Colorado Climate Project

the ROCKY MOUNTAIN CLIMATE Organization

www.coloradoclimate.org

Residential, Commercial & Industrial Policy Work Group

Summary List of Draft Priorities for Analysis

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effective-ness ($\$/tCO_2e$)	Level of CAP Support
		~~2012~~ 2010	2020	Total 2007-2020			
Option #	**RESIDENTIAL, COMMERCIAL & INDUSTRIAL**						
RCI-1	Expanded Demand Side Management	2	11	70	(2,092)	(30)	TBD
RCI-2	Energy Efficiency in Buildings Owned by State and Local Governments	0.2	2	15	(478)	(33)	TBD
RCI-3	Enforcement of Building Codes	N/A	N/A	N/A	N/A	N/A	TBD
RCI-4	Planning and Design	0.4	2	19	289	15	TBD
RCI-5	Inverted Block Rates to Fund Energy Efficiency	1	16	96	2487	26	TBD
RCI-6	Retrofitting Existing Buildings for Energy Efficiency	0.04	0.9	5	(231)	(46)	TBD
RCI-7	Pricing and Purchasing	0.9	2	22	314	15	TBD

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effective-ness ($/tCO_2e$)	Level of CAP Support
		~~2012~~ 2010	2020	Total 2007-2020			
RCI-8	Renewable Energy Systems on New and Existing Buildings	TBD	TBD	TBD	TBD	TBD	TBD
RCI-9	Energy Delivery	0.6	3	19	(107)	(6)	TBD
RCI-10	Targeting Small and Medium Enterprises	N/A	N/A	N/A	N/A	N/A	TBD
	SECTOR TOTAL AFTER ADJUSTING FOR OVERLAPS						
	REDUCTIONS FROM RECENT ACTIONS (table to be added below)						
	SECTOR TOTAL PLUS RECENT ACTIONS						

RCI-1. Expanded Demand Side Management

Policy Description

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

Policy Design

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

Timing: Starting in 2008, through 2020

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

Implementation Mechanisms

TBD

Related Policies/Programs in Place

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

Type(s) of GHG Reductions

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

Estimated GHG Savings and Costs per $MtCO_2e$

	Policy Option	GHG Reductions ($MMtCO_2e$) 2010	2020	Total 2007-2020	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/tCO_2e$)
RCI-1	Expanded Demand Side Management	2	11	70	(2,092)	(30)

~~TBD~~

Data Sources, Methods and Assumptions

Data Sources:

Electricity

- *Estimated DSM potential:*
  - KEMA 2006. Colorado DSM Market Potential Assessment, March 31, 2006, available at http://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 http://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 http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf
- *Electricity prices by sector:* EIA http://www.eia.doe.gov/cneaf/electricity/esr/esr_sum.html (2005 prices) and Annual Energy Outlook 2006 national forecast

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 prices (2005):* EIA http://tonto.eia.doe.gov/dnav/ng/xls/ng_sum_lsum_dcu_SCO_a.xls (2005 prices) and Annual Energy Outlook (future prices)

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 ~~will be~~ used to estimate efficiency savings per $ spent on programs, which in turn were ~~will be~~ used to calculate the spending required to reach the energy use reduction target.

Key Assumptions~~:~~

Parameter	**Value**	**Notes**
Avoided cost of natural gas	$6.3/ MMBtu	Based on AEO 2007 for Mountain region
Avoided cost of delivered electricity	$56/MWh	Sales-weighted average, includes energy & capacity costs. Based on KEMA 2006.
Assumed average measure lifetime	13 years	Lifetime of an efficiency program varies significantly depending on the type of program, which could range from 8 to 30 years. Measures associated with building envelopes typically last longer, while appliances last shorter.
Real discount rate for levelized cost of natural gas savings	5.00%	Consistent with utility operation of program
Cost of Saved Electricity	2.5 cents/kWh (2005$ levelized)	From WGA 2006. $25/MWh of saved energy is slightly higher than other estimates reviewed but is reasonable given the timeframe for this analysis. Other sources identified include: • NorthWestern Energy cited

Parameter	Value	Notes
		$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 http://www.marketdevelop.com/docs/wapa_power_to_save_012307.ppt) • 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
Achievable electricity efficiency potential	1.0% total savings per year	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

Parameter	**Value**	**Notes**
		Sacramento Municipal Utility, and investor owned utilities in California, Connecticut, and Massachusetts.
Achievable gas efficiency potential	1.0% total savings per year	Based on gas sales savings by leading gas utilities (see SWEEP 2006)
Program cost-effectiveness	Total Resource Cost test for a portfolio of all measures	Total Resource Cost Test that takes into account the total system costs of efficiency programs (including costs incurred by utilities, participants, and non-participants) and the total system benefits such as avoided energy, capacity, distribution and transmission.
Other legislation	Effects of HB07-1037 not modeled	This bill was signed by the Governor and became law on May 22, 2007. The PUC has opened an inquiry into the regulatory changes required by this law. The bill requires the PUC to adopt rules establishing: • an expenditure target of at least 0.5% of revenues being spent on DSM programs; • a savings target that is expressed in the amount of gas saved per expenditure; • procedures to recover costs of DSM programs without having to file a rate case; • a method of tying cost-recovery to the group, residential or non-residential, that is receiving the benefit of the DSM program; and • a bonus structure for utilities that achieve the commission's targets. Within 12 months of rule promulgation, gas distribution utilities are required to develop and begin implementing DSM programs for full-service customers.

Parameter	Value	Notes
		These programs may target low-income households. (HB07-1037 Jun 18 2007Fiscal Note, available at http://www.leg.state.co.us)

- ~~Electricity savings per $ of program investment: 2.5 cents/kWh (2005$) (WGA 2006)~~
- ~~All programs aim for cost-effectiveness as a portfolio of measures.~~

Key Uncertainties

- Impact of HB07-1037

Additional Benefits and Costs

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

Feasibility Issues

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

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

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

Policy Description

Energy Efficiency can be an expensive undertaking up front due to the cost of new technologies, as well as improving the efficiency of existing systems. The steps required to determine the cost to improve efficiency include an audit, design, implementation and measurement and verification. All these steps have costs, which prohibit or slow the conversion to GHG reducing efforts, even though the measures would ultimately result in savings. Having low- or zero-interest funding readily available would make it much easier for public agencies to invest in improving the performance of buildings owned by state and local governments.

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

TBD

Related Policies/Programs in Place

Senator Reid from Nevada has proposed a bill to provide 0% financing to school districts in 4 "Sun" states to include NV, CO, NM and AZ. This analysis does not include Sen. Reid's bill in the baseline, however it is worth noting that the cost of RCI-2 would be lower if such a bill is enacted.

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 $MtCO_2e$

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
		2010	2020	Total 2007-2020		
RCI-2	Energy Efficiency in Buildings Owned by State and Local Governments	0.2	2	15	(478)	(33)

~~TBD~~

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, http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/alltables.pdf
- *Commercial floor space projection for the Mountain Regions:* 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, http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/alltables.pdf ~~:~~
- *Cost of saved electricity~~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 http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf~~; also Kinney, Geller, and Ruzzin 2003. Increasing Energy Efficiency in New Buildings in the Southwest: Energy Codes and Best Practices: SWEEP, available at www.swenergy.org/ieenb/index.html~~
- *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: http://www.swenergy.org./pubs/Natural_Gas_DSM_Programs_A_National_Survey.pdf
- ~~*Cost of "beyond code" efficiency improvements:* Southwest Energy Efficiency Project Report, Increasing Energy Efficiency in New Buildings in the Southwest: Energy Codes and Best Practices~~
- ~~*Commercial and educational facility floor space:* 2003 Commercial Buildings Energy Consumption Survey (CBECS), Detailed Tables, dated October 2006 and published~~

~~by EIA, http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/alltables.pdf~~

Quantification Methods:

Benefits: Estimates~~Regional studies~~ of government floor space ~~gas~~ and electricity ~~efficiency potential~~ 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 ~~analyses/experience in other western US states~~ for commercial space were ~~will be~~ used to estimate ~~efficiency savings per~~ $ spent on programs per unit of energy saved ~~,~~ which in turn, was~~will be~~ used to translate energy savings ~~and program savings~~ targets into required spending levels.

Key Assumptions

Parameter	Value	Notes
Ratio of Electricity and Natural Gas Consumption per Unit of Floor Area for State/State-funded Buildings Relative to Average of Commercial Buildings in Colorado	1.00	Placeholder assumption
Forecasted Number of Government Buildings and Forecasted Floor Space of Government Buildings		Based on regional data, broken out into government and non-government using proportions from CBECS and scaled to Colorado based on population
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	
Cost per unit of saved natural gas for the commercial sector	1.4$/MMBtu	
Loan interest	0%	
Timing of costs, benefits, and goal attainment		• Assumed an even ramp in to achieve goals in 2015 • Benefits continue at 2015 level through 2020 with no decay • Program cost terminated after 2015

~~Program investment ($) for the public sector per unit of electricity savings: 4.74 cents/kWh (2005$) (WGA 2006)~~

~~Senator Reid from Nevada has proposed a bill to provide 0% financing to school districts in 4 "Sun" states to include NV, CO, NM and AZ. This analysis does not include Sen. Reid's bill in the baseline, however it is worth noting that the cost of RCI-2 would be lower if such a bill is enacted.~~

Key Uncertainties

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

Additional Benefits and Costs

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

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI–3. Enforcement of Building Codes

Policy Description

Building energy codes can be an effective way to eliminate the least efficient energy approaches in new or renovated buildings. The International Energy Conservation Codes (IECC) have become a widely accepted standard. These codes are updated every three years through an exhaustive consensus process involving a large number of code officials and building experts. Many Colorado jurisdictions adopt the IECC. More will do so, if legislation recently passed by both houses of the Colorado Assembly (HB1146) is signed by the Governor as expected. Adoption of the IECC will do no good, however, if it is not enforced, and enforcement is questionable in many building jurisdictions. Building code jurisdictions need to be encouraged to enforce the IECC with training, technical support and education.

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

Policy Design

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

Timing: Begin funding in 2008

Coverage: Covers the 20,000 new homes per year in CO, plus retrofits.

Implementation Mechanisms

TBD

Related Policies/Programs in Place

Some areas~~, notably Boulder,~~ are already "beyond code".

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

Type(s) of GHG Reductions

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

Estimated GHG Savings and Costs per $MtCO_2e$

N/A. Discussions with industry experts and literature review suggest that increased funding for enforcement could yield considerable energy and emissions savings, if additional training is provided and funding is sustained.

~~TBD~~

Data Sources, Methods and Assumptions

Data Sources:~~: PWG members to provide references on effectiveness of building code~~ City of Fort Collins. "Evaluation of New Home Energy Efficiency: An assessment of the 1996 Fort Collins residential energy code and benchmark study of design, construction and performance for homes built between 1994 and 1999: Summary Report" June 2002~~enforcement, OR to suggest/agree on % increase in compliance to be achieved by proposed level of investment~~.

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

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

Key Assumptions: N/A

Key Uncertainties

~~% increase in compliance to be achieved by a proposed level of investment~~

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

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

Additional Benefits and Costs

- Reducing home heating and cooling costs
- Reducing dependence on imported fuel sources

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

Feasibility Issues

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

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

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-4. Planning and Design

Policy Description

Mandating building design to a very high efficiency standard will ensure that the next generation of buildings in Colorado produces much lower GHG emissions per unit of utility.

Policy Design

Goals:

- ~~For~~ All new construction and major renovations of government-owned buildings, including schools and publicly-owned hospitals, must attain LEED™ certification; 30% must be certified ~~, certification~~ to LEED™ Gold, and the other 70% to LEED™ Silver ~~for 100% of these buildings~~.
- For residential: 70% of new homes to EnergyStar standard "high performing" (see HPH100.org for definition)
- Commercial: new buildings held to Architecture 2030 standards

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

TBD

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:

- 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)
- 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 TBD)

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 $MtCO_2e$

	Policy Option	GHG Reductions ($MMtCO_2e$) 2010	2020	Total 2007-2020	Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/t$CO_2$e)
RCI-4	Planning and Design	0.4	2	19	289	15

~~TBD~~

Data Sources, Methods and Assumptions~~:~~

Data Sources:

- For government (LEED):
- ~~*%Levelized cost of electricity savings:* WGA CDEAC EE, 2005, The Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors Association and The Potential for More Efficient Electricity Use in the Western United States, January, 2006, http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf.~~
    - *~~Total~~ Commercial floor space by building type (i.e., state and local government)~~, electricity~~ and number of commercial buildings by building type in the Mountain Region~~gas consumption~~*: 2003 Commercial Buildings Energy Consumption Survey (CBECS), Detailed Tables, dated October 2006 and published by EIA, http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/alltables.pdf ~~USDOE EIA CBECS data (Table B.5) for the Mountain region, extrapolated using projected Colorado population as a driver.~~

~~http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/alltables.pdf~~

- *Commercial floor space projection for the Mountain Regions:* EIA AEO 2006

- ~~*Energy consumption by housing unit:* US EIA 2004. "Consumption and Expenditure Data Tables" in Residential Energy Consumption Survey 2001, available at http://www.eia.doe.gov/emeu/recs/recs2001/detailcetbls.html~~

- ~~*Cost and benefit of LEED:*~~
  - Enermodal Engineering, Inc. 2007. The Costs and Benefits of LEED-NC in Colorado, prepared for Colorado Governor's Energy Office, March 2007, available at http://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 http://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, http://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*: http://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*: http://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_features

- ~~*Cost of "beyond code" efficiency improvements:* Southwest Energy Efficiency Project Report, Increasing Energy Efficiency in New Buildings in the Southwest: Energy Codes and Best Practices~~

Quantification Methods:

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

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

~~Per-unit energy savings associated with achieving target levels of efficiency (over code or existing practices) to be determined from data sources and/or sources to be provided by PWG members. Projected number of new units per year to be derived from state or federal census projections or other publicly available data.~~

Cross-Sector Key Assumptions:

Parameter	**Value**	**Notes**
Timing of costs, benefits, and goal attainment		• Assumed an even ramp in to achieve goals in 2015 • Benefits continue at 2015 level through 2020 with no decay • Program cost terminated after 2015
Applicability		All units built in 2008 and after are assumed to be new.

Government Sector Policy Key Assumptions:

Parameter	**Value**	**Notes**
Forecasted Number of New Government Buildings and Forecasted Floor Space of New Government Buildings		Based on regional data, broken out into government and non-government using proportions from CBECS and scaled to Colorado based on population
Average Sq. Ft. per Government Building	22,691	Based on average between 2008 and 2020
Ratio of Renovated Government Buildings to New Government Buildings	1.00	Placeholder assumption
Ratio of Electricity and Natural Gas Consumption per Unit Floor Area for State/State-funded Buildings Relative to Average Commercial Building in Colorado	1.00	Placeholder assumption
Energy Use Reductions due to Energy Efficiency in a LEED Gold Building	37%	Above standard code
Energy Use Reductions due to Energy Efficiency in a LEED Silver Building	30%	Above standard code
Standard New Construction Cost w/o LEED Implementation	$169/sq. ft.	Avg. across 11 CO projects; data from hospitals was not present in the sample from which this assumption was made
LEED requirements		Targeted buildings would be required to obtain points from the energy and atmosphere category in order to achieve the assumed

Parameter	**Value**	**Notes**
		average energy reductions for LEED Gold and LEED Silver. Credits from site, water efficiency, materials and resources, and indoor environmental quality can be obtained but would be incremental to energy requirements.
Other legislation	Effects of SB07-051 not modeled	Goals outlined in SB07-051 will overlap with the goals outlined in this policy.
Loan period	30 years	Consistent with life of asset
Real discount rate	5.0%	Consistent with government financing
LEED Construction Cost Premium	3.1%	Avg. across 5 CO LEED Gold and Silver projects; data from hospitals was not present in the sample from which this assumption was made

Commercial Sector Policy Key Assumptions:

Parameter	**Value**	**Notes**
Forecasted Number of New Commercial Buildings and Forecasted Floor Space of New Commercial Buildings		Based on regional data, broken out into government and non-government using proportions from CBECS and scaled to Colorado based on population
Average Sq. Ft. per Commercial Building	14,851	Based on average between 2008 and 2020
Architecture 2030 Reduction Targets		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

Parameter	Value	Notes
Construction Cost Premium	4%	Placeholder assumption

Residential Sector Policy Key Assumptions:

Parameter	Value	Notes
Forecasted Residential Starts per Year		Based on regional data and scaled to Colorado based on population
% Energy Reduction to account for focus on New Homes vs. New/Existing Homes	15%	Based on a dataset comparing energy consumption of new vs. existing homes in California
% Energy Reduction Goal Beyond that for New Homes for EnergyStar "High Performing" Homes	15%	Stated goal
Avg. Sq. Ft. of a New Residential Home	1,973	Based on average between 2008 and 2020
Loan period	30 years	Consistent with life of asset
Real discount rate	7.0%	Consistent with residential financing
Construction Cost Premium	0.5%	Program estimate

~~**Key Assumptions:**~~

~~Per-unit efficiency improvement over BAU associated with these standards~~

Key Uncertainties

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

An estimated construction cost per square foot applicable to the residential sector would be much preferred over the commercial construction cost per square foot that is currently being used. If this data becomes available, adjustments will be made.

Additional Benefits and Costs

- Reducing dependence on imported fuel sources

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

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-5. Inverted Block Rates to Fund Energy Efficiency

Policy Description

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

Note: implementing this state wide would probably require legislation.

Policy Design

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

Timing: Starting in 2010

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

Implementation Mechanisms

TBD

Related Policies/Programs in Place

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

Type(s) of GHG Reductions

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

Estimated GHG Savings and Costs per $MtCO_2e$

~~TBD~~

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
		2010	2020	Total 2007-2020		
RCI-5	Inverted Block Rates to Fund Energy Efficiency	1	16	96	2487	26

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 ~~SWEEP 2002. THE NEW MOTHER LODE: The Potential for More Efficient Electricity Use in the Southwest, November, 2002,~~ http://www.eia.doe.gov/oiaf/analysispaper/elasticity/index.html and http://www.eia.doe.gov/oiaf/analysispaper/elasticity/table1.html
- *Electricity prices:* same sources as used for RCI-1.
- *Return on investment in efficiency measures:* same sources as used for RCI-1.
- *Architecture 2030 targets:* **"**The fossil fuel reduction standard for all new buildings shall be increased to:
  60% in 2010
  70% in 2015
  80% in 2020
  Source: http://www.architecture2030.org/2030_challenge/index.html

~~*PWG members: please assist in defining these targets based on this table from the Architecture 2030 website. Also, targets **must** be related to readily available economic and BAU data for analysis.*~~

2030 CHALLENGE Targets

U.S. Average Site Energy Use and 2030 Challenge Energy Reduction Targets by Space/Building Type (CBECS 2003)[1]

From the Environmental Protection Agency (EPA): Use this chart to find the site fossil-fuel energy targets.

Primary Space/Building Type [2]	Available in Target Finder [3]	Average Source EUI[4] (kBtu/Sq.Ft./Yr)	Average Percent Electric	Average Site EUI[4] (kBtu/Sq.Ft./Yr)	2030 Challenge Site EUI Targets (kBtu/Sq.Ft./Yr) 50% Target	60% Target	70% Target	80% Target	90% Target
Administrative/Professional & Government Office	✓								
Bank	✓								
Clinic/other outpatient health		199.0	76%	84.2	**42.1**	33.7	25.3	16.8	8.4
Convenience store (with or without gas station)		681.1	90%	241.4	**120.7**	96.5	72.4	48.3	24.1
Distribution/shipping center		82.9	61%	44.2	**22.1**	17.7	13.3	8.8	4.4
Fast food		1195.0	64%	534.3	**267.2**	213.7	160.3	106.9	53.4
Fire station/police station		145.7	56%	77.9	**39.0**	31.2	23.4	15.6	7.8
Hospital/inpatient health	✓								
Hotel, Motel or inn	✓								
K-12 School	✓								
Medical Office	✓								
Non-refrigerated warehouse	✓								
Nursing home/assisted living		234.8	54%	124.3	**62.2**	49.7	37.3	24.9	12.4
Post office/postal center		131.9	58%	63.5	**31.8**	25.4	19.1	12.7	6.4
Preschool/daycare		155.3	60%	75.0	**37.5**	30.0	22.5	15.0	7.5
Refrigerated warehouse	✓								
Religious worship		77.5	52%	45.9	**22.9**	18.3	13.8	9.2	4.6
Residence hall/Dormitory	✓								
Restaurant/cafeteria		565.7	53%	301.6	**150.8**	120.7	90.5	60.3	30.2
Retail store		158.3	67%	72.2	**36.1**	28.9	21.7	14.4	7.2
Self-storage		10.9	44%	4.0	**2.0**	1.6	1.2	0.8	0.4
Supermarket/Grocery	✓								
Vehicle repair/service/storage		96.6	64%	50.7	**25.3**	20.3	15.2	10.1	5.1
Secondary Space/Building Type [2]									
Ambulatory Surgical Center	✓								
Computer Data Center	✓								
Garage	✓								
Open Parking Lot	✓								
Swimming Pool	✓								
Residential Space/Building Type [5]									
Single-Family Detached		-	-	44.7	**22.4**	17.9	13.4	8.9	4.5
Single-Family Attached		-	-	45.6	**22.8**	18.2	13.7	9.1	4.6
Multi-Family, 2 to 4 units		-	-	56.1	**28.1**	22.4	16.8	11.2	5.6
Multi-Family, 5 or more units		-	-	48.5	**24.3**	19.4	14.6	9.7	4.9
Mobile Homes		-	-	72.0	**36.0**	28.8	21.6	14.4	7.2

Quantification Methods:

~~TBD. Review recent studies on California block rate structure.~~

Identify the share of electricity consumption among energy sources by sector~~ or possibly by building type~~; estimate electricity consumption levels based on Architecture 2030 target ~~for electricity consumption~~. Project change in electricity consumption based on price elasticity and revenues available for energy efficiency programs. (See the data sources, quantification methods, and assumptions for RCI-1 for an explanation of the analysis of RCI-5's enhanced energy efficiency benefits)

Key Assumptions

Parameter	Value	Notes
Price elasticity of electricity		
Residential	2008 2020 -0.200 -0.490	Source: EIA, http://www.eia.doe.gov/oiaf/analysispaper/elasticity/table1.html
Commercial	-0.100 -0.450	
Conversion of Architecture 2030 goals to kWh standards	US residential electricity consumption per capita, times the relevant annual target US commercial electricity consumption per sq. ft., times the relevant annual target	Base year: 2003
Distribution of customer types to be associated with pricing thresholds	All commercial & residential electricity consumers	Data were not available on the distribution of customer types to be associated with each pricing threshold. This analysis used average consumption, which may obscure changes in behavior for those subject to the surcharges. On aggregate, the resulting reductions in consumption should be similar.
Architecture 2030 Challenge Site EUI Targets	60 % in 2010, 70% in 2015, and 80% in 2020	
Substitution effect for	0	This effect was not analyzed

heating fuel (cross price elasticity)		because it does not appear significant for the analysis. EIA reports that cross-price elasticity for electricity to natural gas for the residential sector is 0.01; for the commercial sector, it is 0.01. (AEO2003)
Assumed Cost of Implementation of Inverted-Block Tariffs	$0/MWh	In practice, there will be some costs associated with implementing inverted-block tariff structures, including program administration costs and changes to billing systems. These costs are not explicitly accounted for in this analysis, but are likely to be quite small relative to the electricity cost savings achieved through the policy.
Avoided Electricity Cost (Residential & Commercial)	$61/MWh	
Levelized Cost of Electricity Savings	2.5 cents/kWh (2005$ 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.

Key Uncertainties

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

Additional Benefits and Costs

TBD

Feasibility Issues

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

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-6. Retrofitting Existing Buildings for Energy Efficiency

Policy Description

This option is designed to improve the energy efficiency of existing privately owned (e.g., non-municipal) ~~residential,~~ commercial and industrial buildings through a variety of energy-efficiency upgrades and improvements in day-to-day operations. Existing buildings account for up to 40% 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~~; and tax credits to homeowners and residential rental property owners~~ 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% of existing commercial non-government (including institutional) and industrial ~~commercial/industrial/institutional~~ buildings per year 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

TBD

Related Policies/Programs in Place

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

~~Proposed~~ Colorado Bill 07-1037 was passed in May, 2007, and directs the Public Utilities Commission to adopt rules establishing funding and cost recovery mechanisms for natural gas distributors of ~~natural gas and electric~~ to engage in conservation and energy efficiency programs, and directs distributors of natural gas and electric to develop and implement cost-effective energy efficiency programs once such rules are adopted. ~~The purpose of the bill is to conserve energy and slow the need for new energy resources to be built or purchased.~~

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 $MtCO_2e$

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/t$CO_2$e)
		2010	2020	Total 2007-2020		
RCI-6	Retrofitting Existing Buildings for Energy Efficiency	0.04	0.9	5	(231)	(46)

~~TBD. Existing buildings account for up to 40% of GHG emissions. Because many buildings are extremely inefficient, small efficiency upgrades can result in dramatic reductions in GHG emissions and economic savings.~~

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, http://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, http://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, http://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: http://www.swenergy.org/news/Xcel_DSM_Potential_Study.pdf and http://swenergy.org/news/Xcel_DSM_Potential_Study_Appendices.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 . and KEMA 2006. Colorado DSM Market Potential Assessment and~~

- ~~*Estimated DSM potential:* KEMA 2006. Colorado DSM Market Potential Assessment and 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 http://www.swenergy.org/nml/New_Mother_Lode.pdf.~~

~~*Program-specific data:* KEMA 2006. Colorado DSM Market Potential; NWPCC 2005. The Fifth Northwest Electric Power and Conservation Plan, available at ; California DEER (Database for Energy Efficiency Resources), available at http://eega.cpuc.ca.gov/deer/; ACEEE 2003. America's Best: Profiles of America's Leading Energy Efficiency Programs, available at http://www.aceee.org/pubs/u032.htm~~

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:

~~Reductions to equal 25% of 5% of total Commercial, industrial and institutional energy use over five years.~~ 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. ~~to be estimated based on public data on cost-effectiveness of retrofits, less economic benefits associated with greater energy efficiency.~~

Key Assumptions:

Parameter	**Value**	**Notes**
Existing Commercial and Industrial Buildings		As of 2008 Commercial buildings were based on regional data, broken out into government and non-government using proportions from CBECS and scaled to Colorado based on population Industrial buildings were based on national data and scaled to Colorado using an estimate of the percentage of industrial firms in Colorado

Average Sq. Ft. per Commercial Building	14,851	
Average Sq. Ft. per Industrial Building	86,458	
Loan interest	0%	
Satisfactory outcome		Assumed that this was achieved and that coverage continued
Timing of costs, benefits, and goal attainment		▪ 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 ▪ Benefits continue after goals are achieved with no decay ▪ Program cost decayed based on participation from 2018 on
Commercial Costs	$40,939/billion btu saved	Based on modeling scenario
Industrial Costs	$40,262/billion btu saved	Based on modeling scenario
Loan period	13 years	Consistent with life of asset
Real discount rate	8.0%	Consistent with commercial financing

~~Cost-effectiveness of retrofits for existing Colorado building stock~~

Key Uncertainties

TBD

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-7. Pricing and Purchasing

Policy Description

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

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

Policy Design

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

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

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

Implementation Mechanisms

TBD

Related Policies/Programs in Place

Types(s) of GHG Reductions

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

Estimated GHG Savings and Costs per $MtCO_2e$

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/t$CO_2$e)
		2010	2020	Total 2007-2020		
RCI-7	Pricing and Purchasing	0.9	2	22	314	15

~~TBD.~~

~~Customers that have real time energy consumption information have been shown to use 4-15% less energy with lasting results. (Primen, 2004)~~

Data Sources, Methods and Assumptions

Data Sources:

Impacts of different types of smart metering:

- "Smart Metering Study Summary" (smart-metering-append.pdf) compiled by CU Denver for the City & County of Denver
- Primen, Inc. 2004. California Information Display Pilot Technology Assessment, http://www.ucop.edu/ciee/dretd/documents/idp_tech_assess_final1221.pdf
- ~~CRA International. 2006. California's Statewide Pricing Pilot: Commercial & Industrial Analysis Update, available at http://www.eere.energy.gov/state_energy_program/project_brief_detail.cfm/pb_id=1036~~
- ~~Resource Insight, Inc. 2003. Peak-Shaving/Demand Response Analysis: Load-Shifting by Residential Customers, June 2003, available at www.capelightcompact.org/pdfs/Peak%20Shaving%20Demand%20Response%20Analysis.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 http://www.energycooperative.org/energy-smart-pricing-plan.php

Cost of Metering

- Primen, Inc. 2004. California Information Display Pilot Technology Assessment, http://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~~real-time~~ metering experienced by other states/localities. Economic savings in reduced energy use will also be estimated. ~~Emissions reduction will draw on California experience.~~

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,

		http://www.ucop.edu/ciee/dretd/documents/idp_tech_assess_final1221.pdf • Idaho Power 2005. Phase One AMR Implementation Status Report under IPC-E-02-12, December 30, 2005 • CA PUC 2006. Advanced Metering Infrastructure (AMI) Update, available at www.cpuc.ca.gov/Static/hottopics/1energy/ami_update+june+2006.pdf
Economic Life of Smart Meters and In-Home Displays	20 years	Assumes equipment lasts for 20 years.
Energy Reduction due to Real Time Pricing and In-Home Display	5%	Primen (2004) cites studies documenting that useful feedback can result in energy reduction by 4 to 15 percent. "Smart Metering Study Summary" (smart-metering-append.pdf) compiled by CU Denver for the City & County of Denver indicate that savings differ widely from 0% to 26%. Five percent savings appears to be a conservative estimate.
Real discount rate for levelized cost of natural gas savings	5.00%	Consistent with utility operation of program

~~Energy use reduction associated with real-time metering and in-home displays, translated from CA to CO~~

Key Uncertainties

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

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

Additional Benefits and Costs

- Electric utilities can save operating and maintenance expense through this measure. Examples include (1) reduced labor cost due to remote meter reading,

(2) better outage management, and (3) more accurate meter reading and consumption forecasting.

- Consumers may be able to have more flexible retail choice under this program.
- Reducing the risk of power shortages
- Reducing vulnerability to energy price spikes
- Reducing peak demand and improving the utilization of the electricity system
- Enabling avoidance of the most controversial energy supply projects
- Reducing water consumption by power plants
- Reducing pollutant emissions by power plants and improving public health

Feasibility Issues

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

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

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

Policy Description

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

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

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

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

Policy Design

Goals:

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

(2) Create a complementary energy efficiency requirement that buildings related to the renewable energy system to be installed must reduce energy consumption by 20% prior to applying for renewable energy tax credits.

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

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

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

Implementation Mechanisms

TBD

Related Policies/Programs in Place

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

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

Type(s) of GHG Reductions

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

Estimated GHG Savings and Costs per $MtCO_2e$

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/t$CO_2$e)
		2010	2020	Total 2007-2020		
RCI-8	Renewable Energy Systems on New and Existing Buildings	TBD	TBD	TBD	TBD	TBD

~~TBD~~

Data Sources, Methods and Assumptions

Data Sources:

- *Housing units and commercial building area:* The Southwest Energy Efficiency Project's Report Increasing Energy Efficiency in New Buildings in the Southwest: Energy Codes and Best Practices, http://www.swenergy.org/ieenb/fact_sheet_arizona.pdf
- *Building floor area:* 2003 Commercial Buildings Energy Consumption Survey Detailed Tables, http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/allbc.pdf, Tables A5 and A6
- *Costs of renewable energy systems:* Iton, Inc. 2005. CPUC Self-Generation Incentive Program Preliminary Cost-Effectiveness Evaluation Report, prepared for California

Public Utilities Commission, available at http://www.cpuc.ca.gov/static/energy/electric/050914_self-generationincentiveprogram_cost-effectiveness+evalreport.pdf or http://www.cpuc.ca.gov/static/energy/electric/051005_sgip.htm; San Diego Regional Energy Office 2007. “Statewide Self-Generation Incentive Program Data” (updated April 2007, 2.3 MB XLS), available at http://www.energycenter.org/ContentPage.asp?ContentID=279&SectionID=276&SectionTarget=35

- *Federal solar tax credits by sector:* Energy Policy Act of 2005, http://www.seia.org/getpdf.php?iid=21
- *PV penetration and performance:* LBL and CESA. "Designing PV Incentive Programs to Promote Performance - A Review of Current Practice," by Galen Barbose, Ryan Wiser, and Mark Bolinger, LBNL. October 2006. Available at http://www.cleanenergystates.org/case.html

Quantification Methods:

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

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

Estimate technical potential for each renewable type (how many and what type of systems can new and existing building accommodate?; Estimate applicable fraction of renewables by building; what is the status and prospect of heating energy use and fuel use by building type?);

Key Assumptions

Parameter	**Value**	**Notes**
Avoided cost of natural gas	$6.3/ MMBtu	Based on AEO 2007 for Mountain region
Avoided cost of delivered electricity	$56/MWh	Sales-weighted average, includes energy & capacity costs. Based on KEMA 2006.
Fraction of RES, COM, IND Buildings (Participants) that will reduce energy consumption by 20% in order to participate in this program by 2018	5%	It is uncertain how many participants are willing to participate in this program by reducing 20% energy consumption. Thus, 5% is a rough estimate.

Cost of saved energy	$25/MWh for electricity $1.5/mmBtu for natural gas, oil, and coal	The cost of saved electricity and natural gas are explained in RCI-1. The cost of saved energy for oil and coal are currently assumed to be close to cost of saved natural gas. They are placeholders and will be examined further later.
Real discount rate for levelized cost of natural gas savings	5.00%	Consistent with utility operation of program

Key Uncertainties

TBD

Additional Benefits and Costs

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

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-9. Energy Delivery

Policy Description

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

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

Policy Design

Goals & Timing: 1500 MW of CHP statewide by 2015 (based on WGA white paper potential)

Coverage: Statewide

Implementation Mechanisms

TBD

Related Policies/Programs in Place

TBD

Types(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 $MtCO_2e$

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
		2010	2020	Total 2007-2020		
RCI-9	Energy Delivery	0.6	3	19	(107)	(6)

~~TBD. One generalized estimate (WGA) is that CO_2 emissions from CHP are 49 percent lower than centralized power generation (coal).~~

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 http://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.

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 http://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 http://www.eea-inc.com/dgchp_reports/TechCharNREL.pdf.

Quantification Methods:

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

Key Assumptions:

- 1,578 MW of technical CHP potential in Colorado (per WGA 2006)
- Existing CHP capacity (CO): 791MW (per PWG)
- Economic CHP potential

Key Uncertainties

TBD

Additional Benefits and Costs

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

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-10. Targeting Small and Medium Enterprises (SMEs)

Policy Description

Introduction

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

Policy Design

Goal: Ramp up to 1 million tons CO2/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~~Ramp~~ up to 1 million tons annual avoided emissions by 2015.

Parties involved: Small and Medium-sized enterprises throughout the state

Implementation Mechanisms

TBD

Related Policies/Programs in Place

TBD

Type~~Types~~(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),~~, as well as~~ avoided transportation (VMT), and~~pollution,~~ waste-related emissions (CO_2 and methane). The program will have~~),~~ GHG-reduction benefits from water conservation, but the benefits have been such a small contribution to the total Ft. Collins program to date that they were ~~will~~ not ~~be~~ analyzed.

Estimated GHG Savings and Costs per $MtCO_2e$

The benefits and costs of this policy were not analyzed.

~~TBD~~

Data Sources, Methods and Assumptions~~:~~

Data Sources: Information provided by Fort Collins program staff.

- ~~*Technical assistance:* TBD~~
- ~~*Public recognition:* TBD~~

- ~~*Publicity of their participation:* TBD~~

Quantification Methods: N/A

~~Potential benefits to be estimated based on information provided by Fort Collins program staff~~

Key Assumptions: N/A

Key Uncertainties

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

- The Fort Collins program is too small scale at this time to be used to extrapolate statewide performance with accuracy. For example, it is unknown what the appropriate staff level would be for a larger program. In Fort Collins, a staff of 1.5 employees managed 48 partners as of 2006 and 70+ partners in 2007. A larger program could experience greater efficiencies due to staff specialization. However, the statewide program may require additional administrative staff to support the participation of a larger number of smaller companies.
- A major benefit of this type of program is the public relations benefit to participants. If businesses perceive that consumers will respond positively to Climate Wise "branding," they will be more likely to invest their time and money in voluntary measures. Community buy-in and word-of-mouth promotion will greatly facilitate the success of the program. However, culture and economic characteristics of Fort Collins may not be representative of the rest of the state. Participation rates are likely to vary in other areas.
- Performance data are generally less reliable during the first few years following program start-up. In Fort Collins' case, little to no performance reporting was available from the first 3 years (2000-2002). Until 2006, participants did not consistently report data on the reductions achieved in each of the program areas (energy efficiency, renewable energy, transportation, waste, and water use). Participant costs have not been uniformly reported throughout.

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

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

Additional Benefits and Costs

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

Feasibility Issues

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

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD