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Energy Supply Policy Work Group

Summary List of Draft Priorities for Analysis

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/tCO_2e$)	Level of CAP Support
		2012	2020	Total 2007-2020			
Option #	**ENERGY SUPPLY**						
ES-1	Renewable Energy Incentives Including Waste to Energy						TBD
ES-2	Mandated Portfolio Standards						TBD
ES-2a	Clean Energy Portfolio Standard						TBD
ES-3	Transmission Infrastructure for Renewables						TBD
ES-4	Cost for CO2 Emissions (Cap and Trade or Tax)						TBD
ES-5	Public Benefit Charge Funds						TBD
ES-6	Incentives for CHP, DG, Smart Grid						TBD
ES-7	Carbon Capture & Storage Infrastructure						TBD
ES-9	R&D for Carbon Emissions Reducing Generating Technologies						TBD

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/tCO_2e$)	Level of CAP Support
		2012	2020	Total 2007-2020			
ES-10	Promote Advanced Fossil Fuel Generation with Carbon Capture, Including IGCC						TBD
ES-11*	Small New Hydro and Efficiency Improvements at Existing Hydro, Identifying Other Small Renewables and Removing Barriers						TBD
ES-12*	Nuclear Energy						TBD
ES-13*	Efficiency Improvements for Existing Generators (Includes Heat Recovery)						TBD
ES-14*	Oil and Gas Operations						TBD
ES-15	CO^2 Emission Standards for Power Plants						
	SECTOR TOTAL AFTER ADJUSTING FOR OVERLAPS						
	REDUCTIONS FROM RECENT ACTIONS (table to be added below)						
	SECTOR TOTAL PLUS RECENT ACTIONS						

* Indicates additional policy options from Call # 4 vote – chosen outside formal balloting process.

ES-1. Renewable Energy Incentives (Including Waste To Energy?)

Policy Option Description

Resource maps of renewable energy in Colorado developed by the Department of Energy's National Renewable Energy Laboratories (NREL), based in Golden, CO, show that Colorado is well-endowed with renewable resources. Wind is prevalent in the northeast and southeast corners of the state. Biomass is available in the northeast. Photovoltaics can be deployed throughout the state. Concentrating solar power can be tapped in the San Luis Valley. Deep geothermal resources exist in the southern portion of the state. Solar and wind alone have the potential to produce 100 times the electricity currently used in Colorado, even after reasonable filters area applied. However, renewables are generally more costly than today's conventional energy supplies. Financial incentives are needed to greatly accelerate the deployment of renewables and allow time for learning curves, economies of scale, and R&D to lower their costs.

Mechanisms include an investment tax credit, an energy production tax credit, a feed-in tariff, and incentives to help support financing of projects. Generous feed-in tariffs have been successful at promoting renewables in Europe. However they come at considerable expense to the taxpayer and are considered unlikely in the U.S. political climate. Production tax credits are generally preferred by renewable energy providers that can produce electricity at under about 10 cents per kWh (wind and geothermal), whereas investment tax credits are generally preferred for more expensive technologies (concentrating solar power). Key to the success of these incentives is that they be guaranteed for a period of at least 5 years to allow time to raise financing and build projects.

Financial incentives that encourage utilities to deploy or purchase renewable energy should also be considered. Finally, R&D aimed at solving Colorado-specific problems can be funded at state universities and NREL. These include resource assessment and performance-cost analysis.

Policy Option Design

Goal: Financing and/or tax incentives to meet goals in ES-2

Timing: 2009

Coverage: First 2000 MW capacity in state

Other: Not applicable.

Implementation Mechanisms

TBD

Related Policies/Programs in Place

See ES-2

Types(s) of GHG Reductions

See ES-2

Estimated GHG Savings and Costs per $MtCO_2e$

TBD

Data Sources:

TBD

Quantification Methods:

To be quantified with ES-2

Key Assumptions

TBD

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

ES-2. Mandated Portfolio Standards

Policy Option Description

A renewable portfolio standard (RPS) is a requirement that utilities must supply a certain percentage of electricity from an eligible renewable energy source(s). For example, an RPS of 5% would mean that for every 100 kWh that a utility supplies, 5 kWh must be generated from renewable resources. About 20 states currently have an RPS, including Colorado. In Montana and some other states, utilities can also meet their RPS (or EPS) by

purchasing certificates from eligible energy projects, typically referred to as Renewable Energy Certificates (RECs) in the case of RPS policies.

Policy Option Design

Goal: 30% of total energy to come from renewables; no more than 85% of this from "big wind".

Timing: by 2020

Coverage: All retail electric suppliers, including municipally owned and co-ops

FOR ANALYSIS PURPOSES: Assume that of the remaining 15% (non-big wind), 3% each for solar, CSP, geothermal, small hydro, biomass.

Assume you can trade each attribute within the state

Implementation Mechanisms

Mandate to all IOUs, munis and coops

Related Policies/Programs in Place

Existing RPS in Colorado requires 20% renewables for IOUs and 10% renewables for cooperatives and municipal utilities (with +40,000 customers) by 2020. IOUs must meet 4% of their annual target with solar, half of which must be located on-site at customers' facilities

In-state renewable resources receive favorable treatment. Each kilowatt-hour (kWh) from eligible in-state renewable projects receives 125% credit for RPS-compliance purposes. Certain community-based project can receive 150% credit under cooperatives and eligible municipal utilities.

Utilities are entitled to recover prudent cost of complying RPS through retail rate mechanism. Utilities that are under compliance with RPS requirements may purchase RECs from other utilities that exceed the requirements.

Types(s) of GHG Reductions

Reduced CO_2 emissions associated with decreased FF generation relative to BAU.

Estimated GHG Savings and Costs per $MtCO_2e$

TBD

Data Sources:

Possible sources: NREL; trade organizations; EIA Annual Energy Outlook; La Capra study used in North Carolina analysis and others; What else??

Ronald Binz 2004. The Impact of a Renewable Energy Standard on Retail Electric Rates in Colorado, available at http://www.environmentcolorado.org/reports/ImpactOfRPS.pdf

MIT Laboratory for Energy and the Environment (LFEE) 2005. Emissions Reductions from Solar Photovoltaic (PV) Systems

Quantification Methods:

Quantify costs and benefits. Obtain data on eligible renewables; develop supply curve showing cost and availability *of each resource type*; project the penetration of each technology assuming compliance with the policy. Identify key design and implementation issues likely to affect the quantity and cost effectiveness of emission reductions.

Calculate penetration and GHG cost effectiveness in three cases:

- BAU case (with existing CO RPS)
- New RPS case (ES-2), and
- New RPS with incentives (ES-1).

Review literature and propose renewable cost and resource availability data.

Key Assumptions

Cost curve for available renewable resources of each resource type in Colorado

Assumes availability of sufficient quantity of each resource type; resolution of structural, zoning, jurisdictional, etc. issues without cost.

Key Uncertainties

TBD

Additional Benefits and Costs

TBD

Feasibility Issues

Current RPS requirement for munis and coops is lower than IOUs—10% by 2020. This policy would be especially burdensome for these entities.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

ES-2a. Clean Energy Portfolio Standards

Policy Option Description

This is a variant on the portfolio standard that is more broadly defined to include energy efficiency, clean coal, new nuclear resources, and carbon offsets, as well as renewable energy, and is based on a proposal by Xcel energy for a nationwide portfolio standard. Jack Ihle volunteered to provide Xcel's analysis, which could be adapted to a Colorado-only program.

Policy Option Design

Goal: Implement Xcel's proposed "clear energy portfolio standard" in Colorado

Timing: TBD

Coverage: TBD

Implementation Mechanisms

TBD

Related Policies/Programs in Place

TBD

Types(s) of GHG Reductions

TBD

Estimated GHG Savings and Costs per $MtCO_2e$

TBD

Data Sources:

TBD

Quantification Methods:

Expand RPS analysis to include additional technologies

Key Assumptions

- National analysis can be reasonably scaled to Colorado
- Other assumptions as contained in xCel proposal and/or EIA analysis.

Key Uncertainties

There is likely to be more uncertainty around this analysis than around the RPS analysis due to uncertainties in the projected costs of new nuclear and IGCC units. Possible data

sources on nuclear and IGCC costs and performance: EIA Annual Energy Outlook, others?

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

ES-3. Transmission Infrastructure for Renewables

Policy Option Description

SB 100 provides that utilities regulated by the Public Utilities Commission are required to file maps of generation resource areas that need transmission, and transmission plans to serve those areas, for approval by the PUC by October 31 of each odd-numbered year. This new law changes the goal of transmission planning and investments by requiring planning and investment for transmission to serve resource areas, not single generators as has been the case in the past. This will break the "chicken and egg" dilemma for new renewable energy projects in the state, where cost effective wind projects could not be built because transmission was not available and transmission could not be built because no wind project developer could develop a project in an area without transmission.

The mitigation option proposed here is to expand the coverage of SB 100 to all Colorado utilities to achieve a seamless, coordinated transmission network solution to support renewable resources statewide, instead of limiting transmission planning to areas served by investor owned and PUC regulated utilities.

The proposed solution is to plan for phased expansion based on the magnitude of the wind resource, along with attention to engineering, cost, statewide and regional transmission needs, and benefits associated with transmission investments including consumer savings from adding diverse resources to utility generation portfolios.

As a guide, this proposal includes full implementation of the National Wind Coordinating Collaborative (NWCC) / Western Governors' Association (WGA) Leadership Forum Draft Action Plans: Implementing Transmission Recommendations in the West. Information on these plans can be found on the following websites:

Press release: http://www.westgov.org/wga/press/plenary1-pr.htm

Policy resolution: http://www.westgov.org/wga/policy/06/clean-energy.pdf

Report: http://www.westgov.org/wga/meetings/am2006/CDEAC06.pdf

General website:
http://nationalwind.org/events/transmission/western/2006/default.htm

Policy Option Design

Goal: Require joint planning and cooperation and to design "expandable" transmission to serve renewable energy resource zones. (providers & RE developers working together.)

Timing: Pass legislation amending SB 100 in the 2008 legislative session.

Coverage: Statutory changes will directly affect utilities and renewable resource developers regulated by the Public Utilities Commission (PUC) . Locally controlled and

regulated utilities and federal power marketing agencies will be encouraged to participate.

Implementation Mechanisms

TBD

Related Policies/Programs in Place

TBD

Types(s) of GHG Reductions

Lower CO_2 emissions associated with displaced fossil fuel-based electricity generation.

Estimated GHG Savings and Costs per $MtCO_2e$

TBD

Data Sources:

Need map of exploitable renewable resources in CO, estimated of distance to major transmission hubs, per-mile cost estimate for transmission lines.

Quantification Methods:

Estimate miles of transmission line needed times dollars per mile. Emissions benefits as in ES-2. Do not include other costs and savings associated with renewable energy generation. Also do not try to quantify other economic benefits associated with expanded transmission system.

Key Assumptions

Assume transmission needs are consistent with the distribution of renewable resources as in ES-2.

Presumes siting, zoning, and transmission network issues can be resolved without cost.

Key Uncertainties

Location and best configuration for transmission projects in absence of engineering study. Unless there is one?

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

ES-4. Cost for CO2 Emissions (Cap and Trade or Tax)

Policy Option Description

Establishing a cost for CO_2 emissions is an alternative, and complementary, GHG-control method relative to direct regulations such as energy efficiency standards. The concept is to internalize the externality, allowing the marketplace find the most efficient reductions. Pricing CO_2 emissions has two primary effects. First, it increases the cost of carbon-based energy to encourage conservation and energy efficiency. Second, it provides an economic advantage to non-carbon-based energy sources.

There are two basic approaches to market control: cap and trade (C&T) and carbon taxes. The cap and trade approach has largely been based on the success of the C&T system for acid rain in the US. A cap is placed on GHG emission permits, which can be traded to find the lowest cost compliance. Typically the caps begin somewhat high and ratchet down on a pre-determined schedule.

Under the carbon tax approach, the government collects a tax per unit of GHG emissions. The tax collection can be done either upstream (e.g., wellhead, power plant) or downstream (e.g., gas pump, electricity bill). A carbon tax can be designed to be net revenue neutral. That is, the carbon tax revenue collected would be offset dollar-for-dollar by a reduction of some other tax.

Hybrid schemes are possible, such as a tax and trade system where an entity facing a large tax liability could offset their taxes through investments in reducing the GHG footprint of another with no or low liability (e.g., a school or hospital).

Policy Option Design

Goal: Consider applying a price to carbon emissions on a state, regional or national basis.

Timing:

Coverage:

Implementation Mechanisms

TBD

Related Policies/Programs in Place

TBD

Types(s) of GHG Reductions

TBD

Estimated GHG Savings and Costs per $MtCO_2e$

TBD

Data Sources:

Synapse Energy Economics, "Climate Change and Power: Carbon Dioxide Emissions Costs and Electricity Resource Planning", Revised as of June, 2006. http://www.synapse-energy.com/Downloads/SynapsePaper.2006-06.0.Climate-Change-and-Power.A0009.pdf

Energy Information Administration, Analysis of S. 139, the Climate Stewardship Act of 2003, EIA June 2003, SR/OIAF/2003-02; Energy Information Administration, Analysis of Senate Amendment 2028, the Climate Stewardship Act of 2003, EIA May 2004, SR/OIAF/2004-06

Paltsev, Sergei; Reilly, John M.; Jacoby, Henry D.; Ellerman, A. Denny; Tay, Kok Hou; Emissions Trading to Reduce Greenhouse Gas Emissions in the United States: the McCain-Lieberman Proposal. MIT Joint Program on the Science and Policy of Global Change; Report No. 97; June 2003.

Bailie et al., Analysis of the Climate Stewardship Act, July 2003; Bailie and Dougherty, Analysis of the Climate Stewardship Act Amendment, Tellus Institute, June, 2004. Available at http://www.tellus.org/energy/publications/McCainLieberman2004.pdf

Utility resource planning that incorporate carbon prices (e.g. Xcel Energy, Idaho Power, and Pacificorp)

Quantification Methods:

There have been numerous federal GHG emission reduction policies proposed in Congress over the past three to four years. There are studies that estimate the impact of some of the federal proposals including price per ton of carbon.

There are also state and regional initiatives such as California's Global Warming Solutions Act, Regional Greenhouse Gas Initiative (RGGI) in the Northeast, and Western Regional Climate Action Initiative. Further, some utilities are predicting and incorporating carbon prices in their resource planning. We will review and summarize these policy developments.

Key Assumptions

TBD

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

ES-5. Public Benefit Charge Funds

Policy Option Description

A "public benefits charge" is a small monthly fee assessed on utility bills. The money that is collected is used to fund "public benefits," which can include low-income weatherization programs, appliance efficiency rebates, renewable energy rebates, energy efficiency programs, and demand-side management programs. More than twenty states currently assess such charges under a variety of names, including wires charge, access charge, universal service charge or distribution charge.

Public benefits charges can be assessed as a percentage of the monthly bill, or as a fixed monthly fee that varies by customer class. The funds can be managed by the utilities that collect them, by a nonprofit set up to do so, or by a state agency.

The goal of public benefits charges, in the context of climate policy, would be to accelerate the capture of cost effective efficiency measures and the deployment of renewable resources. Public benefits charges may range from one to five percent of the monthly bill. In Europe, more than 50 municipal utilities collect fees to promote solar energy installations. In Germany, which has adopted a goal of achieving 20% of its electricity from renewable energy, a typical household may pay up to $15 more each month. In the United States these charges have typically been much smaller.

In Wisconsin, for example, Madison residential customers pay about 10 cents a day, or $3 per month. Wisconsin's public benefits charge collects about $70 million statewide each year. For small business customers, the charge is a maximum of $6 per month per meter. For more information on the Wisconsin program see www.focusonenergy.com

In Colorado, some utilities already assess "energy efficiency" charges, and the proposal is to expand this. Natural gas utilities can also collect such funds, and a bill to require this has been introduced in the Colorado legislature in past sessions.

Policy Option Design

Goal: 4 mills ($0.004)/kWh charge — about. $40 per capita per yr, or just under $190 million/yr . Money to be spent on renewable energy resources

Timing: 2008

Coverage: All retail electric bills.

Implementation Mechanisms

TBD

Related Policies/Programs in Place

TBD

Types(s) of GHG Reductions

Displaced FF-based generation.

Estimated GHG Savings and Costs per $MtCO_2e$

TBD

Data Sources:

Report available at http://www.cleanenergyfunds.org can be consulted for analyses of "best bang for the buck" investments in renewable sources.

Public data on electricity bills in Colorado (consistent with I&F data.)

Quantification Methods:

Use public data sources to estimate emissions reduction return on most efficient renewables investment.

Key Assumptions

We assume that this fund would support commercial renewable technologies and the R&D in ES-9 would fund basic research on renewables.

We assume that this policy would be implemented in place of, and not along with, the expanded RPS in policy ES-2.

Key Uncertainties

Cost of developing renewable resources in Colorado.

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

ES-6. Incentives for CHP, DG, Smart Grid

Policy Option Description

Financial incentives for combined heat & power (CHP) and Distributed Generation (DG) could include: (1) direct subsidies for purchasing/selling systems given to the buyer/seller; (2) tax credits or exemptions for purchasing/selling systems given to the buyer/seller; (3) tax credits or exemptions for operating systems; (4) feed-in tariff, which is a direct payment to CHP/DG owners for each kWh of electricity or BTU of heat generated from a qualifying system; and (5) tax credits for each kWh or BTU generated from a qualifying system.

In addition, the availability of net metering would substantially increase the value of certain kinds of DG resources, as any excess energy produced could be sold to the grid to offset the cost of purchasing power when additional energy is needed.

Barriers to these resources include inadequate information, institutional barriers, high transaction costs for small projects, high financing costs because of lender unfamiliarity and perceived risk, "split incentives" between building owners and tenants, and utility-related policies like interconnection requirements, high standby rates, exit fees, etc. The lack of Standard Offer or long-term contracts, payments at avoided cost levels, and lack of recognition of the value of reduced carbon emissions also creates obstacles.

Policies to remove these barriers include:

- Improved interconnection policies
- Improved rates and fees policies, including net metering
- Streamlined permitting
- Procurement policies
- Education/outreach

Policy Option Design

Goal: Ramp up CHP/DG to 2% of total fossil fuel generation; ½ CHP and ½ other DG

Timing: Achieve 2% by 2020

Coverage: Large industrials, commercial, universities, or anyone with a heating or steam load.

Implementation Mechanisms

TBD

Related Policies/Programs in Place

Colorado Net Metering Law:

Colorado has 2 MW capacity limit on system size under its state wide net metering law, which apply to utilities with +40,000 customers. The information is available at http://www.dsireusa.org/library/includes/incentivesearch.cfm?Incentive_Code=CO26R&Search=TableType&type=Net&CurrentPageID=7&EE=0&RE=1

Some municipal utilities also have established their own net metering rules. See http://www.dsireusa.org/library/includes/statesearch2.cfm?State=CO&back=fintab&CurrentPageID=7&Search=TableState&EE=0&RE=1

Types(s) of GHG Reductions

Improved energy use efficiency associated with expanded use of CHP.

Estimated GHG Savings and Costs per $MtCO_2e$

TBD

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.
  This report estimated 1,578 MW of technical CHP potential in Colorado. The report mentions that the appendix to the report details this analysis. (However, the appendix is not available on their website http://www.westgov.org/wga/initiatives/cdeac/cdeac-reports.htm#TaskForceReports).

CHP Economic Potential:

There are a few CHP economic potential studies we could use to figure out realistic goals of cost-effective CHP installations in Colorado.

- **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.
- **Institute for Sustainable Energy 2004**. Distributed Generation Market Potential: 2004 Update/ Connecticut and Southwest Connecticut, March 15, 2004.

- **ONSITE ENERGY Corporation 2002**. Combined Heat and Power Market Penetration for New York State. October 2001, prepared for New York State Energy Research and Development Administration

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
  CHP cost curves in this report are useful. The cost curves provide levelized cost of electricity from CHP depending on fuel price and CHP size.
- **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
  The database has cost/kW installed data for several DG technologies. It is not clear from the database that those technologies are used for CHP applications.
- **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 (5.5 MB zip file)
  This workbook provides cost and performance data for several CHP applications including gas turbines, reciprocating engines and micro-turbines.
- **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.
  This is the most comprehensive report (although it is getting outdated) on cost and performance of gas-fired CHP technologies.

Quantification Methods:

Estimate cost of CHP and deduct savings associated with reduced fuel use; compare to reduced emissions associated with greater energy use efficiency.

Key Assumptions

- Cost curve for incremental CHP in Colorado
- Efficiency improvement associated with CHP
- Value of avoided energy purchases.

Key Uncertainties

Economic CHP potential in Colorado based on its technical/economic potential

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

ES-7. Carbon Capture & Storage Infrastructure

Policy Option Description

Carbon dioxide capture and sequestration (CCS) in conjunction with advanced fossil fuel generation offers one potential option to significantly reduce the carbon dioxide emissions associated with electricity generation. One barrier to implementation of CCS on a wide scale is the lack of a pipeline infrastructure to carry carbon dioxide to suitable and economic sequestration sites. Another barrier to CCS implementation is regulatory uncertainty in key areas such as regulation of sequestration sites, ownership of underground sequestration resources, and long-term liability against carbon dioxide leakage. This policy recommendation seeks to address these barriers through policies to encourage development of a regional pipeline infrastructure for CCS, and also through policies to reduce regulatory uncertainties that today hinder the planning and development of CCS projects.

Policy Option Design

Goal: Work with neighboring states, WGA to analyze options for regional CO2 transportation and sequestration collaborative

Timing: ASAP. This has to start soon as utilities are making plans for new coal plants and should be able to count on CCS if it will become a reality.

Coverage: Governor's office, legislature.

Implementation Mechanisms

TBD

Related Policies/Programs in Place

TBD

Types(s) of GHG Reductions

Facilitate CO_2 capture and permanent storage before reaching atmosphere

Estimated GHG Savings and Costs per $MtCO_2e$

TBD

Data Sources:

TBD

Quantification Methods:

This option will not be quantified as it relates only to a regional infrastructure initiative.

Key Assumptions

Existence of significant potential for cost-effective, permanent CO_2 storage in region.

Key Uncertainties

Cost and extent of infrastructure needed, ultimate potential for permanent CO_2 storage in region.

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

ES-9. R&D for Carbon Emissions Reducing Generating Technology

Policy Option Description

Research and development (R&D) funding can be targeted toward a particular technology or group of technologies as part of a state program with a mission to build an industry around that technology in the state and/or to set the stage for adoption of the technology for use in the state. For example, an agency could be established to help develop and deploy energy storage technologies. R&D funding can be made available to any renewable or other advanced technology through an open bidding procedure (driven by bids received rather than by a focused strategy to develop a particular technology). Funding can also be given for demonstration projects to help commercialize technologies that have already been developed but are not yet in widespread use.

Under this policy Colorado would establish a fund, funded by a per-kWh charge on electricity use, to be made available for in-state R&D on low- or non-carbon emitting sources of electricity, such as advanced solar, fuel cells, wind power, etc. The fund would *not* be available support to generating technologies which depend on carbon sequestration to become low-emitting.

Policy Option Design

Goals: 0.2 cent/kWh charge = $20/capita-yr, $100 million for low-interest loans to CO research companies & universities. Toward carbon emissions reducing technology

Timing: First funding cycle in 2009; Requests for Proposals (RFPs) circulated in 2008

Coverage: Colorado universities and businesses

SB 246, just passed by the state legislature, provides funding for renewables and efficiency R&D. Costs & emission reduction benefits for this policy will be difficult to quantify.

Implementation Mechanisms

TBD

Related Policies/Programs in Place

TBD

Types(s) of GHG Reductions

TBD

Estimated GHG Savings and Costs per $MtCO_2e$

TBD

Data Sources:

NREL? Other credible sources on cost of and potential for future technology improvements?

Quantification Methods:

Direct R&D benefits hard to quantify unless an applicable study exists?

Key Assumptions

TBD

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

ES-10. Promote Advanced Fossil Fuel Generation with Carbon Capture, Including IGCC

Policy Option Description

Advanced fossil fuel generation technologies, in combination with carbon dioxide capture and sequestration (CCS), offer one potential option to significantly reduce the carbon dioxide emissions associated with electricity generation. Coal generation in conjunction with CCS may combine the cost-effectiveness of coal with low carbon emissions. Coal generation with CCS could be based on integrated gasification combined cycle (IGCC) technology, pulverized coal technology, or some other approach.

Under this proposal, the Climate Action Panel recommends that:

- Based on the importance of commercialization of the option of low-carbon emitting coal-based generation, the Colorado Climate Project and Governor Ritter carefully consider and, if appropriate, support the Colorado IGCC with CCS project as reflected in Xcel Energy's application the Colorado Public Utilities Commission.
- Governor Ritter and Colorado's federal legislators work to obtain meaningful federal funding for the Colorado IGCC with CCS project. Federal funding would leverage the benefits of advanced coal with CCS for the entire nation, mitigate the technology risk of the project borne by Colorado utilities and ratepayers, and directly benefit Colorado's electric customers by reducing the cost of an IGCC with CCS project.

Policy Option Design

Goals: 200 - 600 MW IGCC plant **with CCS** per Xcel plan or similar
- Commission to reevaluate rules for demonstration projects, technology commercialization

Timing: IGCC with CCS project expected to be operational in 2015.

Coverage: One generating plant

Note: This option is somewhat covered by existing legislation that already directs the PUC to consider approval of an IGCC plant, and to waive some of its rules on seeking least cost production.

Costs & emissions benefits for this will be difficult to quantify.

Implementation Mechanisms

TBD

Related Policies/Programs in Place

TBD

Types(s) of GHG Reductions

TBD

Estimated GHG Savings and Costs per $MtCO_2e$

TBD

Data Sources:

TBD

Quantification Methods:

Review of existing studies from various sources.

Key Assumptions

Existence of significant potential for cost-effective, permanent CO_2 storage in region.

Key Uncertainties

Significant uncertainty in cost and benefits; potential for permanent storage of CO_2 in region also unknown.

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

ES-11. Small New Hydro and Efficiency Improvements at Existing Hydro, Identifying Other Small Renewables and Removing Barriers

Policy Option Description

Currently, existing hydroelectric plants in Colorado produce abut 1,200 GWh of electric energy per year. This energy is produced from plants built in the early 1920's and before as well as relatively newer units. Older plants present opportunities for improvements in efficiency and production including more efficient turbines, upgraded generator windings and replacement of mechanical controls with solid state equipment. The improvement in efficiency and plant production can range from 1-2% to as high as 25-30%.

In addition, several studies have suggested there may be 1000 MW or more of hydroelectric potential in Colorado at existing sites such as current impoundments, diversions and water conveyance structures. Depending on the location, small hydroelectric projects can be cost competitive with both fossil-fueled and other renewable power sources. Some sites would be suitable for pump/storage operation, increasing the value during peak operating periods. Pump/storage is also a way of storing energy from wind and solar generating facilities. Opportunities for small hydroelectric development that are often overlooked include sites on domestic water systems.

Many of these sites are located close to loads, thus they would incur minimal transmission and distribution losses. With the recent enthusiastic acceptance of wind energy programs, it is reasonable to expect that small hydroelectric energy programs based on local resources would also be favorably received by customers. Development of this resource could also postpone the need for additional large base loaded plants.

The primary barrier to development of hydroelectric facilities is that the water facilities are owned and operated by water utilities without expertise in power production. The generation potential of each site is often small and thus overlooked by power providers.

Policy Option Design

Goals: Begin with statewide mapping of unexploited potential to geothermal, small hydro, and biomass (expanded SB-91);

- Address institutional barriers to small renewables
- 50 MW of unexploited renewable resources on-line per year
- 300-500 MW by installed capacity at certified environmentally acceptable sites by 2020, at existing federal and non-federal impoundments and diversions

For analysis. assume capacity factor of 35% and installed cost of $3000/kW.

Timing: As above

Coverage: Unexploited resources throughout the state

Implementation Mechanisms

TBD

Related Policies/Programs in Place

Existing statewide mapping program?

Types(s) of GHG Reductions

CO_2 emissions reductions associated with Avoided FF generation.

Estimated GHG Savings and Costs per $MtCO_2e$

TBD

Data Sources:

Potential and cost for exploitation of small hydro to be provided and substantiated by R. Smart.

Quantification Methods:

TBD

Key Assumptions

- Existence of up to 500 MW of accessible but unexploited small hydro.
- Assume institutional, structural, and jurisdictional barriers can be overcome without cost.

Key Uncertainties

Cost curve for exploiting small hydro & other renewable potential.

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

ES-12. Nuclear Energy

Policy Option Description

Electricity generation accounts for 37% of Colorado's greenhouse gas emissions or about 43 million tons of CO_2 annually. Of that, coal-fired base load plants emit 35 MMT/yr. This amount is slated to increase to 48 MMT/yr by 2020 in the Reference Case projection. Since nuclear plants produce base load power they are potentially a direct replacement for coal.

During operation, nuclear plants generate no GHG, although there are GHG emissions associated with the mining, refining, and transport of uranium fuel. There are also life-cycle GHG emissions (due to construction, decommissioning etc.) which may be small relative to the power they produce.

The value of nuclear power as a GHG mitigation option is clouded by several serious (and highly interrelated) issues:

- Cost per MWh.
- Proliferation of nuclear materials.
- Disposal of nuclear waste.
- Safety issues – real or perceived.
- Resource limitations of uranium or other nuclear fuels.
- Siting problems (NIMBY) and licensing delays.
- Willingness of utilities to invest in nuclear.

This GHG mitigation proposal is to take actions at the state level to facilitate the licensing, siting, financing, and construction of new nuclear power plants in Colorado.

Policy Option Design

Goals: One 1000-MW nuclear plant

Timing: On-line by 2020

Parties involved:

Costs of nuke difficult to estimate, especially in a state with little nuclear history. Analysis of the emissions benefits of nuclear energy should account for full life-cycle costs. One possibility is to try to set a reasonable price and benefit level supported by the literature, although estimates may vary widely.

Implementation Mechanisms

TBD

Related Policies/Programs in Place

TBD

Types(s) of GHG Reductions

Avoided CO_2 emissions due to reduced FF-based generation.

Estimated GHG Savings and Costs per $MtCO_2e$

TBD

Data Sources:

TBD

Quantification Methods:

A brief literature review of projected nuclear plant costs. Should federal subsidies (including Price Anderson) be included? Costs associated with risk of catastrophic failure? Costs associated with removal and permanent storage of waste?

Key Assumptions

Nuclear energy is politically feasible in Colorado. Waste storage issues can be solved.

Key Uncertainties

- Lifesysle costs of new nuclear power plants. Ultimate waste disposal technology and cost.
- Ultimate emissions benefit of nuclear energy over fossil fuel, including embodied emissions and emissions associated with production, processing, and transport of fuel.

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

ES-13. Efficiency Improvements for Existing Generators (Includes Heat Recovery)

Policy Option Description

Making efficiency improvements at existing generation stations has a number of benefits such as: offsetting the rising cost of fuel, reducing overall emissions and improving plant reliability. This can be done through improvements in both the combustion and steam cycles, as well as with waste heat recovery.

Efficiency improvements at existing generating stations may be hampered by federal regulation, lawsuits and uncertainty. New Source Review (NSR) and New Source Performance Standard (NSPS) regulations need to be clarified and should encourage, not discourage, efficiency improvements such as turbine upgrades, motor, pump, fan and drive improvements, control system upgrades and recovery of waste heat. Though these are federal programs, the State of Colorado may be able to help mitigate potential problems associated with improvements. Public policy could specifically encourage the State to utilize its regulatory discretion to streamline the process of evaluating a plant's NSR and NSPS requirements. Significant reform of NSR should be addressed in any carbon control regulations to encourage plant efficiency. One option is to reinstate the pollution control project (PCP) exemption and broaden it to include significant plant upgrades such as turbine replacements. Another option is to require issuance of construction permits for efficiency projects on a more timely basis (e.g. permits processed within 12 months).

Efficiency improvements at existing generating stations may also be hampered by lack of regulatory cost recovery certainty for regulated investor-owned utilities under the jurisdiction of the Colorado Public Utilities Commission (PUC). Public policy could specifically encourage the PUC to allow for the recovery of costs for efficiency improvements at existing generators. These efficiency improvements could reduce customer energy costs as well as carbon dioxide emissions.

Policy Option Design

Goals: Decreasing average heat rate by x%/year by 2020 relative to 2006 *or* meet average heat rate target of 10,000, also decreasing by 2%/year.

Timing: Utilities report total heat input/total MWh output in 2008; first year of reduction is 2011. Use imputed value for purchases unless specific data are provided.

Parties involved: All generation owners in CO.

Other: As needed, identify incentives that encourage plant efficiency improvements and utilization of new technology to reduce emissions.

Annual reduction goal TBD; for analysis, assume that the costs do not include additional costs associated with NSR regulations, if applicable.

Implementation Mechanisms

TBD

Related Policies/Programs in Place

TBD

Type(s) of GHG Reductions

Efficiency improvements on plants, plus replacement of coal-fired generation with gas over time.

Estimated GHG Savings and Costs per $MtCO_2e$

TBD

Data Sources:

I&F of BAU generation sources in Colorado;

Quantification Methods:

Begin with cost curve for efficiency improvements in existing plants in Colorado

Estimate required stock turnover and replacement technology required to achieve these reductions.

Key Assumptions

Key Uncertainties

- Potential and cost for efficiency improvements at existing plants.
- Heat rates of future generating technologies.
- What is target reduction level?
- Efficiency improvements at existing generating stations may be hampered by federal regulation, lawsuits and uncertainty

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

ES-14. Oil and Gas Operations

Policy Option Description

There are a number of ways in which Greenhouse Gas (GHG) emissions in the oil and gas industry can be reduced. Methane is a potent GHG, so any leaks during production, processing, and transportation/distribution should be addressed. Eliminating these leaks is economically beneficial because it prevents the waste of valuable product. The EPA Natural Gas STAR program offers numerous methods of preventing leaks.

There are also a number of ways in which CO_2 emissions in the oil and gas industry can be reduced. The CCAP recommends that Colorado focus attention on reducing GHG emissions from fuel combustion in the oil and gas industry through education, financial incentives, mandates and/or standards – coupled with cost and investment recovery mechanisms, if appropriate.

Further study and analysis of the approaches recommended above by the Colorado Department of Public Health and Environment and other appropriate agencies may suggest changes in goals and determinations regarding the economic and technical feasibility of these approaches.

Policy Option Design

Goals: 35% reduction in GHG emissions from methane relative to baseline case by 2020 (subject to limitations in what it is possible to analyze)

Also reduce uncertainty in methane losses (target for increased accuracy)

Timing: Achieve level of reduction by 2020

Parties involved: Colorado oil and gas permittees.

Implementation Mechanisms

TBD

Related Policies/Programs in Place

TBD

Types(s) of GHG Reductions

Reduced methane emissions from oil & gas operations.

Estimated GHG Savings and Costs per $MtCO_2e$

TBD

Data Sources:

Data on cost and feasibility to be provided by PWG members.

Quantification Methods:

Cost & benefit estimates to be based on data to be provided by PWG members.

Key Assumptions

TBD

Key Uncertainties

Cost and feasibility of reaching target.

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

ES-15. CO_2 Emissions Standards for Power Plants

Policy Option Description

A carbon dioxide emissions performance standard is an emissions standard requiring that all new non-peaking power plants located in Colorado or serving Colorado electricity customers have carbon dioxide emission no greater than 1,100 pounds of CO2 per megawatt-hour. In addition, to ensure that power providers have the necessary incentives to invest in new low- carbon dioxide emitting facilities rather than continue to operate aging high-carbon dioxide emitting plants the standard would also apply to existing facilities once they reach 60 years of age. The 1,100 pounds per megawatt-hour standard is based on the level of emissions of a new combined-cycle natural gas plant.

Mitigation Option Design

Goal: Establish a power plant carbon dioxide emission standard of 1,100 pounds per megawatt-hour for non-peaking plants. (Peaking is CF < 10%) Applies to new power sold in the state of CO, or 60+ old plants

Timing: Given the lead time of constructing new fossil fuel plants, a standard established today would impact new plants that come on-line after 2011 and any that have been in operation 60 years or more.

Coverage: Would apply to all new non-peaking power plants, or those that have operated for 60 year or more, that are located in Colorado or that provide power to Colorado electricity customers.

Implementation Mechanisms

TBD

Related Policies/Programs in Place

TBD

Types(s) of GHG Reductions

TBD

Estimated GHG Savings and Costs per $MtCO_2e$

TBD

Data Sources:

I&F, industry standard estimates of delivered plant costs.

Quantification Methods:

Estimate cost of replacing all new coal plants in baseline I&F, as well as all plants over 60 years old, with gas-burning technology.

Key Assumptions

Cost of new plants & fuel unaffected by altered investment strategy.

Key Uncertainties

TBD

Additional Benefits and Costs

TBD

Feasibility Issues

Trying to apply this standard to non-Colorado facilities may violate interstate commerce clause. This may be rectifyable if the requirement is for portfolio of power purchased by LSEs. (This issue has been discussed extensively in the RGGI process.)

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD