Residential, Commercial, and Industrial (RCI) Technical Work Group

Summary List of Draft Priorities for Analysis

Option No.	GHG Reduction Policy Option Name	GHG Reductions ($MMtCO_2e$)			Net Present Value (Million $)	Cost-Effectiveness ($/tCO_2e$)	Level of Support
		2015	2025	Total (2008–2025)			
RCI-1	Maximize Savings From the Utility Conservation Improvement Program (CIP)						
RCI-1	**1.5% savings level**	**6.0**	**14.7**	**133.8**	**–$8,449**	**–$63.2**	**Enacted***
RCI-1b	2.0% savings level	*Not quantified*					
RCI-2	Improved Uniform Statewide Building Codes	0.004	0.005	0.077	–$44	–$576	Pending
RCI-3	Green Building Guidelines and Standards Based on *Architecture 2030*	0.62	0.94	11.1	–$296	–$27	Pending
RCI-4	Incentives and Resources to Promote Combined Heat and Power (CHP)	0.96	4.95	33.1	$125	$3.8	Pending
RCI-5	Program to Reduce Emissions of Non-Fuel, High-Global-Warming-Potential GHGs	0.02	0.05	0.5	–$2	–$5	Pending
RCI-6	Non-Utility Strategies and Incentives to Encourage Energy Efficiency and Reduce GHG Emissions	0.25	1.30	8.3	–$307	–$37	Pending
RCI-7	Conservation Improvement-Type Program for Propane and Fuel Oil Efficiency	0.05	0.05	0.7	–$21	–$28	Pending
RCI-8	Energy Performance Disclosure	*Not quantified*					Pending
RCI-9	Promote Technology-Specific Applications to Reduce GHG Emissions	*Not quantified*					Pending
RCI-10	Support Strong Federal Appliance Standards and Require High State Standards in the Absence of Federal Standards	0.8	1.4	15.3	–$1,895	–$124	Approved
	Sector Total After Adjusting for Overlaps (RCI, non-electricity)	**0.56**	**–0.23**	**4.8**	**–$639**	**–$133**	
	Sector Total After Adjusting for Overlaps (Integrated RCI and ES for Electricity)	**1.48**	**6.91**	**48.4**	**–$915**	**–$19**	
	Reductions From Recent Actions†	**10.7**	**20.9**	**150.8**	**–$8,449**	**–$63.2**	
	Sector Total Plus Recent Actions	**12.7**	**27.8**	**204.0**	**–$10,003**	**–$49.0**	

GHG = greenhouse gas; MMt = million metric tons; CO_2e = carbon dioxide equivalent; $/t$CO_2e$ = dollars per ton of carbon dioxide equivalent.

* Legislation enacted in 2007.

† NPV and cost-effectiveness values are for CIP only.

The RCI TWG recommendations are in **bold**.

RCI-1. Maximize Savings From the Utility Conservation Improvement Program (CIP)

Policy Description

Senate File 145 establishes an energy policy goal for the State of Minnesota to achieve annual savings equal to 1.5% of annual retail energy sales of electricity and natural gas. At least 1% of these sales should come directly through energy conservation improvement programs and rate design. The additional 0.5% of savings can come indirectly through energy codes and appliance efficiency standards, programs designed to transform the market or change consumer behavior, energy savings resulting from efficiency improvements to the utility infrastructure and system, and other activities to promote energy efficiency and energy conservation. These savings are based on the average of the last 3 years of sales for the utility.

The MCCAG recommends that the Department of Commerce work closely with the affected utilities and other parties to develop strategies and programs to achieve the increased energy savings goals in the new law. Much work is needed to support this achievement. Such strategies and programs should include

- Development and implementation of a state policy of "decoupling," or separation of utility sales from revenues**,**
- Development by utilities of a standardized portfolio of energy efficiency programs and program rebates that are designed to (1) overcome market barriers, such as lack of consumer knowledge of products and costs and (2) to capture overall system efficiencies - not just equipment efficiencies. For example, finding ways that the operation of entire class of equipment or entire systems can be made more efficient.
- Utilities should collaborate in joint efforts to achieve market transformation, to conduct market and product research and to change consumer behavior. For example, the utilities should act to stimulate industry-wide efficiency changes and energy savings in products that consume electricity.
- The Department of Commerce should develop a standardized method for evaluating the success of utility programs.
- The state should seek to remove disincentives or regulations that inhibit energy efficiency.

At its December meeting, the MCCAG asked the RCI TWG to consider a level of electric and natural gas utility energy conservation higher than the 1.5% annual energy savings goal in the recently passed 2007 legislation (see RCI-1). In addition, the RCI TWG notes that the Midwest Governor's Association, on November 15, 2007, at its Midwest Energy Summit agreed upon a region-wide goal for energy efficiency savings as follows:

> "Meet at least 2 percent of regional annual retail sales of natural gas and electricity through energy efficiency improvements by 2015, and continue to achieve an additional 2 percent in efficiency improvements every year thereafter."

Achieving annual energy efficiency savings equal to 2% of annual retail energy sales of electricity and natural gas by 2015 in Minnesota is a desirable goal. However, the technical feasibility and cost-effectiveness of achieving a higher energy savings level than the current 1.5% Minnesota goal is uncertain for electric and natural gas utilities.

Therefore, the MCCAG recommends that the State immediately undertake a study of the technical feasibility and cost-effectiveness of achieving a 2 percent energy efficiency savings goal for electric and natural gas utilities by the year 2015, and adopt such a goal if the study provides assurance that the goal can be reasonably achieved. Such a study should be undertaken by an independent organization and should include input from relevant state agencies, electric and natural gas utilities, and other interested parties.

Policy Design

Goals: As noted above.

Timing: The Department of Commerce program will begin June 1, 2008 with the exception of Xcel. The Department of Commerce will report back to the Legislature on CIP goals by 2010.

Parties Involved: The residential, commercial, and industrial sectors are covered by the program.

Other: Not applicable

Implementation Mechanisms

As noted above.

Related Policies/Programs in Place

Minnesota natural gas and electric utilities existing CIP programs.

Type(s) of GHG Reductions

Reductions from avoided fossil-fuel electricity generation and natural gas consumption as a result of energy conservation programs

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources: The following sources were used in the analysis

- Office of the Legislative Auditor, State of Minnesota, 2005, "Evaluation Report: Energy Conservation Improvement Program."
- Spreadsheet attachment in an email from Peter Ciborowski to Bill Dougherty dated October 26, 2007.
- Minnesota Legislation regarding the Conservation Improvement Program, 2007.

Quantification Methods: See Annex 1.

Key Assumptions: See Annex 2.

Key Uncertainties

Projected sales, program costs.

Additional Benefits and Costs

Reduced air pollution.

Feasibility Issues

As noted above.

Status of Group Approval

Approved.

Level of Group Support

Approved.

Barriers to Consensus

None.

RCI-2. Improved Uniform Statewide Building Codes

Policy Description

Building energy codes specify minimum energy efficiency requirements for new buildings or for existing buildings undergoing a renovation. Given the long lifetime of most buildings, amending state building codes to include minimum energy efficiency requirements and periodically updating energy efficiency codes will provide long-term GHG emission reductions.

The Minnesota Department of Labor and Industry (DOLI) has the responsibility of promulgating the building code in Minnesota. Where possible, the Department has approved the International Code Council's (ICC) "I" family of codes. In July of 2007, the 2006 International Residential Code (IRC) and the 2006 International Building Code (IBC) were both adopted with Minnesota specific amendments to address the Minnesota climate and building practices. Both were also adopted without their respective energy code chapters, as DOLI had been working for some time to amend Minnesota's existing energy code. DOLI decided some time ago that the 2006 IRC Chapter 11 (energy code chapter) would be adopted with Minnesota amendments.

Chapter 11 if the 2006 IRC is greatly simplified compared to past codes, and is expected to be widely accepted because of a US Department of Energy's initiated amendment. That amendment allows builders to comply using a simple "cookbook" compliance method, without needing to perform computer calculations of window, wall and other building component areas.

As a result of the high-energy efficiency requirements required by code since 2000, Minnesota leads the nation in producing energy efficient one- and two-family homes. The new residential code will not significantly increase the efficiency of one- and two-family residential buildings. However the applicability of the new code will be broadened to include townhouses, and by doing so will increase the energy efficiency of those structures.

The new Minnesota Commercial Energy code is based on ASHRAE 91.1-2004 standard, with important state amendments. The percentage increase energy efficiency is unknown at this time, but will be substantial, if stakeholders understand its importance and install components correctly so that efficiencies are realized.

A policy to implement and enforce the commercial and residential energy codes statewide should be addressed legislatively. Here are some facts about the current energy code requirements:

- Approximately 85% of Minnesota's population lives in an area where the building code (including the energy code) has been adopted and enforced.
- 39 of 87 Minnesota counties have adopted the State Building Code.
- In accordance with state law, virtually all cities with population 2,500 and above are enforcing the State Building Code, even if they are located in a county which is not enforcing the code.

- If a municipality or county chooses to enforce a building/energy code it must be the Minnesota State Building Code. A municipality may not adopt a code that is more or less stringent than the Minnesota State Building Code.
- A statewide building code requirement would affect 48 sparsely populated counties, outside of any cities in those with population 2,500 and above, that have not adopted the Minnesota State Building Code.
- While the code is not enforced statewide, homebuilders who are licensed by the state are required to the build code-compliant homes regardless of location.

Additional measures to support the requirement that the building code be implemented statewide would include

- Consumer and realtor education about the importance of energy efficiency
- Improved enforcement of existing energy and mechanical codes
- Training for code officials on energy code compliance and its importance
- Training for builders, remodelers, and mechanical contractors on energy code compliance
- Development of a clearinghouse for information on how to provide access to software tools to calculate the impact of energy efficiency and solar technologies on building energy performance

Policy Design

Goals: As noted above.

Timing: Recognizing that the State of Minnesota will be implementing a new commercial and residential energy code in 2008, other strategies that should be considered include

- Implementing the energy code statewide in 2009 for all non-agriculture buildings. (Currently, agricultural buildings are exempt for building and energy code compliance)
- Updating energy codes every three years that are at least as efficient as the most recently adopted version of ICC's energy codes.
    - Three-year cycles will allow Minnesota construction and renovation to keep consistent most recent ICC national code cycles and keep the construction industry updated with new materials and methods that increase energy efficiency. The 3-year cycle will also allow policy makers to address unintended consequences to durability or structural integrity caused by well-intentioned code changes.
- Mandating education on each new energy code cycle for
    - Residential contractors seeking a Minnesota license;
    - Residential contractors renewing a Minnesota license;
    - All building code officials who perform energy efficiency or mechanical inspections; and
    - All architects registered in the State of Minnesota who approve building designs or renovations that affect energy use.

- Requiring all mechanical contractors in Minnesota to be licensed and require at least ??.0 hours of continuing education on energy and mechanical code requirements during every new code cycle.
- Developing an educational program for the public and realtors through Department of Commerce's Energy Information Office explaining Home Energy Rating System (HERS) scores for different types of housing.
    - Require all realtors to complete at least 1.0 hours of continuing education about HERS ratings in existing and new residential homes by 2011.

Parties Involved: Current Energy Code Rules under the Building Code were adopted on April 15, 2000, for one- and two-family residential buildings and July 20, 1999, for commercial and residential buildings other than one- and two-family. The Department of Labor and Industry predicts that the new energy codes will go into effect in late 2007, or if there is a public hearing, by mid-2008: Minnesota Rules Chapter 7670 and Minnesota Rules Chapter 7672 cover new construction and remodeling of single-family and two-family homes. Builders can choose from one or the other, which has led to a lot of confusion for compliance and enforcement.

- This code will be replaced by the new Residential Energy Code, Minnesota Rules Chapter 1322.

Minnesota Rules Chapter 7674 covers multi-family new construction and remodeling buildings that are 3 stories or less.

- Townhome units with separate entryways that do not share common spaces (e.g., hallways, laundry rooms, or foyers) will be covered under the new Residential Energy Code, Minnesota Rules Chapter 1322.
- Multi-family buildings that do not meet the townhome requirements for Chapter 1322, will be covered under the new Commercial Energy Code, Chapter 1323.

Minnesota Rules Chapter 7676 covers all buildings except low rise residential.

- All commercial buildings that do not meet the townhome requirements for Chapter 1322, will be covered under the new Commercial Energy Code, Chapter 1323.

Minnesota Rules Chapter 7678 covers requirements for insulation manufacturer's to register uniform testing of energy efficiency and equipment manufacturer to register equipment efficiencies with the Minnesota Department of Commerce. Chapter 7678 will be repealed, as all of these requirements will be embodied in standards to be adopted by reference in Chapter 1322 or 1323.

Agricultural buildings as defined in Minnesota Statutes, section 16B.60, and subdivision 5 are exempt from the Minnesota State Building Code.

Implementation Mechanisms

Mandating the code statewide requires a statute revision by the Minnesota Legislature. The Department of Labor and Industry has developed a *Minnesota State Building Code Adoption*

Guide for local jurisdictions. See: http://www.doli.state.mn.us/pdf/bc_pr_code_adoption_guide_1_06update.pdf

Code revisions should be implemented by the Department of Labor and Industry using the rule making process, which allows for public input.

Related Policies/Programs in Place

Minnesota Rules Chapters 7670, 7672, 7674, 7676, and 7678. See http://www.mncodes.org/energy.htm

Type(s) of GHG Reductions

Reductions from avoided fossil-fuel combustion for electricity and space heating.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources: The following sources were used in the analysis.

- Average Retail Price for Bundled and Unbundled Consumers by Sector, Census Division, and State, 2005, available at: http://www.eia.doe.gov/cneaf/electricity/esr/esr_sum.html
- Annual Estimates of Housing Units for the United States and States: April 1, 2000, to July 1, 2005, available at U.S. Census Bureau annual data, released at the end of every July: http://www.census.gov/popest/housing/HU-EST2005.html
- New Privately Owned Housing Units, Authorized Unadjusted Units for Regions, Divisions, and States, U.S. Census Bureau annual data, released at the end of every July: http://www.census.gov/const/C40/Table2/t2yu200512.txt
- 2001 EIA Residential Energy Consumption Survey, available at: http://www.eia.doe.gov/emeu/recs/recs2001/detailcetbls.html#space
- Ratios of new residential/commercial floor space to total floor space, from EIA, available at: http://www.eia.doe.gov/emeu/cbecs/excel/b1.xls
- Cooling degree-days in Minnesota, available at: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/cdd.200501-200607.pdf
- Heating degree-days in Minnesota, available from Department of Commerce at: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/hdd.200507-200607.pdf
- Minnesota population projection, Minnesota State Demographic Center, available at: http://www.demography.state.mn.us/documents/MinnesotaPopulationProjections20052035.pdf
- Utility electricity sales in 2005, available from EIA at: http://www.eia.doe.gov/cneaf/electricity/page/eia826.html
- Sectoral electricity consumption, available from EIA at: http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html (file sales_revenue.xls)
- The Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors' Association: The Potential for More Efficient

Electricity Use in the Western United States, January, 2006, http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf

Quantification Methods: See Annex 1.

Key Assumptions: See Annex 2.

Key Uncertainties

Projected economic growth rate in counties not covered by the current codes.

Additional Benefits and Costs

Uniform standards; reduced air pollution.

Feasibility Issues

None.

Status of Group Approval

Approved.

Level of Group Support

Approved.

Barriers to Consensus

None.

RCI-3. Green Building Guidelines and Standards Based on *Architecture 2030*

Policy Description

Promote, incentivize, or adopt green building guidelines and standards for the reduction of carbon emissions for all commercial and residential buildings consistent with *Architecture 2030* targets. Clearly communicate the fact that reducing energy use does not always proportionally reduce emissions. Consider developing disincentives to technologies that do not reduce emissions.

Require state and local government agencies including school districts to adopt required building guidelines and standards for the reduction of carbon emissions for all buildings consistent with *Architecture 2030* targets. New buildings must require the following reductions in carbon emissions:

2010	60% reduction
2015	70% reduction
2020	80% reduction
2025	90% reduction
2030	100% reduction

Specific energy targets for each building type are shown at: http://www.architecture2030.org/2030_challenge/2030_Challenge_Targets.pdf. These would need to be converted into carbon emissions in a Minnesota context.

All guidelines and standards for major renovations of existing buildings must require reductions in carbon emissions consistent with the *Architecture 2030* target of 50% reduction. Provide a variance process when meeting criteria is not appropriate or financially unfeasible.

Track building energy performance and associated greenhouse gas (GHG) emissions during ongoing building operations.

Provide education and training for all key decision makers and those involved in implementation of this policy. Emphasize education for design professionals such as architects, engineers, interior designers, planners and landscape architects. Also include education for building owners, developers, contractors/builders, building operators/facility managers, financing, real estate and insurance communities.

Minnesota 2030 is intended to encourage a transformation of the building industry in Minnesota. Minnesota 2030 would adapt to Minnesota the ever-increasing goals of a national initiative called *Architecture 2030.* Including an ultimate goal for eliminating net carbon emissions from the use of buildings by 2030. Minnesota 2030 would be a performance standard that would complement, not conflict, with existing green building programs such as LEED or Green Globes. Any green building approach could be used as long as it met the performance standards of Minnesota 2030.

Minnesota 2030 would develop standards and incentives to meet the unique needs of Minnesota. Minnesota 2030 would be an incentivized voluntary program for the private sector but would be mandated for selected public sector buildings. Initially, Minnesota 2030 goals would be only modestly more aggressive than current codes but would strengthen over time as long as they continued to be cost-effective. The overall initiative would include the following components: Design Assistance and Modeling, Utility Financial Incentives, State Incentives, Commissioning, Data Analysis and Continuous Improvement, Training and Capacity Building, State and Local Government and Schools.

On an ongoing basis, buildings built to the new standards will be monitored to assure that the required energy savings are cost effective, and will remain cost-effective as the standards become strengthened over time.

Policy Design

Goals: As noted above

Timing: Program begins in voluntary form when law passes in June, 2008 and is in place with requirements and incentives on January 1, 2010. The goal is to have program in place by 2010.

Parties Involved: Mandatory program is for all public building owners (state, county, city and school). Incentives and disincentives are for all private building owners (Residential, Commercial and Industrial). Research organizations should support this effort.

Implementation Mechanisms

The program should be implemented as follows:

- Pass legislation mandating that all state and local government agencies including school districts must meet *Architecture 2030* criteria for new and existing buildings. Provide funding mechanisms to assist state and local governments and school districts in meeting these criteria.
- Provide tax incentives, utility design assistance and incentive programs, financing incentives (such as "green mortgages"), or other inducements for construction of new and retrofit of existing residential and commercial buildings.
- Provide expedited code review for projects meeting certain energy and green building standards and benchmarks.
- Require designer (AE) to sign off on plans that the "best available energy technology" was used in completion of design, or explain why it was not. Require building owner to sign off they have been informed of energy efficiency technologies by their design team, and accept the current design as meeting their requirements.
- Utilize performance contracting/shared savings arrangements as appropriate.
- Establish a database of ongoing building performance tracking in all sectors (building on existing database models).

- Establish a clearinghouse that provides information and assistance on green building guidelines and standards, the best available technologies for certain applications, a database of ongoing building performance tracking in all sectors, and access to design assistance and software tools to calculate the impacts of energy efficiency and renewable energy strategies buildings.
- Establish education programs for building professionals and other participants in implementing this policy.
- Mandate that State Boards of Licensing for building professionals cover knowledge of the improved building codes and building energy performance requirements reflected in various policy options in licensing exams.

Related Policies/Programs in Place

Guidelines that are either required or voluntary in Minnesota include: Minnesota Sustainable Building Guidelines (B3), LEED, Green Globes, NAHB Guidelines, GreenStar, Green Communities (Minnesota Housing Process), and Energy Star.

Existing federal and state tax credits. Need to inventory other current incentives in the state.

Current legislative goal of 100 LEED or Green Globes and 1000 Energy Star Buildings in Minnesota.

Existing continuing education mechanisms for professional education and development of new models as needed.

Type(s) of GHG Reductions

Reductions from avoided fossil-fuel combustion for electricity and space heating.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources: The following sources were used in the analysis:

- Minnesota GHG forecast developed for this process (based on the worksheet called "Energy Use and CO_2" in a spreadsheet called GHGemitsum07_Working.xls)
- Average Retail Price for Bundled and Unbundled Consumers by Sector, Census Division, and State, 2005, available at: http://www.eia.doe.gov/cneaf/electricity/esr/esr_sum.html
- Annual Estimates of Housing Units for the United States and States: April 1, 2000, to July 1, 2005, available at U.S. Census Bureau annual data, released at the end of every July: http://www.census.gov/popest/housing/HU-EST2005.html
- New Privately Owned Housing Units, Authorized Unadjusted Units for Regions, Divisions, and States, U.S. Census Bureau annual data, released at the end of every July, available at http://www.census.gov/const/C40/Table2/t2yu200512.txt
- 2001 EIA Residential Energy Consumption Survey, available at: http://www.eia.doe.gov/emeu/recs/recs2001/detailcetbls.html#space

- Ratios of new residential/commercial floor space to total floor space, from EIA, available at: http://www.eia.doe.gov/emeu/cbecs/excel/b1.xls
- Cooling degree-days in Minnesota, available at: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/cdd.200501-200607.pdf
- Heating degree-days in Minnesota, available from Department of Commerce at: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/hdd.200507-200607.pdf
- Minnesota population projection, Minnesota State Demographic Center, available at: http://www.demography.state.mn.us/documents/MinnesotaPopulationProjections20052035.pdf
- Utility electricity sales in 2005, available from EIA at: http://www.eia.doe.gov/cneaf/electricity/page/eia826.html
- Sectoral electricity consumption, from EIA, available from EIA, http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html (file sales_revenue.xls)
- The Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors Association: The Potential for More Efficient Electricity Use in the Western United States, January 2006, http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf

Quantification Methods: See Annex 1.

Key Assumptions: See Annex 2.

Key Uncertainties

New privately owned housing units; projected energy consumption in buildings.

Additional Benefits and Costs

Reduced local air pollution.

Feasibility Issues

None.

Status of Group Approval

Approved.

Level of Group Support

Approved.

Barriers to Consensus

None.

RCI-4 Incentives and Resources to Promote Combined Heat and Power (CHP)

Policy Description

Combined heat and power (CHP) systems reduce fossil fuel use and GHG emissions, both through the improved efficiency of the CHP systems, relative to separate heat and power technologies, and by avoiding transmission and distribution losses associated with moving power from central power stations that are located far away from where the electricity is used. This Policy Option should include the following:

- Promotion of the use of natural gas-fired CHP systems
- Promotion of the use of biomass-fired CHP systems
- Creation/expansion of markets for, and incentives designed to promote implementation of, CHP units in capacities suitable for residential, commercial, and industrial users.
- Provision of tax benefits, attractive financing arrangements, utility rebates and other incentives to promote CHP technologies.
- Removal of barriers to CHP development, such as utility rate structures (discounted electric rates that compete with CHP) and interconnection standards (should be designed to facilitate economical and efficient CHP connection to the grid).
- Full consideration of the economic and environmental benefits of CHP as a resource in each electric utility's Integrated Resource Plan.
- Needs to be integrated with MCCAG Energy Sector work.

Potential supporting measures for this option include training/certification of installers/contractors, net metering and other pricing arrangements, establishment of clear, and consistent interconnection standards, and creation/support of markets for biomass fuels.

Policy Design

Goals: Achieve 50% of the CHP technical potential in Minnesota.

Timing: Implement changes in regulation necessary to encourage technologies by 2010.

Parties Involved: Encouraging the development of combined heat and power will require coordination and cooperation among a number of different parties, including (but not limited to)

- Regulators (Minnesota Utilities Commission, US EPA);
- Utilities;
- Other State Agencies;
- Industry Associations;
- Equipment suppliers/vendors/installers, building professionals, engineers; and

- R&D Associations.

Other: Not applicable.

Implementation Mechanisms

Potential implementation mechanisms and supporting activities for this mitigation option include

- Incentives to reduce first cost to a specific payback level can be coupled with requirements for new buildings. Specific implementation measures mentioned as possible for this option include tax credits, low/no interest loans, and similar financial incentives to business, industries and commercial firms to adopt CHP/distributed generation/renewables. The latter approach is especially important for small manufacturers, and could just be access to micro-loans.
- Encouragement CHP systems of 20 MW or smaller (or of equivalent mechanical power) by a rapid adoption and customer-friendly implementation of FERC Order 2006 for Standardization of Small Generator Interconnection Agreements and Procedures.
- Qualify heat use from CHP systems for existing renewable and energy efficiency incentive and loan programs.
- Allow energy service companies to sell CHP and consumer-sited distributed generation output to third party customers.
- Facilitate governmental and non profit organizations to easily sell renewable energy credits and tax credits to the market place.
- Support for switching to less carbon-intensive energy resources (coal and oil to natural gas or biomass, electricity to solar water heating or space/process heat).

Voluntary emissions targets for industrial operations can include

- CHP/distributed generation-related/renewables R&D contracts with private firms, grants and contracts with universities, intramural R&D conducted at government laboratories, R&D contracts with private/public consortia.
- Patent protection, R&D tax credits, production subsidies or tax credits to firms bringing new CHP/distributed generation-related/renewables technologies to market, tax credits or rebates for new technology buyers, government procurement, and demonstration projects.
- Methane capture and use in CHP systems at sewage treatment plants as a specific focus.
- Consider integration of distributed generation options with regional demand response initiatives/recommendations.

Expanded use of combined heat and power generation in Minnesota will need to be accompanied by reviews of related regulations, including

- Review of net-metering policies e.g., electricity consumers who install on-site combined heat and power or, distributed generation fueled with renewable or fossil fuels. This review could consider the impact of NO_x and power factor requirements on net-metering and availability of information for small customers.

- Consideration of rate issues in Minnesota, including decoupling of utility revenues from sales and rate design, with a specific focus on the impacts of rate design on GHG emissions.

Related Policies/Programs in Place

Midwest CHP Applications Center

Type(s) of GHG Reductions

CO_2e reductions from avoided electricity production and avoided on-site fuel combustion less additional on-site CO_2e emissions from fuel used in CHP systems.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources: The following sources were used in the analysis:

- Form EIA-906, available at: http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html
- Inventory of Cogeneration Potential in Minnesota, Minnesota Planning Minnesota Environmental Quality Board August, 2001; page iv, available at: http://www.eqb.state.mn.us/pdf/2001/CogenInventory.pdf
- Energy Information Administration, "Assumptions to the Annual Energy Outlook 2007," DOE/EIA-0554, April 2007, available at: http://www.eia.doe.gov/oiaf/aeo/assumption/pdf/electricity.pdf

Quantification Methods: See Annex 1.

Key Assumptions: See Annex 2.

Key Uncertainties

Costs of new CHP units, integration into electric system, projected fuel prices; available markets for heat production, CHP potential in Minnesota.

Additional Benefits and Costs

Reduced local air pollution; lower transmission and distribution costs.

Feasibility Issues

Cost-effectiveness of CHP systems dependent on price of natural gas; interconnection is an issue.

Status of Group Approval

Approved.

Level of Group Support

Approved.

Barriers to Consensus

Level and type of incentives.

RCI-5. Program to Reduce Emissions of Non-Fuel, High-Global-Warming-Potential GHGs

Policy Description

High-global-warming-potential greenhouse gases (HGWP GHGs) are classes of chemicals, some of which have a global warming impact thousands of times that of CO_2. They have a number of commercial and industrial uses. Often substitutes are available. This option recommends that the Minnesota Pollution Control Agency undertake a rulemaking process to identify uses and emission sources of HGWP GHGs and to eliminate the use or escape of such gases where that can be done at a reasonable cost.

HGWP GHGs include the chemical species hydrofluorocarbons (HFCs), perfluororocarbons (PFCs), and sulfur hexafluoride (SF_6). They are among gases reported by EPA pursuant to The International Convention on Climate Change (http://www.ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_Ch02.pdf).

Some of the HGWP GHGs have a global warming effect up to 23,000 times the impact of CO_2. For example, a pound of sulfur hexafluoride is equal to the global warming impact of 11 tons of CO_2.

In many cases, the cost of reducing these gases can be very low. Thus, an overall percentage reduction of GHGs (including CO_2) will be more cost-effective if this subject is effectively addressed at an early date.

The major sources include

- Air conditioning (mobile),
- Refrigerants,
- Aerosols,
- Foam insulations,
- Electric power systems,
- Semiconductor manufacturing,
- Solvents,
- Fire extinguishers, and
- Aerosol products.

Perhaps the major expected increase in these gases will result as HFCs are increasingly being used to replace ozone-depleting chlorofluorocarbons (CFCs) and HCFCs in insulating foams, refrigeration and air-conditioning, fire suppression, solvent cleaning, and propellants used in aerosols and metered dose inhalers. In many cases, alternative substances or methods are available. Also the maintenance and disposal of equipment or building materials that contain

these substances can be a large source of emissions. EPA's Web site on this subject (http://www.epa.gov/highgwp/projections.html) states: "EPA is actively working to reduce emissions of high GWP gases given their potency and long atmospheric lifetimes. Through a set of voluntary partnerships, EPA and industry are making substantial progress in reducing emissions by developing and implementing cost-effective improvements to industrial processes."

EPA has established voluntary partnerships in the electrical, aluminum, semiconductor and magnesium industries. In addition, EPA has published a list of acceptable substitutes for ozone-depleting substances, which are controlled by the Montreal Protocol (http://www.epa.gov/ozone/snap/index.html).

EPA's Web site also contains extensive information on the costs of control (http://www.epa.gov/highgwp/projections.html).

In addition, see "Meeting Report of the Joint IPCC/TEAP on Options for the Limitation of Emissions of HFCs and PFCs," Petten, May 1999.

Policy Design

1. Elimination of emissions of HGWP GHGs at reasonable cost.

The RCI TWG recommends that the Minnesota Pollution Control Agency undertake a rulemaking process to identify uses and emission sources of HGWP GHGs and to eliminate the use of such gases where that can be done at a reasonable cost. For purposes solely of calculation of the costs and effects of this option, a reasonable cost is determined to be $15 per CO_2 equivalent ton.

- The rulemaking process should include an initial scoping process to determine
  - Which industries are the subject of an EPA voluntary partnership, or some other voluntary program, or EPA regulation resulting in reasonable measures to reduce emissions of HGWP GHGs;
  - Which Minnesota industries/companies should be exempt from regulation because they have taken reasonable measures to reduce their emissions of HGWP GHGs;
  - Individual companies not participating in such voluntary programs would not be exempted, nor would industries or companies where reductions of HGWP GHGs are possible at reasonable costs but are not being achieved.
  - To the extent that tradable credits result from the rulemaking process for reductions in emissions, the PCA should develop a mechanism to provide such credits for companies that have reduced such emissions voluntarily.
- The rulemaking process of the MPCA would
  - Require the elimination of such gases, on a phased basis, where this can be done at no cost.
  - Require the elimination or reduction of such gases by the use of prudent managerial practices, process changes, and improved technology or by substitution of other substances, or other means, where the cost of CO_2-equivalent reduction can be accomplished at a reasonable cost.

- The reasonable cost per ton of CO_2 equivalent reduction should be established by the agency in the rulemaking process, taking into account the availability of alternatives.

2. Promotion and funding for process optimization.

If the elimination of HGWP GHGs can be undertaken at a reasonable cost, the PCA should mandate this through the rulemaking process (if it has not been done voluntarily through EPA programs or otherwise). In other cases, the state should provide funding and incentives for the reduction and phaseout of HGP GHGs, through tax incentives and funding for programs that offer education and technical assistance.

3. Use of lower-impact alternatives for coolants, refrigerants, aerosols, solvents, and insulation.

Again, where substitutes can be used at a reasonable cost, that should be done pursuant to the rulemaking described above, if not voluntarily. Where substitutes are not available at reasonable costs, the state should undertake to reduce the use and emissions of HGWP GHGs through incentives and through the funding of programs that can provide technical assistance. EPA's Web site at http://www.epa.gov/ozone/snap/ has pertinent background information.

Implementation Mechanisms

Minnesota Pollution Control Agency rulemaking process.

Legislative action to provide tax incentives and funding for technical support and assistance.

Technical support through MnTAP or similar entities.

Related Policies/Programs in Place

MnTAP (Minnesota Technical Assistance Program).

Type(s) of GHG Reductions

Reductions from avoided emissions of HGWP GHGs.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

- "U.S. High GWP Gas Emissions 1990–2010: Inventories, Projections, and Opportunities for Reductions," June 2001, available at: http://www.epa.gov/highgwp/projections.html
- Population projections from the Minnesota State Demographic Center, http://www.demography.state.mn.us/documents/MinnesotaPopulationProjections20052035.pdf
- National population projections from the U.S. Census Bureau, available at: http://www.census.gov/population/projections/SummaryTabA1.xls
- California Staff Analysis of Proposed Early Action for Climate Change Mitigation in California, 2007, HFC for mobile air conditioning available at: http://www.arb.ca.gov/cc/ccea/hfc-mac/documents/hfcdiy.pdf

Quantification Methods: See Annex 1.

Key Assumptions: See Annex 2.

Key Uncertainties

Costs of achieving reductions.

Additional Benefits and Costs

None.

Feasibility Issues

Feasibility issues should be examined as part of the rulemaking process.

Status of Group Approval

Approved.

Level of Group Support

Approved.

Barriers to Consensus

None.

RCI-6. Non-Utility Strategies and Incentives To Encourage Energy Efficiency and Reduce GHG Emissions

Policy Description

Implement cost-effective non-utility strategies and incentives for industrial processes in manufacturing and commercial facilities that complement (but not duplicate) utility-based programs to reduce greenhouse gas (GHG) emissions through energy efficiency (E2) and adoption of renewable energy technologies. These strategies must include mechanisms to:

- Maximize convenience for program users/participants
- Capture overall technology and system efficiencies
- Conduct research, evaluation, and analysis of E2 opportunities
- Provide market, cost, and other incentives to implement
- Remove of disincentives and/or regulatory barriers
- Partner with appropriate groups
- Provide technical assistance for implementation of energy efficient technologies

The proposed programs/strategies/mechanisms fall into four categories: technical assistance for implementation of energy efficiency and renewable energy, tax incentives or benefits, state economic assistance, and direct reduction of GHGs from industry.

Implementation Mechanisms

1. Technical Assistance—voluntary, non-regulatory assistance for residential/commercial/industrial entities as a mechanism to implement policies and expand related programs that would result in GHG reductions through energy efficiency savings and adoption of renewable energy technologies

- Provide technical assistance to industrial and commercial facilities including:
  - site assessments and student intern projects for E2 opportunities related to compressed air, steam systems, process heat, process refrigeration, pumps, fans, motors, etc.
  - energy efficient technology demonstrations and pilots
  - resource development including Web resources and Best Practices documents
  - workshops and seminars, including DOE Best Practices trainings
  - partnering with relevant industry associations and utilities
  - evaluate renewable energy technology options
- Assist industries with implementation of **the low hanging fruit of energy savings** through the above services. These four seem to be easy to implement with quick payback: process-related insulation, steam traps, lighting, and compressed air.
- Assist in the formation of **process energy conservation teams** within industrial facilities, or within an industry sector working with industry associations. The people in the plant have the

most knowledge about their process but they might get stalled on implementation. Energy conservation teams would be best suited initially for the quick hits that come from focusing on operation and maintenance activities. Over time these groups will provide the ideas for the larger capital projects.

- Assist facilities that run their own boilers to look at **optimizing the operation of the steam system.** Examples include right sizing boilers, waste heat recovery from steam systems, boiler turndown, load balancing for buildings with multiple boilers, and improvements to boiler efficiency.
- Develop **benchmarks for industrial and commercial operations** where they don't exist or are not widely known, for industrial/commercial facilities or operations. The EPA Energy Star program currently has three industries that have specific energy performance indicators that can be used to benchmark a facility to help prioritize where efforts should be focused. These include cement manufacturing, wet corn milling, and auto manufacturing. The energy performance indicator for a cement plant is based on the total amount of energy required to produce a short ton or MMBtu/short ton of clinker. d Focus groups could be formed to promote energy conservation in high energy use industries.
- Promote, develop information and resources, provide assistance for the following **industrial energy efficient technologies** that are not frequently used and also help reduce GHG emissions:
    - waste heat recovery (Example: metal casting)
    - pumping systems (potential 20% savings)
    - combined heat and power (cogeneration)
    - boiler blow down heat exchangers or flash steam recovery systems
- Have an outside party **work with utilities and companies to track why energy efficient and renewable energy technologies are not being implemented**. This work would be "field proofing" ideas about barriers, such as getting industry feedback before beginning on a project. If this information already exists, it could be useful guidance on how to improve implementation.

2. Direct reduction of GHGs from industry (in addition to RCI-5 and others)

- Encourage the reduction of industrial emissions of GHGs (defined as climate change greenhouse gases including CO2, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) from industries that have the greatest volumes: food processing, ethanol, petroleum refining, and taconite mining. This could be achieved via voluntary initiatives, technical assistance, best practices checklists, policy (cap and trade), and/or regulatory and other incentives. Educate industries that these activities result in carbon offset credits that they can use as revenues.

3. Tax Incentive Programs (that are not already in place)

- Provide tax incentives for capital equipment that reduces energy use per unit of product by more than 10% (possibly on a sliding scale). Projects would be done in collaboration with their local utility. To protect public interest, applicants would adhere to the same measurement and verification protocols required by DOC of Minnesota utility CIP custom

energy efficiency projects of similar size. Equipment suppliers or businesses would need to measure energy consumption before and after installation of equipment.

- Offer tax incentives for specific technologies (ie, pumps, motors, fans, boilers, compressed air systems) known to deliver energy efficiency. NEMA (National Electrical Manufacturers Association) Premium motors and adjustable speed drives (ASDs) in the right applications are possible technologies, but there are many others. The EPA and DOE Web sites list many Energy Star products for commercial facilities (food, service, lighting, office equipment, etc) that could be given a tax incentive. This would be the simplest to administer because no verification (other then receipt for filing taxes) would be needed. Exempting qualifying items from sales tax would be even simpler to administer, such as is done for groceries. To protect public interest, applicants would use the same measurement and verification protocols required by DOC of Minnesota utility CIP prescriptive energy efficiency projects.
- **Identify the large energy users and offer a tax incentive for energy reduction per ton of production.** Discussions may be needed to determine what size credit might serve as an incentive. Large energy users are probably relatively efficient now, but still represent a substantial opportunity. A screening of energy intensity per ton of product may be needed to determine if variation in credit is warranted. Facility benchmarks might be available but not shared with the public. Pre and post testing would help ensure savings are achieved.
- **Offer tax incentives for facilities that can move into the top 10% of a benchmark**. Various building energy benchmarks (energy/ft2) exist for different sectors (schools, warehouses, churches, etc). For example, give a credit for making it into the top 10% or 25% or give a credit based on how far they moved toward conservation. There is an existing federal tax credit for buildings that reduce their energy consumption. The program grants a tax deduction of $1.80 per ft2 for reducing energy consumption by 50% or more. If the reduction is at least 16.67%, then the tax deduction is $0.60 per ft2. The program requires using DOE approved software programs to calculate the energy savings.
- Provide tax incentives for reducing GHGs by adopting renewable energy technologies such as biomass, biofuels, and biogas. Implementing renewable energy technologies offset the use of fossil fuels, thus helping reduce greenhouse gas emissions.

4. State Economic Assistance

- **Low/no interest loans or other economic assistance** for those companies and public entities that do audits, identify energy goals, are doing their first energy project, or implement their energy efficient technologies. The loans may require that an energy analysis is performed to calculate the energy savings that will be achieved which will help ensure the loan will be paid off.
- Conduct a **review of all Minnesota economic development assistance projects to ensure that they encourage/require state of the art efficiency and environmental technologies** (key to Minnesota industrial competitiveness).
- Promote and pilot test **performance contracting** in energy areas. Performance contracting is defined as a contract between a building owner and a contractor for the purpose of saving energy in the owner's building. The contractor agrees to research, design, build, and maintain capital improvements which are expected to save energy and dollars. The owner agrees to pay the contractor from savings realized during the contract period.

Policy Design

Goals—program begins:

Tax benefits: 2010

Technical assistance: 2008–2009
State economic assistance: 2010
Direct reduction of GHGs from industry: 2010

Goals—goals achieved:

Tax benefits: 2012
Technical assistance: 2010
State economic assistance: 2012
Direct reduction of GHGs from industry: 2012

Parties Involved

Tax benefits: residential/commercial/industrial

Technical assistance: commercial/industrial

State economic assistance: residential/commercial/industrial

Direct reduction of GHGs from industry: industrial

Type(s) of GHG Reductions

- Reductions from avoided fossil-fuel electricity generation as a result of implementation of energy efficient practices and technologies.
- Reductions of industrial based GHGs of methane and nitrous oxides.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources: The following sources were used in the analysis

- Retrospective Examination of Demand-Side Energy Efficiency Policies, Discussion Paper, June 2004; revised September 2004 RFF DP 04-19 REV, 2004 Resources for the Future, Kenneth Gillingham, Richard Newell, and Karen Palmer
- Minnesota GHG forecast developed for this process (based on the worksheet called "Energy Use and CO_2" in a spreadsheet called GHGemitsum07_Working.xls)
- Residential and commercial electricity customers, available at http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html
- Average Retail Price for Bundled and Unbundled Consumers by Sector, Census Division, and State, 2005, available at: http://www.eia.doe.gov/cneaf/electricity/esr/esr_sum.html
- Annual Estimates of Housing Units for the United States and States: April 1, 2000, to July 1, 2005, available at U.S. Census Bureau annual data, released at the end of every July, available at: http://www.census.gov/popest/housing/HU-EST2005.html

- New Privately Owned Housing Units, Authorized Unadjusted Units for Regions, Divisions, and States, U.S. Census Bureau annual data, released at the end of every July, available at: http://www.census.gov/const/C40/Table2/t2yu200512.txt
- 2001 EIA Residential Energy Consumption Survey available at: http://www.eia.doe.gov/emeu/recs/recs2001/detailcetbls.html#space)
- Ratios of new residential/commercial floor space to total floor space, from EIA, available at http://www.eia.doe.gov/emeu/cbecs/excel/b1.xls
- Cooling degree-days in Minnesota, available at: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/cdd.200501-200607.pdf
- Heating degree-days in Minnesota, available from Department of Commerce at: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/hdd.200507-200607.pdf
- Minnesota population projection, Minnesota State Demographic Center, available at: http://www.demography.state.mn.us/documents/MinnesotaPopulationProjections20052035.pdf
- Utility electricity sales in 2005, available from U.S Energy Information Administration at: http://www.eia.doe.gov/cneaf/electricity/page/eia826.html
- Sectoral electricity consumption, from EIA, available from U.S Energy Information Administration at: http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html (file sales_revenue.xls)
- The Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors Association: The Potential for More Efficient Electricity Use in the Western United States, January 2006, http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf)

Quantification Methods: See Annex 1

Key Assumptions: See Annex 2

Related Policies and Programs in Place

Technical assistance: Build on existing energy efficiency services of the Minnesota Technical Assistance Program (MnTAP) at the University of Minnesota (for manufacturers) and the Center for Energy and the Environment (CEE) (for small business and commercial firms)

State economic assistance: Minnesota Department of Commerce, State Energy Office grants; MPCA grants and loans

Direct reduction of GHGs from industry: Industry program initiatives and MnTAP

Other Related Policies/Programs in Place

Minnesota Department of Commerce, Conservation Improvement Program (CIP).

Goals of utility conservation programs are to: promote consumer and industry awareness of energy conservation and its positive effect on the environment; reduce utility bills for homes and

businesses; generate innovations in developing energy efficient products and technologies; and promote new energy resource development.

Next Generation Act of 2007: It is the energy policy of the state of Minnesota to achieve annual energy savings equal to 1.5 percent of annual retail energy sales of electricity and natural gas directly through energy conservation improvement programs and rate design, and indirectly through energy codes and applicance standards, programs designed to transform the market or change consumer behavior, energy savings resulting from efficiency improvements to the utility infrastructure and system and other efforts to promote energy efficiency and energy conservation.

Section 1605b of the 1992 Energy Policy Act (Public Law 102-485) mandated the creation of a national inventory of greenhouse gases and a national database of voluntary reductions in greenhouse gas emissions. In doing so, Section 1605b directed the Department of Energy to establish a procedure for voluntary reporting of greenhouse gas emissions and emissions reductions by companies from the year 1987 forward, on a yearly basis.

The Department of Energy runs a suite of programs dedicated to improving the energy efficiency of buildings. These programs include: Building America, Rebuild America, the High Performance Buildings Initiative, and the Zero Energy Buildings Initiative. All of these programs work through the development of voluntary public-private partnerships.

The Department of Energy Office of Industrial Technologies runs two programs primarily focused on industrial energy audits: Industrial Assessment Centers (IAC) and Plant-wide Assessments (PWA).

The Partnership for Advanced Technology in Housing (PATH) program is a voluntary public-private partnership between homebuilders, product manufacturers, insurance companies, and financial companies and the U.S. Department of Housing and Urban Development (HUD). It is dedicated to improving the energy efficiency, affordability, durability, environmental sustainability, and resistance to natural disasters of residential housing.

Energy Star is an umbrella term encompassing a broad range of programs, all designed to encourage energy efficient investments.

DOE Weatherization Assistance Program (WAP) was authorized under Title IV of the Energy Conservation and Production Act (Public Law 94-385) in 1976 to fund weatherization measures for low-income households to reduce their energy use. WAP prioritizes services to low-income families with children, the elderly, people with disabilities, and low-income households with a high energy burden. The program works through partnerships between DOE and state and local agencies in which DOE provides program grants.

The DOE Climate Challenge program is a voluntary partnership between electric utilities and DOE designed to facilitate voluntary greenhouse gas emissions reductions by utilities.

Key Uncertainties

Cost effectiveness of technical assistance visits

Additional Benefits and Costs

Reduced local air pollution

Feasibility Issues

Measuring the effectiveness or total energy savings from a conservation initiative or program can be problematic due to difficulties in defining the right baseline, failure to correct for free riding or the "rebound" effect, use of inappropriate discount rates, and double counting of the same energy savings attributed to multiple government programs. A major question that arises when measuring program costs or cost-effectiveness is whether or not all of the salient costs (costs to business, costs to consumers, including consumer surplus losses due to quality changes, and costs to the government) are being accounted for. Equally important, the benefits of the programs (including otherwise unaccounted for spillovers) must be properly accounted for. All of these issues combined suggest that considerable care must be taken in interpreting existing estimates of the effectiveness and cost of energy efficiency programs.

Status of Group Approval

Approved

Level of Group Support

Approved

Barriers to Consensus

None

RCI-7. Conservation Improvement-Type Program for Propane and Fuel Oil Efficiency

Policy Description

Implement cost-effective programs to reduce propane and fuel-oil use; target rebates to overcome market barriers; maximize convenience to program participants; capture overall system efficiencies, not just equipment efficiencies; joint efforts to achieve market transformation; ongoing research, evaluation and analysis; complement government, utility and non-utility efficiency programs; and seek to remove any disincentives or regulatory barriers to energy efficiency.

Policy Design

Goals:

- Establish minimum efficiency heating plant standards consistent with the United States Department of Energy's Energy Star program. Current Energy Star efficiency standards are 80% for fuel oil, and 85% for propane (including water heating). Recommend rebates for high efficiency models starting at 85% for fuel oil, and 90% for propane.
- Establish and implement plan for inspection and tune up of all existing in- use heating systems and establish inspection cycle. This plan should include inspection of fuel storage and delivery systems. Inspections are to be conducted and certified by certified and trained personnel.
- Remove fuel rate disincentives and/or penalties for reduced energy consumption as a result of installing high efficiency heating equipment.
- Train and certify fuel hauler drivers in efficiency standards to recognize and tag storage and furnace systems for non-compliance.
- Provide low interest loans for low income households to encourage installation of higher efficiency models.
- Encourage manufactures to take advantage of new technological developments such as alarm systems for leaks, monoxide, etc. and for component failure (i.e. filter plug, restricted heat exchanger).
- Provide public recognition to those individuals or companies that are successful leaders in promoting efficiency standards.

Timing: 2009. All goals must be initiated and progress evaluated.

Parties Involved: All Parties with interest.

Other: Not applicable

Implementation Mechanisms

Create an ongoing state task force of consumers, state agencies, utilities; and business representatives' to annually review Conservation Improvement Program initiatives and make changes according to program effectiveness, technological changes, and critical fuel changes.

Related Policies/Programs in Place

Xcel's CIP Program.

Type(s) of GHG Reductions

Reductions from avoided propane and fuel oil combustion.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

- Minnesota GHG forecast developed for this process (based on the worksheet called "Energy Use and CO2" in a spreadsheet called GHGemitsum07_Working.xls)
- Annual Estimates of Housing Units for the United States and States: April 1, 2000 to July 1, 2005 (available at U.S Census Bureau annual data, released end of every July: http://www.census.gov/popest/housing/HU-EST2005.html
- New Privately Owned Housing Units, Authorized Unadjusted Units for Regions, Divisions, and States, U.S Census Bureau annual data, released end of every July, available at http://www.census.gov/const/C40/Table2/t2yu200512.txt
- Ratios of new residential/commercial floor space to total floor space, from EIA, available at http://www.eia.doe.gov/emeu/cbecs/excel/b1.xls
- Regional fuel prices for fuel oil and propane from the EIA AEO2007 estimates for the West North Central region (available at http://www.eia.doe.gov/oiaf/aeo/supplement/)
- Minnesota natural gas prices from the EIA (available at http://tonto.eia.doe.gov/dnav/ng/ng_pri_sum_dcu_SMN_a.htm)

Quantification Methods: See Annex 1.

Key Assumptions: See Annex 2.

Key Uncertainties

Ramp up period for achieving efficiency improvement; projected fuel oil and propane fuel costs.

Additional Benefits and Costs

Reduced local air pollution.

Feasibility Issues

TBD

Status of Group Approval

Pending approval.

Level of Group Support

Pending approval.

Barriers to Consensus

Quantification of total costs.

RCI-8. Energy Performance Disclosure

Policy Description

In order to engage utility consumers to actively take a role in Minnesota's energy future by considering efficiency and environmental impacts when using energy or purchasing energy consuming appliances, we propose the following:

Propose that utilities provide an energy performance disclosure to parties owning any public, commercial or residential property, preferably in an electronic format. It is proposed that this information be made available by the property owner to the prospective buyer or renter to allow for energy efficiency and environmental impacts to be an integral part of the decision to buy or rent.

Energy consumption history shall be provided by the utility to the owner to share with a perspective purchaser or renter of the property. The owner is obligated to provide the performance disclosure of their account for the term of their ownership, up to a maximum of the 12 most recent months. Additional information that would continue to encourage sound energy decisions such as a rating factor based upon kBtu/SF/year (from the owner) and CO_2 emissions (from the utility company) should also be included.

Develop a task force of utilities and parties of concern to devise a uniform utility information standard that would provide relevant energy efficiency and environmental impact information to customers; for example, information that indicates the incremental cost of energy per the quantity of billable units, a comparison to an average customer's energy usage, environmental impacts of such usage, and fuel portfolios, if applicable. The purpose of this action is to quantify the consumer's energy usage and to raise the level of interest.

Policy Design

Goals: In this case, the goal is the implementation of the program.

Timing: Program begins in voluntary form after law passes in mid 2008 and is mandatory on Jan 1, 2010.

Parties Involved: All building owners, public and private and all utility companies would be covered by the program.

Implementation Mechanisms

Research is needed regarding the systems that need to be put in place for distributing information on commercial and residential buildings for sale or lease (i.e. the MLS system). It ius also important to make sure the utilities are able to produce the information required. Eventually, more detailed information may be required to be disclosed.

Related Policies/Programs in Place

None.

Type(s) of GHG Reductions

Reductions from avoided fossil-fuel electricity generation and fuels combustion.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources: Not applicable.

Quantification Methods: This is a non-quantified option

Key Assumptions: Not applicable.

Key Uncertainties

Timing; scope of disclosure

Additional Benefits and Costs

Public awareness/education

Feasibility Issues

Take on the issue of the difference in performance based on the occupant's usage. An example would be to measure on an occupant versus SF basis or average out a number of units.

That each utility bill include relevant energy efficiency and environmental impact information, such as the monthly incremental energy unit charge (less tax), and for comparison, the historical charge for the same period from the previous billing year.

To engage and educate the consumer regarding their incremental monthly billing charges, and as an outcome, initiate sound knowledge based energy decisions.

Status of Group Approval

Approved.

Level of Group Support

Approved.

Barriers to Consensus

None.

RCI-9. Promote Technology-Specific Applications to Reduce GHG Emissions

Policy Description

Promote through incentives, technology-specific applications that reduce GHG emissions. Identify the options through research and organize in categories such as space heating, lighting, water heating, and plug loads. Include a process to determine and clarify which applications work best in reducing GHG emissions. Clearly communicate the fact that reducing energy use dose not always proportionally reduce emissions. Consider developing disincentives to technologies that do not reduce emissions.

Emphasize producing on-site renewable energy as a technology specific application. Clarify what is considered as renewable (i.e. solar hot water heat, photovoltaics and wind generation, as determined by current state law). Require 2% of energy used by state funded buildings to be on site renewable. Provide incentives to owners of other public and private buildings who produce at least 2% of their required building energy on-site.

Policy Design

Goals: The goal is to have program in place by 2010.

Timing: Program begins in voluntary form when law passes in June, 2008 and is in place with requirements and incentives on Jan. 1, 2010.

Parties Involved: Mandatory program is for state funded building owners. Incentives and disincentives are for all other public and private building owners (Residential, Commercial, and Industrial). Research organizations should support this effort.

Other: Supplement with research of technology specific applications for GHG reductions.

Implementation Mechanisms

The program should be implemented by informing all building owners about the program, determining/funding possible private incentives and coordinating with education and training programs handled in other Programs.

Related Policies/Programs in Place

Need to inventory all current incentives in the state (including an evaluation of the current cap on requiring utility companies to buy back renewable power at the cost of purchase).

Type(s) of GHG Reductions

Reductions from avoided fossil-fuel electricity generation and energy generation.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources: Not applicable.

Quantification Methods: This option is not quantified

Key Assumptions: Not applicable.

Key Uncertainties

Timing of program; scope of coverage

Additional Benefits and Costs

Promote local innovation

Feasibility Issues

Interaction with appliance standards and utility programs.

Status of Group Approval

Approved

Level of Group Support

Approved

Barriers to Consensus

None

RCI-10. Support Strong Federal Appliance Standards and Require High State Standards in the Absence of Federal Standards

Policy Description

Implementation of State appliance efficiency standards for appliances not covered by federal standards or where higher-than-federal standard efficiency requirements are appropriate.

Appliance efficiency standards reduce the market cost of energy efficiency improvements by incorporating technological advances into base appliance models, thereby, thereby creating economies of scale. Minnesota should adopt appliance efficiency standards at the state level not covered by federal standards. California has established appliance efficiency standards for a number of appliances not currently included in national legislation, such as consumer electronics (standby power use), and general service incandescent lamps.

The specific policy approach suggested by the RCI TWG is to

- Address existing federal appliance efficiency standards by developing a State of Minnesota Residential Appliance Efficiency Standard. (Consider adoption of the appliance efficiency standards already adopted by California.). Request that the Governor through the National Governors Association provide the leadership to seek adoption of the Minnesota Residential Appliance Efficiency Standard by the Federal Government.
- As part of a Minnesota Residential Appliance Efficiency Standard, require that all energy consuming appliances be labeled for average annual energy consumption (kilowatt-hours, or thermal units). The information provided in the label would be in addition to any existing Energy Star information that may already be provided for comparison purposes.
- Also as part of a Minnesota Residential Appliance Efficiency Standard require the development of a consumer education program on appliance efficiency. Insist that all utilities and appliance retailers in the state of Minnesota provide appliance efficiency information to their consumers/customers.
- Require high-efficiency Energy Star appliances be installed in all new residential construction and major retrofits.
- Require utilities to provide Energy Star appliance rebates where they are deemed cost-effective. (The Minnesota DOC commissioner will determine cost effectiveness in the CIP process.)
- Advocate for the adoption of a State of Minnesota Residential Appliance Upgrade Program. The program would require the seller of a home to establish an appliance escrow account for any of the major appliances within the home that are older than 15 years. The escrow account would only be made available to the home buyer for upgrading of the major appliances in the home to Energy Star-rated appliances.

- Where possible, require and/or encourage appliance manufacturers to adopt grid-friendly "smart chip" technology into their appliances that will allow utilities to communicate with "smart chip" appliances to curtail energy usage and/or respond to energy pricing changes.

Policy Design

Goals: Increase stringency of a set of appliance standards to the level of those recommended by the report: "Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards."

Timing: Adopt new standards by 2009.

Parties Involved: State agencies to enforce state codes and standards.

Other: Not applicable.

Implementation Mechanisms

Potential implementation mechanisms and supporting activities for this mitigation option include

- Appliance Standards promulgated by legislation or developed administratively;
- Assistance programs to help low-income consumers with purchase of appliances meeting more stringent standards, so as to reduce the higher-first-cost burden of higher-efficiency appliances on those consumers;
- Elevated energy standards for appliances and equipment purchased by public agencies; and
- Work with manufacturers and consider impacts on manufacturers when setting new standards.

Related Policies/Programs in Place

The state is an ENERGY STAR Partner

Type(s) of GHG Reductions

GHG impacts are similar in nature to those noted for RCI-1 above.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

- Population projections from the Minnesota State Demographic Center, http://www.demography.state.mn.us/documents/MinnesotaPopulationProjections20052035.pdf
- National population projections from the US Census Bureau, available at http://www.census.gov/population/projections/SummaryTabA1.xls
- "Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards", by Steven Nadel, Andrew deLaski, Jim Kleisch, and Toru Kubo (available at http://www.standardsasap.org/documents/a051.pdf)

- "Clean and Diversified Energy Initiative", by Western Governor's Association Energy Efficiency Task Force Report (available at http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf)
- Minnesota GHG forecast developed for this process (based on the worksheet called "Energy Use and CO2" in a spreadsheet called GHGemitsum07_Working.xls)
- Regional fuel prices from the EIA AEO2007 estimates for the West North Central region (available at http://www.eia.doe.gov/oiaf/aeo/supplement/)
- Minnesota natural gas prices from the EIA (available at http://tonto.eia.doe.gov/dnav/ng/ng_pri_sum_dcu_SMN_a.htm)

Quantification Methods: See Annex 1

Key Assumptions: See Annex 2

Key Uncertainties

Scaling down of results of a national study to Minnesota conditions

Additional Benefits and Costs

Reduced local air pollution

Feasibility Issues

TBD

Status of Group Approval

Pending approval

Level of Group Support

Pending approval

Barriers to Consensus

Quantification of emission reductions and associated implementation costs.

Annex 1. Methodology for the Quantification of RCI Mitigation Options

This memo outlines key elements of the methodology used for quantifying the greenhouse gas (GHG) impacts and costs for those Technical Work Group (TWG) policy options that are considered amenable to quantification. The list of topics addressed in this memo is summarized below. Feedback from Residential, Commercial, and Industrial (RCI) Sector TWG members is encouraged.

A. Premises
B. Outputs
C. Methodology
D. Assumptions
E. Cost Inclusion

A. Premises

There are a number of key premises upon which the analysis will be based, as briefly outlined below.

- *CCS role*—Unless a member of the RCI TWG offers to undertake an analysis of any of the options, we assume that we (i.e., Center for Climate Strategies [CCS]) will undertake the analysis of the RCI options. In the case where an RCI TWG member does offer to undertake the analysis of one or more options, we will provide analytical support (e.g., review and technical feedback) as needed.
- *Transparency*—Data sources, methods, key assumptions, and key uncertainties are clearly indicated.
- *Analytical approach*—We adopt the general approach of cost-effectiveness (and net present value [NPV]) analysis, as widely applied to GHG mitigation policy options.[1] We include direct, economic costs from the perspective of the state as whole (i.e., avoided costs of electricity rather than consumer electricity prices).
- *Bottom-up analysis*—We adopt a bottom-up approach that is amenable to transparency and is capable of reflecting the costs (and cost savings) associated with individual policy options, in contrast to macroeconomic analysis, which aims to capture flows and interactions across all sectors of the economy. Potential macroeconomic impacts, cost, or benefits that fall disproportionately on specific groups or actors, as well external costs and benefits, should be noted qualitatively where studies or other information are available.

B. Outputs

The analysis of mitigation options will be organized to produce the following results:

[1] See, for example, Section 2.4 of the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, Working Group III, for more discussion of various economic analysis approaches. http://www.mnp.nl/ipcc/pages_media/AR4-chapters.html

- *Net GHG reduction potential* in million metric tons of carbon dioxide equivalent ($MMtCO_2e$) using the Intergovernmental Panel on Climate Change (IPCC) 100-year global warming potential, reported annually for the years 2015, 2020, and 2025, as cumulatively for the period 2008–2025. Where significant additional GHG reductions or costs occur beyond the project period as a direct result of actions taken during the project period, these will be indicated as appropriate.
- *Net present value cost* (or cost savings) for the period 2008–2025 in 2006 constant dollars, using a 5% real discount rate.[2] Positive numbers represent options with net costs; negative numbers represent options with net cost savings.
- *Cost per $MtCO_2e$* emissions reduced (or removed) in units of dollars per metric ton of carbon dioxide equivalent ($\$/tCO_2e$). This figure represents the NPV cost divided by the cumulative emission reductions, both over the 2008–2025 period.

C. Methodology

As much as possible, the analysis will proceed using simple spreadsheet modeling techniques in which assumptions are transparent and readily accessible to any TWG member for review and adjustment. To ensure consistent results across options, common factors and assumptions will be used for items such as:

- *Electricity avoided costs and emissions*—Common values ($\$/MWh$ and tCO_2/MWh) are being developed based on available studies. Now that a complete set of options has been identified, each option will 1) first be analyzed individually and 2) be addressed as part of an overall integrated analysis.
- *Fuel costs and projected escalation*—Fuel cost estimates will be based on common sources wherever possible. For example, fossil fuel price escalation will be indexed to United States Department of Energy (US DOE) projections as indicated in their most recent Annual Energy Outlook.
- *Overlap with other TWGs*—There are some RCI options that may overlap with options being considered in the Energy Supply (ES) TWG. The analysis for these options will take place in close coordination with the assumptions other inputs used in the ES TWG.
- *Full fuel cycle approach*—Related to the previous point, a fuel cycle analysis is applied wherever emissions impacts upstream (e.g., production, extraction) or downstream (e.g., waste disposal) from a specific activity constitute a significant fraction of a policy option's emissions impacts *and* studies are sufficient to enable estimation.

D. Assumptions

As much as possible, the analysis will seek to rely on data sources that are Minnesota-specific, and which TWG members are in a good position to obtain and provide. The success of this approach will depend on how accessible the information is to TWG members and the timeliness with which it can be provided to the CCS analysis team. Where Minnesota-specific information can not be readily obtained, the analysis will rely on published data from the US DOE, National Laboratories, and other state climate change processes.

[2] Capital investments with lifetimes longer than 2025 are represented in terms of levelized or amortized costs, in order to avoid "end effects."

E. Cost Inclusion

There are several types of costs that will be explicitly considered in the analysis and several types that we propose to exclude, as summarized below.

- *Costs included:*
  - Capital costs levelized (amortized) where appropriate (e.g., for new energy-efficient equipment),
  - Operations and maintenance (O&M) and other labor costs (or incremental costs relative to standard practice),
  - Fuel and material costs (e.g., for natural gas, electricity, biomass resources, water, fertilizer, material use, and electricity transmission and distribution), and
  - Other direct costs, administrative costs, and other costs (where readily estimated).
- *Costs excluded:*
  - External costs such as the monetized environmental or social benefits/impacts (e.g., value of damage by air pollutants on structures and crops), quality-of-life improvements, improved road safety, or other health impacts and benefits;
  - Energy security benefits;
  - Macroeconomic impacts related to the impact of reduced or increased consumer spending and shifting of cost and benefits among actors in the economy.

Annex 2. Key Assumptions

RCI-1. Maximize Savings From the Utility Conservation Improvement Program (CIP)

Assumed start year for the new CIP legislation

2008

Total anual level of savings in electricity sales associated with new CIP legislation (%/yr)

1.5%	source: MN legislation; see 216B.241 ENERGY CONSERVATION IMPROVEMENT

Current estimates of accumulated embedded energy efficiency and conservation in 2003 based on the previous CIP legislation (i.e., savings from previous CIP activities as a percentage of total sales):

	2	
1	0.8%	source: Office of the Legislative Auditor, State of Minnesota, 2005, "Evaluation Report: Energy Conservation Improvement Program", January, page 5
2	0.5%	source: RCI TWG estimate as proposed during the TWG meeting held on 23 October 2007 **(default)**
3	0.4%	source: spreadsheet attachment in an email from Peter Ciborowski to Bill Dougherty dated 26 October 2007

2003 expenditures in MN for demand side electricity savings associated with the previus CIP statute

$52	2003 expenditures by regulated utilities (million $)
325	2003 savings from utility expenditures (GWh)

Financial parameters

2.5%	projected inflation rate (2003-2005)
5%	real discount rate (%)
10	Levelization period (years)

Marginal resource associated with electricity savings

	1	
1	coal & natural gas, prorata (default)	
2	100% coal	
3	system average	

Starting 2005 assumption for the full levelized cost--program costs, utility costs, and participant cost--of electric energy efficiency improvements

	1		
1	Value is	30	2005$/MWh
2	Value is user-defined		

Adjustment in 2005 assumption for the full levelized cost--program costs, utility costs, and participant cost--of electric energy efficiency improvements to account for aggressiveness of new MN CIP

	1		
1	Value increases by 1%/year, or by	18%	on average over the planning period
2	User-defined		

Final 2005 assumption for the full levelized cost--program costs, utility costs, and participant cost--of electric energy efficiency improvements

35.5	2005$/MWh

Estimated avoided costs, including the RES

156.5	2005$/MWh

RCI-2. Improved Uniform Statewide Building Codes

Assumed start year for the new CIP legislation

2009

Assumption for improvement of the residential building code relative to the current residential building code in areas where the building code HAS BEEN adotpted and IS BEING enforced

1

1	no improvement in energy efficiency (default)		
2	User-defined		

Assumption for improvement of the residential building code relative to the current residential building code in areas where the building code has NOT been adotpted

1

1	improvement in energy efficiency of	3%	(default)
2	User-defined		

Assumption for percent of the state population covered by current residential building codes

1

1	The percent of MN's population is	85%	covered by the current building code (default)
2	User-defined		

Assumption for future enforcement of the residential building code

1

1	100% Statewide (default)
2	User-defined

Assumption for improvement of the commercial building code relative to the current commercial building code in areas where the building code HAS BEEN adotpted and IS BEING enforced

1

1	no improvement in energy efficiency (default)
2	User-defined

Assumption for improvement of the commercial building code relative to the current commercial building code in areas where the building code has NOT been adotpted

1

1	improvement in energy efficiency of	5%	(default)
2	User-defined		

Assumption for percent of the state commercial activity covered by current commercial building codes

1

1	Percent of MN's commercial sector,	85%	is covered by the current building code (default)
2	User-defined		

Assumption for future enforcement of the commercial building code

1

1	100% Statewide (default)
2	User-defined

Marginal resource associated with electricity savings

1

1	coal & natural gas, prorata (default)
2	100% coal
3	system average

Real discount rate

1

1	Use	5%
2	User-defined	

RCI-3. Green Building Guidelines and Standards Based on *Architecture 2030*

Assumed CO2 reduction targets to meet the Architecture 2030 Challenge (% relative to Reference Case)

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
0%	0%	0%	0%	0%	60%	62%	64%	66%	68%	70%	72%	74%	76%	78%	80%	82%	84%	86%	88%	90%

Percentage of new buildings subject to the new guidelines

1	Use	80%
2	User-defined	

1

80% *since not user-defined, ignore value in cell at left*

Annual percentage of the existing building stock subject to renovation

1	Use	5%
2	User-defined	

1

10% *since not user-defined, ignore value in cell at left*

Percentage of annual rennovated building stock subject to the new guidelines

1	Use	50%
2	User-defined	

1

50% *since not user-defined, ignore value in cell at left*

Real discount rate

1	Use	5%
2	User-defined	

1

4% *since not user-defined, ignore value in cell at left*

Payback period for efficient equipment (years)

1	Use	14
2	User-defined	

1

10 *since not user-defined, ignore value in cell at left*

Lifespan for efficient equipment (years)

1	Use	30
2	User-defined	

1

30 *since not user-defined, ignore value in cell at left*

RCI-4. Incentives and Resources To Promote Combined Heat and Power (CHP)

Assumed start year for the new CHP facilities

2013

Assumption for CHP potential in MN based on most recent available estimates

1

1	Maximum of:	2,100	MW (default)
2	Minimum of:	1,600	MW (default)
3	User-defined		

Assumption for percentage of installed CHP by 2025

1

1	Up to specified potential (defaul)
2	User-defined

Marginal resource associated with electricity savings

1

1	coal & natural gas, prorata (default)
2	100% coal
3	system average

Combined heat and power (CHP) cost and performance

	2010					2025				
Parameter	NG	Biomass	Coal	electricity	oil	NG	Biomass	Coal	electricity	oil
Average full-capacity-equivalent hours of operation	5,000	5,000	5,000			5,000	5,000	5,000		
Fraction of new capacity	90%	5%	5%			83%	18%	0%		
Average net heat rate by fuel (btu per kWh)	10,000	13,000	12,000			10,000	13,000	12,000		
Useable cogenerated heat output (% energy input)	40%	40%	40%			40%	40%	40%		
Fraction useable heat output replacing space/water/process heat	90%	90%	90%			90%	90%	90%		
Fraction of CHP heat output displacing thermal energy	75%	5%	0%	15%	5%	75%	5%	0%	15%	5%
Net efficiency of displaced boiler/heater thermal energy	85%	80%	80%	92%	80%	85%	80%	80%	92%	80%
Average overnight installed captial costs by fuel type (2005$/kW)	$2,000	$2,500	$2,500			$2,000	$2,500	$2,500		
CHP transmission cost (2005$/kW)	$0	$0	$0			$0	$0	$0		
Economic life of system (years)	20	20	20			20	20	20		
Fixed O&M costs (2005$/kW)	0	0	0			0	0	0		
Variable O&M costs (2005 $/MWh)	16.00	20.00	20.00			16.00	20.00	20.00		

RCI-5. Program To Reduce Emissions of Non-Fuel, High-Global-Warming-Potential GHGs

GENERAL ASSUMPTIONS

Assumed start year for the option

2009

Implementation ramp-up schedule

1

1	Linearly up to maximum by 2025 (default)
2	User-defined ramp-up period

Real discount rate

5%

Cost effectiveness threshold (2005$/tCO2e avlided)

$15.0

Inflation rate

1

1	Use	2.50%
2	User-defined	

Global warming potential

HFC-134a	1,300
SF-6	23,900

SF6 - ELECTRIC TRANSMISSION

Mitigation cost (recycling) (2005$/tCO2e)

1

1	EPA assumption (default)	-9.31
2	User-defined	

Maximum mitigation reduction potential (recycling)

1

1	EPA assumption (default)	10%
2	User-defined	

Mitigation cost (leak detection) (2005$/tCO2e)

1

1	EPA assumption (default)	6.56
2	User-defined	

Maximum mitigation reduction potential (leak detection)

1

1	EPA assumption (default)	20%
2	User-defined	

HFC and PFC - SEMICONDUCTORS

HFC and PFC mitigation cost (NF3 remote clean technology) (2005$/tCO2e)

	1
1	EPA assumption (default) 5.20
2	User-defined

HFC and PFC maximum mitigation reduction potential (NF3 remote clean technology)

	1
1	EPA assumption (default) 9%
2	User-defined

HFC and PFC mitigation cost (point of use plasma) (2005$/tCO2e)

	1
1	EPA assumption (default) 11.63
2	User-defined

HFC and PFC maximum mitigation reduction potential (point of use plasma)

	1
1	EPA assumption (default) 7%
2	User-defined

HFC and PFC mitigation cost (thermal destruction) (2005$/tCO2e)

	1
1	EPA assumption (default) 42.42
2	User-defined

HFC and PFC maximum mitigation reduction potential (thermal destruction)

	1
1	EPA assumption (default) 19%
2	User-defined

HFC and PFC mitigation cost (catalytic destruction) (2005$/tCO2e)

	1
1	EPA assumption (default) 10.84
2	User-defined

HFC and PFC maximum mitigation reduction potential (catalytic destruction)

	1
1	EPA assumption (default) 21%
2	User-defined

HFC mitigation cost for refrigerants (distributed system) (2005$/tCO2e)

	1
1	EPA assumption (default) -8.17
2	User-defined

HFC - REFRIGERANTS (not including mobile air conditioning)

HFC maximum mitigation reduction potential (distributed system)

	1
1	EPA assumption (default) 4%
2	User-defined

HFC mitigation cost (Ammonia secondary loop system) (2005$/tCO2e)

	1
1	EPA assumption (default) 19.74
2	User-defined

HFC maximum mitigation reduction potential (Ammonia secondary loop system)

	1
1	EPA assumption (default) 4%
2	User-defined

HFC mitigation cost (HFC secondary loop system) (2005$/tCO2e)

	1
1	EPA assumption (default) 20.18
2	User-defined

HFC maximum mitigation reduction potential (HFC secondary loop system)

	1
1	EPA assumption (default) 1%
2	User-defined

SF-6 - SOLVENTS

SF-6 mitigation cost (alternative solvents) (2005$/tCO2e)

	1
1	EPA assumption (default) 0.26
2	User-defined

SF-6 maximum mitigation reduction potential (alternative solvents)

	1
1	EPA assumption (default) 30%
2	User-defined

SF-6 mitigation cost (NIK replacements) (2005$/tCO2e)

	1
1	EPA assumption (default) 4,118
2	User-defined

SF-6 maximum mitigation reduction potential (NIK replacements)

	1
1	EPA assumption (default) 3%
2	User-defined

SF-6 mitigation cost (Retrofit options) (2005$/tCO2e)

	1
1	EPA assumption (default) 78.64
2	User-defined

SF-6 maximum mitigation reduction potential (Retrofit options)

	1
1	EPA assumption (default) 2%
2	User-defined

RCI-6. Non-Utility Strategies and Incentives To Encourage Energy Efficiency and Reduce GHG Emissions

Start-up year for option

	1	
1	Use	2013
2	User-defined	

Average energy savings from application of measures associated with non-utility strategies and incentives in the residential sector (% relative to Reference Case)

	1	
1	Use	13%
2	User-defined	

Average energy savings from application of measures associated with non-utility strategies and incentives in the commercial sector (% relative to Reference Case)

	1	
1	Use	13%
2	User-defined	

Average energy savings from application of measures associated with non-utility strategies and incentives in the industrial sector (% relative to Reference Case)

	1	
1	Use	15%
2	User-defined	

Annual technical assistance visits to residential sector customers

	1	
1	Use	10,000
2	User-defined	

Annual technical assistance visits to comercial sector customers

	1	
1	Use	1,500
2	User-defined	

Annual technical assistance visits to industrial sector customers

	1	
1	Use	300
2	User-defined	

RCI-7. Conservation Improvement-Type Program for Propane and Fuel Oil Efficiency

Assumed start year for the option

2009

Equipment efficiency improvement target for fuel oil

1

1 Efficiency of equipment using fuel oil improves from 80% to 85% (default)
2 User-defined (Efficiency of equipment using fuel oil improves from 80% to 85%

Ramp-up period for achieving the efficiency improvement target for fuel oil in MN (years)

1

1 Policy ramps up linearly over a 5 year period (default)
2 User-defined (Policy ramps up linearly over a 10 year period)

Phase-in for efficient fuel oil equipment

Start year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
2008				0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2009					17%	34%	51%	68%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
2010						0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2011							0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2012								0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2013									0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2014										0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2015											0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2016												0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2017													0%	0%	0%	0%	0%	0%	0%	0%	0%
2018														0%	0%	0%	0%	0%	0%	0%	0%
2019															0%	0%	0%	0%	0%	0%	0%
2020																0%	0%	0%	0%	0%	0%
2021																	0%	0%	0%	0%	0%
2022																		0%	0%	0%	0%
2023																			0%	0%	0%
2024																				0%	0%
2025																					0%
efficiency	0%	0%	0%	0%	17%	34%	51%	68%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Share	0%	0%	0%	0%	20%	40%	60%	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Equipment efficiency improvement target for propane

1

1 Efficiency of equipment using proane improves from 85% to 90% (default)
2 User-defined (Efficiency of equipment using propane improves fror 85% to 90%

Ramp-up period for achieving the efficiency improvement target for propane in MN (years)

1

1 Policy ramps up linearly over a 5 year period (default)
2 User-defined (Policy ramps up linearly over a 10 year period)

Phase-in for efficient propane equipment

Start year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
2008				0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2009					18%	36%	54%	72%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
2010						0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2011							0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2012								0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2013									0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2014										0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2015											0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2016												0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2017													0%	0%	0%	0%	0%	0%	0%	0%	0%
2018														0%	0%	0%	0%	0%	0%	0%	0%
2019															0%	0%	0%	0%	0%	0%	0%
2020																0%	0%	0%	0%	0%	0%
2021																	0%	0%	0%	0%	0%
2022																		0%	0%	0%	0%
2023																			0%	0%	0%
2024																				0%	0%
2025																					0%
efficiency	0%	0%	0%	0%	18%	36%	54%	72%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Share	0%	0%	0%	0%	20%	40%	60%	80%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Percentage of new fuel oil use subject to the new efficiency standards

	1
1 Use	100%
2 User-defined	

50% *since not user-defined, ignore value in cell at left*

Percentage of new propane use subject to the new efficiency standards

	1
1 Use	100%
2 User-defined	

since not user-defined, ignore value in cell at left

Percentage of existing fuel oil use subject to the new efficiency standards

	1
1 Use	50%
2 User-defined	

25% *since not user-defined, ignore value in cell at left*

Percentage of existing propane use subject to the new efficiency standards

	1
1 Use	50%
2 User-defined	

50% *since not user-defined, ignore value in cell at left*

CO2e emission factors (tCO2e per mmbtu)

0.07	diesel fuel oil
0.06	propane

Payback period for efficient equipment (years)

	1	oil	ropane
1	Use	14	6
2	User-defined		

14 7 *since not user-defined, ignore values in cells at left*

Lifespan for efficient equipment (years)

	1	oil	ropane
1	Use	30	8
2	User-defined		

30 25 *since not user-defined, ignore values in cells at left*

Real discount rate

	1
1 Use	5%
2 User-defined	

4% *since not user-defined, ignore value in cell at left*

RCI-10. Support Strong Federal Appliance Standards and Require High State Standards in the Absence of Federal Standards

Summary of national savings from appliance standards on appliances not currently covered by federal statutes

Source: "Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards", 2005, by Steven Nadel, Andrew deLaski, Jim Kleisch, and Toru Kubo, available at http://www.standardsasap.org/documents/a051.pdf; page v.

		2020 savings		2030 savings		NPV (2030)	
#	Technology	TWh	trillion btu	TWh	trillion btu	billion $	Start year
1	Ceiling fan lights	18.9	197	18.9	190	13	2007
2	Commercial clothes washers	0.3	9	0.3	9	0.9	2007
3	Commercial ice-makers	0.6	7	0.6	6	0.4	2007
4	Commercial refrigerators & freezers	2.4	25	2.4	24	1.3	2010
5	Commercial unit heaters	0	39	0	55	3	2007
6	Dehumidifiers	1	10	1.1	11	0.7	2007
7	Digital cable & satellite boxes	1.4	14	1.4	14	1.2	2007
8	Digital television adapters	0.3	3	0	0	1.1	2007
9	Exit signs	1.7	18	2.9	29	1.4	2007
10	External power supplies	4.9	51	4.9	49	3.3	2007
11	Large commercial packaged AC & heat pumps	1.5	16	2.2	22	0.9	2010
12	Low-voltage dry-type transformers	3.1	32	5.4	54	2.6	2007
13	Medium-voltage dry-type transformers	2.7	28	4.7	47	2.4	2007
14	Metal halide lamp fixtures	9	93	14.4	144	7.3	2008
15	Pre-rinse spray valves	0	56	0	56	8	2007
16	Reflector lamps	3.9	40	3.9	39	2.6	2007
17	Torchiere lighting fixtures	11.8	123	11.8	119	8.4	2007
18	Traffic signals	1.3	13	1.3	13	0.6	2007
	total	64.8	774	76.2	881	59.1	

Natural gas savings

Source: "Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards", 2005, by Steven Nadel, Andrew deLaski, Jim Kleisch, and Toru Kubo, available at http://www.standardsasap.org/documents/a051.pdf; page v.

1.03 mmbtu per MCF

	Savings - All fuels		Savings Estimate - Natural Gas					
	trillion btu		billion cubic feet		trillion btu		NG Share ot total	
	2020	2030	2020	2030	2020	2030	2020	2030
Demand side			100		103	117	13%	13%
Supply side			336		346	394	45%	45%
total	774	881	436		449	511	58%	58%

Cost of electricity used for estimating economic benefits of appliance standards in the Nadel et al report

Source: "Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards", 2005, by Steven Nadel, Andrew deLaski, Jim Kleisch, and Toru Kubo, available at http://www.standardsasap.org/documents/a051.pdf; page 64.
Sectoral shares of total residential/commercial electricity use from the MN GHG inventory and forecast called GHGemitsum07_Working.xls ("Energy Use and CO2" worksheet) prepared by R. Strait

	Cents/kWh (MN)		$/MWh (MN)	
	2003$	2005$	2003$	2005$
Residential electricity price	7.7	8.1	77	81
Commercial electricity price	6.1	6.4	61	64
Residential sector electricity share (2005)	50.12%			
Commercial sector electricity share (2005)	49.88%			
Average	6.9	7.3	69	73

Estimate of the cost of achiecing electricity savings from appliance standards

Source: "Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards", 2005, by Steven Nadel, Andrew deLaski, Jim Kleisch, and Toru Kubo, available at http://www.standardsasap.org/documents/a051.pdf; page 42.

cost (2005$/MWh)	$11.90

MN avoided electricity costs

Source: avoided cost calculations for this study

MN avoided cost (2005$/MWh)	$156

Adjustment factor to apply to NPV

Source: Adjustment factor that scales the NPV by the ratio of the MN net avoided cost and the USA net avoided cost

Adjustment factor	2.39

Share of NPV associated with electricity savings

Source: estimate of the share of savings from appliance standards associated with electricity

	2020	2030
rough assumption	87%	87%