensus

None identified.

RCI-11. Cost of Service Inverted Block Rates

Policy Description

This option is an increasing block rate design that would solely be structured to recover cost of service, as in traditional ratemaking. Such a policy might encourage greater levels of energy efficiency based on a price elasticity effect, but would provide no excess funds to specifically promote energy efficiency programs.

Policy Design

Goal: Consider implementing inverted block rates to encourage the efficient use of electricity .

Timing: Starting in 2010.

Parties Involved: Rates are applicable statewide, Residential and Commercial sectors.

Implementation Mechanisms

For IOUs: Inverted rate applied to cost of service as approved by the PUC.

For other load serving entities: Inverted rate applied to cost of service as approved by the relevant authority.

Statewide implementation would likely require legislative change.

Related Policies/Programs in Place

None noted.

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.

Data Sources, Methods, and Assumptions

Data Sources: Not applicable.

Quantification Methods: This policy was not analyzed.

Key Assumptions: Not applicable.

Key Uncertainties

None noted.

Additional Benefits and Costs

Potential additional benefits:

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

Feasibility Issues

For IOUs, this policy must go through a regulatory process. For utilities not under PUC authority, this policy would require approval by other authorities.

This policy is mutually exclusive to RCI-5 and RCI-7.

Status of Group Approval

Unanimous consent of those CAP members present and voting.

Level of Group Support

No objections.

Barriers to Consensus

None identified.