Appendix F
Residential, Commercial, and Industrial Sectors Policy Recommendations

Summary List of Policy Recommendations

Policy No.	Policy Recommendations	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)*	*Quantified as a "Recent Action"*					Enacted
RCI-2	Improved Uniform Statewide Building Codes	0.004	0.005	0.077	–$44	–$576	Unanimous
RCI-3	Green Building Guidelines and Standards Based on *Architecture 2030*	0.62	0.94	11.1	–$296	–$27	Unanimous
RCI-4	Incentives and Resources To Promote Combined Heat and Power (CHP)	0.96	4.95	33.1	$125	$3.8	Unanimous
RCI-5	Program To Reduce Emissions of Non-Fuel, High-Global-Warming-Potential GHGs	0.02	0.05	0.5	–$2	–$5	Unanimous
RCI-6	Non-Utility Strategies and Incentives To Encourage Energy Efficiency and Reduce GHG Emissions	0.25	1.30	8.3	–$307	–$37	Unanimous
RCI-7	Conservation Improvement-Type Program for Propane and Fuel Oil Efficiency	0.05	0.05	0.7	–$21	–$28	Unanimous
RCI-8	Energy Performance Disclosure	*Not quantified*					Unanimous
RCI-9	Promote Technology-Specific Applications To Reduce GHG Emissions	*Not quantified*					Unanimous
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	Unanimous
	Sector Total After Adjusting for Overlaps (RCI, Non-Electricity)	**0.76**	**0.69**	**10.41**	**–$464**	**–$44.6**	
	Sector Total After Adjusting for Overlaps (Integrated RCI and ES for Electricity)	**1.56**	**7.34**	**51.06**	**–$1,098**	**–$21.5**	
	Reductions From Recent Actions	**6.50**	**15.50**	**$143.4**	**–$8,454**	**–$59.0**	
	New Commercial Building Code	**0.18**	**0.21**	**3.16**	**–$1.8**	**–$0.6**	
	Sustainability Guidelines (New State Buildings)	**0.22**	**0.46**	**4.72**	**–$1.7**	**–$0.4**	
	10% Savings in State Buildings	**0.09**	**0.11**	**1.75**	**–$0.9**	**–$0.5**	
	RCI-1: New CIP*	**6.01**	**14.72**	**133.8**	**–$8,449**	**–$63.2**	
	Sector Total Plus Recent Actions	**8.82**	**23.53**	**204.9**	**–$10,016**	**–$48.9**	

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; ES = Energy Supply.

Negative values in the Net Present Value (NPV) and the Cost-Effectiveness columns represent net cost savings associated with the recommendations. Totals in some columns may not add to the totals shown due to rounding.

Only the results of recommendations included in the final tabulation of GHG reductions and costs are shown in this table. For discussion of any sensitivity analyses undertaken, please see the discussion in RCI Appendix F, Annex 1.

* The CIP considered here is based on the CIP requirements (i.e., 1.5% energy savings goal) included in the Next Generation Energy Act of 2007; therefore, the emission reductions and cost savings estimated are included under "recent actions."

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

Policy Description

Senate File 145 establishes an energy policy goal for 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 Minnesota Climate Change Advisory Group (MCCAG) recommends that the Minnesota Department of Commerce (MnDOC) 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. Such strategies and programs should include:

- The state should develop and implement a policy of "decoupling," or separation of utility sales from revenues**.**
- Utilities should develop 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) capture overall system efficiencies—not just equipment efficiencies. This might include finding ways to improve the efficiency of the operation of entire class of equipment or entire systems.
- 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.
- MnDOC 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 Residential, Commercial, and Industrial (RCI) Technical Work Group (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. In addition, on November 15, 2007, at its Midwest Energy Summit, the Midwestern Governors Association (MGA) agreed upon a regional 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 an energy savings level higher than the current 1.5% Minnesota goal are uncertain for electric and natural gas utilities. Therefore, the MCCAG recommends that Minnesota immediately undertake a study of the technical feasibility and cost-effectiveness of achieving a 2% energy efficiency savings goal for electric and natural gas utilities by 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 MnDOC program will begin June 1, 2008, with the exception of Xcel. MnDOC will report back to the state legislature on Conservation Improvement Program (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

- State of Minnesota, Office of the Legislative Auditor, *Energy Conservation Improvement Program: Evaluation Report Summary*, St. Paul, MN, January 2005, available at: http://www.auditor.leg.state.mn.us/PED/pedrep/0504a.pdf
- Spreadsheet attachment in an e-mail from Peter Ciborowski to Bill Dougherty of the Center for Climate Strategies (CCS), 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

Complete.

Level of Group Support

Enacted. Note that the 1.5% energy savings goal is included in existing Minnesota law and, therefore, is considered an existing action. The MCCAG included this as a priority for analysis in order to estimate the emission reductions and costs associated with the 1.5% energy savings goal and to consider increasing the goal.

Barriers to Consensus

Not applicable.

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 greenhouse gas (GHG) emission reductions.

The Minnesota Department of Labor and Industry (DOLI) has the responsibility of promulgating the building code in Minnesota. Where possible, DOLI has approved the International Code Council's (ICC's) "I" family of codes. In July 2007, the 2006 International Residential Code (IRC) and the 2006 International Building Code 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 of the 2006 IRC is greatly simplified compared with past codes, and is expected to be widely accepted because of a U.S. Department of Energy (DOE)-initiated amendment. That amendment allows builders to comply using a simple "cookbook" compliance method, without needing to perform computer calculations of windows, walls, 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. Although the new residential code will not significantly increase the efficiency of one- and two-family residential buildings, its applicability will be broadened to include townhouses and, by doing so, will increase their energy efficiency.

The new Minnesota commercial energy code is based on the American Society of Heating, Refrigerating and Air-Conditioning Engineers standard ASHRAE 91.1-2004, with important state amendments. The percentage increase in 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. Following are some facts about the current energy code requirements:

- Approximately 85% of Minnesota's population lives in an area where the Minnesota State Building Code (including the energy code) has been adopted and enforced.
- Of Minnesota's 87 counties, 39 have adopted the Minnesota State Building Code.

- In accordance with state law, virtually all cities with populations of 2,500 and above are enforcing the Minnesota State Building Code, even if they are located in a county that is not enforcing the code.
- If a municipality or county chooses to enforce a building or 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 with populations of 2,500 and above, that have not adopted the Minnesota State Building Code.
- While the Minnesota State Building Code is not enforced statewide, homebuilders who are licensed by the state are required to 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; and
- Development of a clearinghouse for information on how to provide access to software tools to calculate the impacts of energy efficiency and solar technologies on building energy performance.

Policy Design

Goals: As noted above.

Timing: Recognizing that 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-agricultural buildings. (Currently, agricultural buildings are exempt from building and energy code compliance).
- Updating energy codes every 3 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 with the most recent ICC national code cycles and to 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 for 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 requiring several hours of continuing education on energy and mechanical code requirements during every new code cycle. The number of hours for continuing education will be determined by the certifying agency/organization.
- Developing an educational program for the public and realtors through MnDOC's Energy Information Office, explaining Home Energy Rating System (HERS) scores for different types of housing.
    - Require all realtors to complete at least 1 hour 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 buildings. DOLI 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 one- and two-family homes. Builders can choose from one or the other, which has led to confusion in complying with and enforcing the codes.

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

Minnesota Rules Chapter 7674 covers multifamily 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.
- Multifamily buildings that do not meet the townhome requirements for Chapter 1322 will be covered under the new Commercial Energy Code, Minnesota Rules 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, Minnesota Rules Chapter 1323.

Minnesota Rules Chapter 7678 covers requirements for insulation manufacturers to register uniform testing of energy efficiency and equipment manufacturers to register equipment efficiencies with MnDOC. 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. DOLI has developed a *Minnesota State Building Code Adoption Guide* for local jurisdictions.[1] Code revisions should be implemented by DOLI using the rulemaking 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.

- U.S. DOE, Energy Information Administration (EIA), Office of Energy Statistics, "Electric Sales, Revenue, and Average Price 2006," 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
- U.S. Census Bureau, "Annual Estimates of Housing Units for the United States and States: April 1, 2000 to July 1, 2005," HU-EST2005-0l, July 2007. (Annual data released at end of every July.) Available at: http://www.census.gov/popest/housing/HU-EST2005.html
- U.S Census Bureau, "New Privately Owned Housing Units, Authorized Unadjusted Units for Regions, Divisions, and States," July 2007. (Annual data released at end of every July.) Available at: http://www.census.gov/const/C40/Table2/t2yu200512.txt
- U.S. DOE, EIA, "Residential Energy Consumption Survey 2001: Consumption and Expenditure Data Tables," November 18, 2004. Available at: http://www.eia.doe.gov/emeu/recs/recs2001/detailcetbls.html
- Ratios of new residential/commercial floor space to total floor space, from EIA, "Table B1. Summary Table: Totals and Means of Floorspace, Number of Workers, and Hours of Operation, 1999." Available at: http://www.eia.doe.gov/emeu/cbecs/excel/b1.xls
- U.S. Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data, and Information Service. Historical Climatology Series 5-2: Monthly State, Regional and National Cooling Degree-Days Weighted by Population (Includes Aerially Weighted Temperature and Precipitation). Asheville, NC: National Climatic Data Center. Available at: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/cdd.200501-200607.pdf

[1] State of Minnesota, Department of Labor and Industry, Construction Codes and Licensing Division. Minnesota State Building Code Adoption Guide. St. Paul, MN, January 2006. See: http://www.doli.state.mn.us/pdf/bc_pr_code_adoption_guide_1_06update.pdf

- U.S. DOC, NOAA, National Environmental Satellite, Data, and Information Service. Historical Climatology Series 5-1: Monthly State, Regional and National Heating Degree-Days Weighted by Population (Includes Aerially Weighted Temperature and Precipitation). Asheville, NC: National Climatic Data Center. Available at: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/hdd.200507-200607.pdf
- Minnesota population projection, from Martha McMurry, *Minnesota Population Projections 2005–2035*, St. Paul, MN: Minnesota State Demographic Center, June 6, 2007. Available at: http://www.demography.state.mn.us/documents/MinnesotaPopulationProjections20052035.pdf
- Utility electricity sales in 2005, from U.S. DOE, EIA, Office of Energy Statistics, "Form EIA-826 Database Monthly Electric Utility Sales and Revenue Data (2005)." Available at: http://www.eia.doe.gov/cneaf/electricity/page/eia826.html
- Sectoral electricity consumption, from U.S. DOE, EIA, Office of Energy Statistics, "1990–2006 Revenue from Retail Sales of Electricity by State by Sector by Provider," EIA-861. Available at: http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html (file sales_revenue.xls).
- 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*, Denver, CO: Western Governors' Association, January 2006. Available at: 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

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

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

Policy Description

Minnesota 2030 is intended to encourage a transformation of the building industry in Minnesota. It 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 the Leadership in Energy and Environmental Design Green Building Rating System™ (LEED) and Green Globes. Any green building approach can be used, as long as it meets the performance standards of Minnesota 2030.

Minnesota 2030 would develop standards and incentives to meet the unique needs of Minnesota. It would be an incentivized voluntary program for the private sector, but would be mandated for selected public-sector buildings. State and local government agencies, including school districts, would be required to adopt guidelines and standards for the reduction of carbon emissions for all buildings consistent with *Architecture 2030* targets.[2] New building standards would be required to make the following reductions in carbon emissions:

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

All guidelines and standards for major renovations of existing buildings would require reductions in carbon emissions consistent with the *Architecture 2030* target of 50% reduction. A variance process would be provided when meeting criteria is inappropriate or financially infeasible.

Initially, Minnesota 2030 goals would be only be modestly more aggressive than current codes, but would be strengthened over time as long as they continue 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 Governments and Schools.

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

Policy Design

Goals: As noted above.

[2] 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.

Timing: The program will be voluntary when the law passes in June 2008. The goal is to have program in place on January 1, 2010, at which time the mandatory requirements, incentives, and disincentives will apply.

Parties Involved: The 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, 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 designers (architects and engineers) to sign off on plans certifying that the "best available energy technology" was used in completion of design, or explain why it was not. Require building owners to certify 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.
- Establish education and training programs for all key decision makers, building professionals, and other participants in implementing this policy, including design professionals, such as architects, engineers, interior designers, planners, and landscape architects; building owners; developers, contractors/builders, and building operators/facility managers; and the financing, real estate, and insurance communities.
- Clearly communicate the fact that reducing energy use does not always proportionally reduce emissions, and consider developing disincentives to technologies that do not reduce emissions.

- Mandate that state boards of licensing exams for building professionals cover knowledge of the improved building codes and building energy performance requirements reflected in various policy options.

Related Policies/Programs in Place

Guidelines that are either required or voluntary in Minnesota include Minnesota Sustainable Building Guidelines (B3), LEED, Green Globes, National Association of Home Builders Guidelines, GreenStar, Green Communities (Minnesota Housing Process), and ENERGY STAR.

Existing federal and state tax credits. An inventory of other current incentives in the state needs to be conducted.

The current legislative goals of 100 LEED or Green Globes and 1,000 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:

- Minnesota inventory provided by P. Ciborowski (Minnesota Pollution Control Agency) to R. Strait (CCS).
- U.S. DOE, Energy Information Administration (EIA), Office of Energy Statistics, "Electric Sales, Revenue, and Average Price 2006," 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
- U.S. Census Bureau, "Annual Estimates of Housing Units for the United States and States: April 1, 2000 to July 1, 2005," HU-EST2005-0l, July 2007. (Annual data released at end of every July.) Available at: http://www.census.gov/popest/housing/HU-EST2005.html
- U.S Census Bureau, "New Privately Owned Housing Units, Authorized Unadjusted Units for Regions, Divisions, and States," July 2007. (Annual data released at end of every July.) Available at: http://www.census.gov/const/C40/Table2/t2yu200512.txt
- U.S. DOE, EIA, "Residential Energy Consumption Survey 2001: Consumption and Expenditure Data Tables," November 18, 2004. Available at: http://www.eia.doe.gov/emeu/recs/recs2001/detailcetbls.html
- Ratios of new residential/commercial floor space to total floor space, from EIA, "Table B1. Summary Table: Totals and Means of Floorspace, Number of Workers, and Hours of Operation, 1999." Available at: http://www.eia.doe.gov/emeu/cbecs/excel/b1.xls

- U.S. Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data, and Information Service. Historical Climatology Series 5-2: Monthly State, Regional and National Cooling Degree-Days Weighted by Population (Includes Aerially Weighted Temperature and Precipitation). Asheville, NC: National Climatic Data Center. Available at: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/cdd.200501-200607.pdf
- U.S. DOC, NOAA, National Environmental Satellite, Data, and Information Service. Historical Climatology Series 5-1: Monthly State, Regional and National Heating Degree-Days Weighted by Population (Includes Aerially Weighted Temperature and Precipitation). Asheville, NC: National Climatic Data Center. Available at: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/hdd.200507-200607.pdf
- Minnesota population projection, from Martha McMurry, *Minnesota Population Projections 2005–2035*, St. Paul, MN: Minnesota State Demographic Center, June 6, 2007. Available at: http://www.demography.state.mn.us/documents/MinnesotaPopulationProjections20052035.pdf
- Utility electricity sales in 2005, from U.S. DOE, EIA, Office of Energy Statistics, "Form EIA-826 Database Monthly Electric Utility Sales and Revenue Data (2005)." Available at: http://www.eia.doe.gov/cneaf/electricity/page/eia826.html
- Sectoral electricity consumption, from U.S. DOE, EIA, Office of Energy Statistics, "1990–2006 Revenue from Retail Sales of Electricity by State by Sector by Provider," EIA-861. Available at: http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html (file sales_revenue.xls).
- 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*, Denver, CO: Western Governors' Association, January 2006. Available at: 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

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

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 from where the electricity is used. This policy includes

- Promotion of the use of natural gas-fired CHP systems.
- Promotion of the use of biomass-fired CHP systems.
- Creation or 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.

Potential supporting measures for this policy include training and certification of installers and contractors, net metering and other pricing arrangements, establishment of clear and consistent interconnection standards, and creation and 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 CHP will require coordination and cooperation among a number of different parties, including regulators (Minnesota Utilities Commission, U.S. Environmental Protection Agency [EPA]); utilities; other state agencies; industry associations; equipment suppliers/vendors/installers, building professionals, engineers; and research and development (R&D) associations.

Other: Not applicable.

Implementation Mechanisms

The following are potential implementation mechanisms and supporting activities for this mitigation policy.

- Couple incentives to reduce first cost to a specific payback level with requirements for new buildings. For example tax credits, low- or no-interest loans, and similar financial incentives to could be provided to businesses, industries, and commercial firms that adopt CHP/distributed generation/renewables. This is especially important for small manufacturers, who could be provided access to micro-loans.
- Encourage CHP systems of 20 megawatts (MW) or smaller (or of equivalent mechanical power) by a rapid adoption and customer-friendly implementation of Federal Energy Regulatory Commission 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 nonprofit organizations sales of renewable energy credits and tax credits to the marketplace.
- Provide 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 emission targets for industrial operations can include:

- Fund CHP/distributed generation-related/renewable energy 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.
- Provide patent protection, R&D tax credits, production subsidies or tax credits to firms bringing new CHP/distributed generation-related/renewable energy technologies to market, tax credits or rebates for new technology buyers, government procurement, and demonstration projects.
- Treat 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 and recommendations.

Expanded use of CHP 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 CHP or distributed generation fueled with renewable or fossil fuels. This review could consider the impact of nitrogen oxides 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

Carbon dioxide equivalent (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:

- U.S. DOE, EIA, Office of Energy Statistics, "Electric Power Annual 2006—State Data Tables. 1990–2006 Net Generation by State by Type of Producer of Energy Source," EIA-906. Available at: http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html
- Minnesota Planning Minnesota Environmental Quality Board, *Inventory of Cogeneration Potential in Minnesota*, August, 2001. Available at: http://www.eqb.state.mn.us/pdf/2001/CogenInventory.pdf
- U.S. DOE, EIA, Office of Energy Statistics, *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. Note that the quantification of this policy recommendation was integrated with MCCAG Energy Sector analysis.

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 the price of natural gas; interconnection is an issue.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

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

Policy Description

High-global-warming-potential (HGWP) GHGs are classes of chemicals that have a number of commercial and industrial uses. They include the chemical species hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).[3] This policy recommends that the Minnesota Pollution Control Agency (MPCA) 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.

Some of the HGWP GHGs have a global warming effect of up to 23,000 times that of carbon dioxide (CO_2). For example, a pound of sulfur hexafluoride is equal to the global warming impact of 11 tons of CO_2. Often substitutes for these gases are available, and in many cases, the cost of reducing their use 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 of HGWP GHGs 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 and hydrochlorofluorocarbons 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

[3] HGWP GHGs are among the gases reported by EPA pursuant to the Intergovernmental Panel on Climate Change, http://www.ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_Ch02.pdf. See Metz, B., O. Davidson, P. Bosch, R. Dave, and L. Meyer, eds, *Climate Change 2007: Mitigation of Climate Change*, Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, New York, NY: Cambridge University Press, 2007, available at: http://www.ipcc.ch/ipccreports/ar4-wg3.htm

these substances can be a large source of emissions. EPA's Web site on this subject 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."[4] EPA's Web site also contains extensive information on the costs of control.

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 on Substances That Deplete the Ozone Layer.[5]

Policy Design

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

The MCCAG recommends that MPCA 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 recommendation, a reasonable cost is determined to be $15 per ton CO_2 equivalent.

- 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; and
  - Which Minnesota industries and 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 exempt from regulation, 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, MPCA should develop a mechanism to provide such credits for companies that have reduced such emissions voluntarily.
- MPCA's rulemaking process would:
  - Require the elimination of HGWP GHGs, 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_2e reduction can be accomplished at a reasonable cost.

[4] See http://www.epa.gov/highgwp/projections.html

[5] See http://www.epa.gov/ozone/snap/index.html. See also L. Kuijpers and R. Ybema, eds., *Proceedings of the Joint IPCC/TEAP Expert Meeting on Options for the Limitation of Emissions of HFCs and PFCs*, Energieonderzoek Centrum Nederland ECN-RX-99-029, Petten, Netherlands: Intergovernmental Panel on Climate Change and Technology and Economic Assessment Panel, July 15, 1999.

- Establish the reasonable cost per ton of CO_2e reduction, taking into account the availability of alternatives.

2. **Promotion and funding for process optimization.**

   If HGWP GHGs can be eliminated at a reasonable cost, MPCA 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.[6]

Implementation Mechanisms

MPCA rulemaking process.

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

Technical support through the Minnesota Technical Assistance Program (MnTAP) or similar entities.

Related Policies/Programs in Place

MnTAP.

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. Environmental Protection Agency, Office of Air and Radiation, *U.S. High GWP Gas Emissions 1990–2010: Inventories, Projections, and Opportunities for Reductions*, EPA 000-F-97-000, June 2001. Available at: http://www.epa.gov/highgwp/projections.html
- Population projections from Martha McMurry, *Minnesota Population Projections 2005–2035*, St. Paul, MN: Minnesota State Demographic Center, June 6, 2007. Available at: http://www.demography.state.mn.us/documents/MinnesotaPopulationProjections20052035.pdf

[6] EPA's Web site at http://www.epa.gov/ozone/snap/ has pertinent background information.

- U.S Census Bureau, "Interim Projections of the Total Population for the United States and States: April 1, 2000 to July 1, 2030." Available at: http://www.census.gov/population/projections/SummaryTabA1.xls
- California Environmental Protection Agency, Air Resources Board, *Proposed Early Action to Mitigate Climate Change in California*, April 20, 2007. 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

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

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

Policy Description

This policy implements 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 GHG emissions through energy efficiency and adoption of renewable energy technologies. These strategies include mechanisms to:

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

Implementation Mechanisms

The recommended implementation mechanisms fall into four categories: technical assistance for implementation of energy-efficient and renewable energy technologies, and direct reduction of GHGs from industry, tax incentives or benefits, and state economic assistance.

1. Technical Assistance—Voluntary, nonregulatory assistance for residential, commercial, and 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 energy efficiency opportunities related to compressed air, steam systems, process heat, process refrigeration, pumps, fans, motors, etc.;
    - Energy-efficient technology demonstrations and pilot programs;
    - Resource development, including Web resources and best practices documents;
    - Workshops and seminars, including DOE best practices training;
    - Partnering with relevant industry associations and utilities; and
    - Evaluation of renewable energy technology options.
- Assist industries with implementation of the low-hanging fruit of energy savings through the above services. Four technology areas 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 may 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 and 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: 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 1 million British thermal units (MMBtu) per short ton of clinker. Focus groups could be formed to promote energy conservation in high-energy-use industries.
- Promote, develop information and resources, and provide assistance for the following industrial energy-efficient technologies that are not frequently used and also help reduce GHG emissions:
    - Waste heat recovery (e.g., metal casting),
    - Pumping systems (potential 20% savings),
    - Combined heat and power (cogeneration), and
    - Boiler blowdown 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 GHGs, including CO_2, methane (CH_4), nitrous oxide (N_2O), HFCs, PFCs, and SF_6) 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 (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 conducted in collaboration with the local utility. To protect public interest, applicants would adhere to the same measurement and verification protocols required by MnDOC of 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 (i.e., pumps, motors, fans, boilers, compressed air systems) known to deliver energy efficiency. NEMA (National Electrical Manufacturers Association) Premium motors and adjustable speed drives 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 MnDOC 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 per square foot [ft^2]) exist for different sectors (schools, warehouses, churches, etc). For example, credit could be given for making it into the top 10% or 25%, or could be based on how far energy users moved toward conservation. An existing federal program grants a tax deduction of \$1.80 per ft^2 for buildings that reduce their energy consumption by 50% or more. If the reduction is at least 16.67%, then the tax deduction is \$0.60 per $ft.^2$ 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 offsets the use of fossil fuels, thus helping reduce GHG emissions.

4. State Economic Assistance

- Offer low- or no-interest loans or other economic assistance to companies and public entities that do audits, identify energy goals, are doing their first energy project, or are implementing energy-efficient technologies. The loans may require that an energy analysis be 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 or require state-of-the-art efficiency and environmental technologies (key to Minnesota's 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 that 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 customers, commercial establishments, and industrial facilities.

Technical assistance: Commercial establishments and industrial facilities.

State economic assistance: Residential customers, commercial establishments, and industrial facilities.

Direct reduction of GHGs from industry: Industrial facilities.

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 CH_4 and N_2O.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources: The following sources were used in the analysis

- Kenneth Gillingham, Richard Newell, and Karen Palmer, *Retrospective Examination of Demand-Side Energy Efficiency Policies*, RFF DP 04-19 REV, Washington, DC: Resources for the Future, 2004; revised September 2004. Available at: http://www.rff.org/Documents/RFF-DP-04-19REV.pdf
- Minnesota inventory provided by P. Ciborowski (MPCA) to R. Strait (CCS).
- U.S. DOE, Energy Information Administration (EIA), Office of Energy Statistics, "Electric Sales, Revenue, and Average Price 2006," 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
- 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

- U.S. Census Bureau, "Annual Estimates of Housing Units for the United States and States: April 1, 2000 to July 1, 2005," HU-EST2005-0l, July 2007. (Annual data released at end of every July.) Available at: http://www.census.gov/popest/housing/HU-EST2005.html
- U.S Census Bureau, "New Privately Owned Housing Units, Authorized Unadjusted Units for Regions, Divisions, and States," July 2007. (Annual data released at end of every July.) Available at: http://www.census.gov/const/C40/Table2/t2yu200512.txt
- U.S. DOE, EIA, "Residential Energy Consumption Survey 2001: Consumption and Expenditure Data Tables," November 18, 2004. Available at: http://www.eia.doe.gov/emeu/recs/recs2001/detailcetbls.html
- Ratios of new residential/commercial floor space to total floor space, from EIA, "Table B1. Summary Table: Totals and Means of Floorspace, Number of Workers, and Hours of Operation, 1999." Available at: http://www.eia.doe.gov/emeu/cbecs/excel/b1.xls
- U.S. Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), National Environmental Satellite, Data, and Information Service. Historical Climatology Series 5-2: Monthly State, Regional and National Cooling Degree-Days Weighted by Population (Includes Aerially Weighted Temperature and Precipitation). Asheville, NC: National Climatic Data Center. Available at: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/cdd.200501-200607.pdf
- U.S. DOC, NOAA, National Environmental Satellite, Data, and Information Service. Historical Climatology Series 5-1: Monthly State, Regional and National Heating Degree-Days Weighted by Population (Includes Aerially Weighted Temperature and Precipitation). Asheville, NC: National Climatic Data Center. Available at: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/hdd.200507-200607.pdf
- Minnesota population projection, from Martha McMurry, *Minnesota Population Projections 2005–2035*, St. Paul, MN: Minnesota State Demographic Center, June 6, 2007. Available at: http://www.demography.state.mn.us/documents/MinnesotaPopulationProjections20052035.pdf
- Utility electricity sales in 2005, from U.S. DOE, EIA, Office of Energy Statistics, "Form EIA-826 Database Monthly Electric Utility Sales and Revenue Data (2005)." Available at: http://www.eia.doe.gov/cneaf/electricity/page/eia826.html
- Sectoral electricity consumption, from U.S. DOE, EIA, Office of Energy Statistics, "1990–2006 Revenue from Retail Sales of Electricity by State by Sector by Provider," EIA-861. Available at: http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html (file sales_revenue.xls).
- 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*, Denver, CO: Western Governors' Association, January 2006. Available at: 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 the existing energy efficiency services of MnTAP (for manufacturers) and the Center for Energy and the Environment (for small businesses and commercial firms).

State economic assistance: MnDOC, 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

MnDOC Conservation Improvement Program (CIP).

The 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: Minnesota's energy policy aims to achieve annual energy savings equal to 1.5% 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 appliance 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 GHGs and a national database of voluntary reductions in GHG emissions. In doing so, Section 1605b directed DOE to establish a procedure for voluntary annual reporting of GHG emissions and emission reductions by companies from the year 1987 forward.

DOE runs a suite of programs dedicated to improving the energy efficiency of buildings, including 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.

DOE's Office of Industrial Technologies runs two programs primarily focused on industrial energy audits: Industrial Assessment Centers and Plant-wide Assessments.

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. It is dedicated to improving residential housing's energy efficiency, affordability, durability, environmental sustainability, and resistance to natural disasters.

ENERGY STAR is an umbrella term encompassing a broad range of programs, all designed to encourage energy-efficient investments.

DOE's 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 that are recipients of DOE program grants.

The Climate Challenge program is a voluntary partnership between electric utilities and DOE designed to facilitate voluntary GHG emission 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 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

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

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

Policy Description

This policy implements cost-effective programs to reduce propane and fuel-oil use; targets rebates to overcome market barriers; maximizes convenience to program participants; captures overall system efficiencies, not just equipment efficiencies; involves joint efforts to achieve market transformation; includes ongoing research, evaluation, and analysis; complements government, utility, and non-utility efficiency programs; and seeks to remove any disincentives or regulatory barriers to energy efficiency.

Policy Design

Goals:

- Establish minimum efficiency heating plant standards consistent with US DOE'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 a plan for inspection and tune-up of all existing in-use heating systems and establish an inspection cycle. This plan should include inspection of fuel storage and delivery systems. Inspections are to be conducted and certified by trained, certified personnel.
- Remove fuel rate disincentives and/or penalties for reduced energy consumption as a result of installing high-efficiency heating equipment.
- 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 carbon monoxide leaks, etc., and for component failure (e.g., filter plug, restricted heat exchanger).
- Provide public recognition to individuals or companies that are successful leaders in promoting efficiency standards.

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

Parties Involved: All interested parties.

Other: Not applicable.

Implementation Mechanisms

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

Related Policies/Programs in Place

Xcel's CIP.

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 inventory provided by P. Ciborowski (MPCA) to R. Strait (CCS).
- U.S. Census Bureau, "Annual Estimates of Housing Units for the United States and States: April 1, 2000 to July 1, 2005," HU-EST2005-0l, July 2007. (Annual data released at end of every July.) Available at: http://www.census.gov/popest/housing/HU-EST2005.html
- U.S Census Bureau, "New Privately Owned Housing Units, Authorized Unadjusted Units for Regions, Divisions, and States," July 2007. (Annual data released at 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, "Table B1. Summary Table: Totals and Means of Floorspace, Number of Workers, and Hours of Operation, 1999." Available at: http://www.eia.doe.gov/emeu/cbecs/excel/b1.xls
- Regional fuel prices for fuel oil and propane from U.S. DOE, EIA, Office of Energy Statistics, "Supplemental Tables to the Annual Energy Outlook 2007." Available at: http://www.eia.doe.gov/oiaf/aeo/supplement/
- U.S. DOE, EIA, Office of Energy Statistics, "Natural Gas Prices." 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

None.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

RCI-8. Energy Performance Disclosure

Policy Description

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, the MCCAG recommends the following:

- Require utilities to provide an energy performance disclosure to parties owning any public, commercial, or residential property, preferably in an electronic format, and require property owners to make this information available to prospective buyers or renters to allow for energy efficiency and environmental impacts to be an integral part of the decision to buy or rent.
- Require utilities to provide property owners an energy consumption history to share with prospective purchasers or renters of the property, and require owners 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. The energy consumption history should include additional information that would continue to encourage sound energy decisions, such as a rating factor based upon $kBtu/ft^2$/year (from the owner) and CO_2 emissions (from the utility company).
- 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, the standard might include information that indicates the incremental cost of energy per the quantity of billable units, a comparison with an average customer's energy use, the environmental impacts of such use, and fuel portfolios, if applicable. The purpose of this action is to quantify the consumer's energy use and to raise the level of interest.

Policy Design

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

Timing: The program is voluntary form after law passes in mid-2008 and will become mandatory on January 1, 2010.

Parties Involved: All public and private building owners and 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 (e.g., the Multiple Listing System). It is 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 fuel combustion.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources: Not applicable.

Quantification Methods: This is a nonquantified option.

Key Assumptions: Not applicable.

Key Uncertainties

Timing; scope of disclosure.

Additional Benefits and Costs

Public awareness and education.

Feasibility Issues

The issue of the difference in performance based on the occupant's energy use. An example would be to measure on an occupant versus square foot basis or to average out a number of units.

The feasibility of the implementation of this option is focused on the fact that each utility bill is to 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.

The feasibility of the implementation of this option is focused on the fact that new programs may be needed to engage and educate consumers regarding their incremental monthly billing charges and, as an outcome, to initiate sound knowledge-based energy decisions.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

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

Policy Description

Technology plays a critical role in the development of energy processes, including demand-side efficiency. Major progress in climate change policy requires improvements to technologies as well as increased rates of technology adoption and use. To achieve these ends, this policy option recommends the following actions:

- Use incentives to promote technology-specific applications that reduce GHG emissions.
- Identify the options through research, and organize them 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, and 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 to be renewable energy (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 technology, and 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 the program in place by 2010.

Timing: The program is voluntary form when law passes in June 2008, and the mandatory requirements and incentives apply once the program is in place on January 1, 2010.

Parties Involved: The program is mandatory 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

Inform all building owners about the program, determine/fund possible private incentives, and coordinate with other programs' education and training efforts.

Related Policies/Programs in Place

An inventory of all current incentives in Minnesota needs to be conducted (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

Promotes local innovation.

Feasibility Issues

Interaction with appliance standards and utility programs.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

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

Policy Description

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. This policy recommends that Minnesota adopt appliance efficiency standards not covered by federal standards or where higher-than-federal standard efficiency requirements are appropriate. 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.

Specifically, this policy recommends that the state:

- Address existing federal appliance efficiency standards by developing a State of Minnesota Residential Appliance Efficiency Standard. (Consider adoption of the appliance efficiency standards adopted by California.). Request that the Governor, through the National Governors Association, provide the leadership to seek the federal government's adoption of the Minnesota Residential Appliance Efficiency Standard.
- 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 Minnesota provide appliance efficiency information to their customers.
- Require high-efficiency ENERGY STAR appliances to 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 MnDOC commissioner will determine cost-effectiveness in the CIP process.)
- Advocate for the adoption of a State of Minnesota Residential Appliance Upgrade Program.
- 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 use and/or respond to energy pricing changes.

Policy Design

Goals: Increase the stringency of a set of appliance standards to the levels of those recommended by the report *Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards*.[7]

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 purchase 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
- Working with manufacturers and considering the impacts on manufacturers when setting new standards.

Related Policies/Programs in Place

The state is an ENERGY STAR Partner.

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:

- Martha McMurry, *Minnesota Population Projections 2005–2035*, St. Paul, MN: Minnesota State Demographic Center, June 6, 2007. Available at: http://www.demography.state.mn.us/documents/MinnesotaPopulationProjections20052035.pdf
- U.S Census Bureau. "Interim Projections of the Total Population for the United States and States: April 1, 2000 to July 1, 2030." Available at: http://www.census.gov/population/projections/SummaryTabA1.xls

[7] S. Nadel, A. deLaski, M. Eldridge, and J. Kleisch, *Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards*, Washington, DC: American Council for an Energy-Efficient Economy, March 2006, available at: http://www.aceee.org/pubs/a062.htm

- Steven Nadel, Andrew deLaski, Maggie Eldridge, and Jim Kleisch, *Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards*, Washington, DC: American Council for an Energy-Efficient Economy, March 2006. Available at: http://www.aceee.org/pubs/a062.htm
- 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*, Denver, CO: Western Governors' Association, January 2006. Available at: http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf
- Minnesota inventory provided by P. Ciborowski (MPCA) to R. Strait (CCS).
- U.S. DOE, EIA, Office of Energy Statistics, "Supplemental Tables to the Annual Energy Outlook 2007." Available at: http://www.eia.doe.gov/oiaf/aeo/supplement/
- Minnesota natural gas prices from U.S. DOE, EIA, Office of Energy Statistics, "Natural Gas Prices." 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

None.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

RCI Reductions from Recent Actions

RCI-Existing Action #1—Implementation of Existing Commercial Building Code

Building energy codes specify minimum energy efficiency requirements for new commercial buildings. 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 new Minnesota Commercial Energy code (http://www.doli.state.mn.us/buildingcodes.html) is based on the ASHRAE 91.1-2004 standard, with important state amendments. Though the percentage increase in energy efficiency is unknown at this time, it will be substantial if stakeholders understand its importance and install components correctly so that efficiencies are realized.

Because this energy code has been implemented recently, it is included in the evaluation of existing actions. However, the effects of the building code are not anticipated to take effect until 2009.

Policy Design

Goals:

Reduce energy use in new commercial buildings up to 50%, beginning in 2009.

Timing:

The policy currently exists. The Minnesota DOLI predicts that the new energy codes will go into effect in late 2007, or if there is a public hearing, by mid-2008.

Parties Involved: The following is a list of buildings or projects that are covered:

- Current Energy Code Rules under the State Building Code adopted on July 20, 1999, for commercial buildings.
- 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.
- 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. DOLI has developed a *Minnesota State Building Code Adoption Guide* for local jurisdictions available at: http://www.doli.state.mn.us/pdf/bc_pr_code_adoption_guide_1_06update.pdf

DOLI should implement code revisions using the rulemaking process, which allows for public input.

Related Policies/Programs in Place

Minnesota Rules Chapters 7670, 7672, 7674, 7676, and 7678 (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

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

- 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
- DOC-published cooling degree-days in Minnesota, available at: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/cdd.200501-200607.pdf
- DOC-published heating degree-days in Minnesota, available 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
- Minnesota population projection in comparison to other Midwestern states, available at: http://www.census.gov/popest/datasets.html
- EIA-published utility electricity sales in 2005, available at: http://www.eia.doe.gov/cneaf/electricity/page/eia826.html
- EIA-published sectoral electricity consumption data, available at: http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html (file sales_revenue.xls).
- 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, available at: http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf
- Estimate of building lifetime, Energy Information Administration/NEMS Model Documentation 2007: Commercial Sector Demand Module, Appendix A, available at: http://tonto.eia.doe.gov/FTPROOT/modeldoc/m066(2007).pdf
- Growth in commercial area floor space, from EIA, Supplemental Tables to the Annual Energy Outlook 2007. Table 22, Commercial Sector Energy Consumption, Floorspace, and Equipment Efficiency, available at: http://www.eia.doe.gov/oiaf/aeo/supplement/sup_rci.xls

Quantification Methods: See Appendix E.

Key Assumptions: The electricity and gas use reductions that result from more stringent building codes, relative to the Reference Case, are assumed to be 50% for the period 2009 to 2025. The square footage affected by this policy option is assumed to be 4% of available square footage in every year. The square footage affected is attributable to an annual 2% demolition/rebuild rate of existing square footage and 2% growth rate in total square footage within the state. The discount rate used is 5%.

Key Uncertainties

Extent of improvement estimated at between 30% and 50%; may be initially less than 50% and eventually more than 50%, depending on technologies available, cost, and effectiveness of operation and enforcement.

Replacement frequency of existing commercial buildings.

Growth of new commercial buildings.

Additional Benefits and Costs

Uniform standards, reduced air pollution, reduced electricity use, more comfortable buildings.

Feasibility Issues

This is an existing action, so it is feasible.

Status of Group Approval

Approved.

Level of Group Support

Not assessed, because it is an existing action.

Barriers to Consensus

None.

RCI-Existing Action #2—10% Reduction of Energy Use in State Buildings

Policy Description

The Departments of Administration and Commerce implemented the Saving Energy program in response to Governor Tim Pawlenty's Executive Order 05-16. The goal of the program is to reduce energy use by 10% in 2006 and pursue long-term energy conservation measures.

The results of the program for the first year are documented in the April 2, 2007, State Agency Energy Conservation Progress Report on the Governor's Executive Order 05-16 (available at: http://www.savingenergy.state.mn.us/files/2006_Report.pdf). This report, prepared by the Department of Administration, Plant Management Division, Energy Management Services, in cooperation with the Minnesota Department of Commerce, documents the energy reduction achieved throughout state facilities. Although some departments achieved a 14% savings, the overall savings achieved in the first year was 4.8%. The report stated that the state saved $1.25 million in energy costs.

Policy Design

Goals: 10% reduction in energy use in state buildings.

Timing: The program began in 2006 and is ongoing.

Parties Involved: This program is for all state buildings.

Implementation Mechanisms

The project was implemented through communications and operations activities. Communications consisted of setting up a Web site; holding seminars, presentations, and energy fairs; publishing an employee newsletter; and having other events for staff. Operations activities consisted of developing a Web-based energy consumption reporting system, implementing a pricing program to manage risk in state fuel procurement, identifying high-energy-use buildings, optimizing utility company rebates, and using third-party leases/purchases funding to replace old, inefficient equipment.

Related Policies/Programs in Place

Guidelines that are either required or voluntary in Minnesota include Minnesota Sustainable Building Guidelines (B3), LEED, Green Globes, National Association of Home Builders (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 1,000 ENERGY STAR buildings in Minnesota.

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 available at: http://www.mnclimatechange.us/ewebeditpro/items/O3F16231.pdf
- 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
- 2001 EIA Residential Energy Consumption Survey, available at: http://www.eia.doe.gov/emeu/recs/recs2001/detailcetbls.html#space
- DOC-published cooling degree-days in Minnesota, available at: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/cdd.200501-200607.pdf
- DOC-published heating degree-days in Minnesota, available 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
- EIA-published utility electricity sales in 2005, available at: http://www.eia.doe.gov/cneaf/electricity/page/eia826.html
- Sectoral electricity consumption data, from EIA, available 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, available at: http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf
- Estimate of building lifetime, Energy Information Administration/NEMS Model Documentation 2007: Commercial Sector Demand Module, Appendix A, available at: http://tonto.eia.doe.gov/FTPROOT/modeldoc/m066(2007).pdf
- Growth in commercial area floor space, from EIA, Supplemental Tables to the Annual Energy Outlook 2007. Table 22, Commercial Sector Energy Consumption, Floorspace, and Equipment Efficiency, available at: http://www.eia.doe.gov/oiaf/aeo/supplement/sup_rci.xls

Quantification Methods: See Appendix E.

Key Assumptions: The electricity and gas use reductions that result from this policy option increase from 4% in 2006, to 8% in 2007, and 10% in 2008 through 2025. It is assumed that 10% of all commercial floorspace in Minnesota is government-owned and that commercial floorspace increases at the same rate as the national average growth rate (~2%). The discount rate used is 5%.

Key Uncertainties

Number and square footage of state buildings.

Additional Benefits and Costs

Reduced local air pollution.

Feasibility Issues

The executive order mandating thermostat setpoints could not be achieved in all facilities, due to concerns with humidity control.

Reporting compliance was not complete across all state agencies.

Status of Group Approval

Approved.

Level of Group Support

Existing policy; not applicable.

Barriers to Consensus

None.

RCI-Existing Action #3—Sustainability Program for State Buildings

Policy Description

The Minnesota Legislature established a goal of achieving 30% savings in existing public buildings in 2001. The Departments of Administration and Commerce refer to this initiative as "Buildings, Benchmarks and Beyond" or the B3 project. The Legislature required conservation benchmarking for all public buildings to identify and prioritize a decent list of poorly performing buildings. This applies to more than 10,000 buildings. The Legislature also required the creation of guidelines to make sure that the designs of new buildings are cost-effective and energy efficient.

The Departments of Administration and Commerce and their team of academics and consultants developed the State of Minnesota Sustainable Building Guidelines, version 2.0, issued in September of 2006 (http://www.msbg.umn.edu/). The guidelines set up a process that will eventually lead to a full accounting of the actual human, community, environmental, and life cycle economic costs and benefits of sustainable building design.

Sustainable design is a means to reduce energy expenditures; enhance the health, well-being, and productivity of the building occupants; and improve the quality of the natural environment. All of these can contribute to high-performance State buildings with lower life cycle costs. To move toward ensuring these outcomes, the guidelines attempt to quantify the human, community, environmental, and life cycle economic costs and benefits for each project.

Policy Design

Goals:

- Exceed existing energy code by at least 30% in state buildings.
- Encourage continual energy conservation improvements in new buildings.
- Ensure good indoor air quality.
- Create and maintain a healthy environment.
- Facilitate productivity improvements.
- Specify ways to reduce material costs.
- Consider the long-term operating costs of the building, including the use of renewable energy sources and distributed electric energy generation that uses a renewable source of natural gas or a fuel that is as clean or cleaner than natural gas.

Timing: The program began in 2003 and is ongoing.

Parties Involved: This program is for all state buildings.

Implementation Mechanisms

All new buildings funded in whole or part by Minnesota bond monies after January 15, 2004, must comply with the guidelines.

Related Policies/Programs in Place

Governor Tim Pawlenty's Executive Order 05-16 to reduce energy use in state buildings by 10%.

Guidelines that are either required or voluntary in Minnesota include 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 1,000 ENERGY STAR buildings in Minnesota.

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 available at: http://www.mnclimatechange.us/ewebeditpro/items/O3F16231.pdf
- 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
- 2001 EIA Residential Energy Consumption Survey, available at: http://www.eia.doe.gov/emeu/recs/recs2001/detailcetbls.html#space
- DOC-published cooling degree-days in Minnesota, available at: http://lwf.ncdc.noaa.gov/oa/documentlibrary/hcs/cdd.200501-200607.pdf
- DOC-published heating degree-days in Minnesota, available 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
- EIA-published utility electricity sales in 2005, available at: http://www.eia.doe.gov/cneaf/electricity/page/eia826.html
- Sectoral electricity consumption data, from EIA, available 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, available at: http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf

- Estimate of building lifetime, Energy Information Administration/NEMS Model Documentation 2007: Commercial Sector Demand Module, Appendix A, available at http://tonto.eia.doe.gov/FTPROOT/modeldoc/m066(2007).pdf
- Growth in commercial area floor space, from EIA, Supplemental Tables to the Annual Energy Outlook 2007. Table 22, Commercial Sector Energy Consumption, Floorspace, and Equipment Efficiency, available at http://www.eia.doe.gov/oiaf/aeo/supplement/sup_rci.xls

Quantification Methods: See Appendix E.

Key Assumptions: The electricity and gas use reductions that result from this policy option increase from 4% in 2006, to 8% in 2007, and 3% annually thereafter, to a maximum reduction of 30% in 2018. It is assumed that 10% of all commercial floorspace in Minnesota is government-owned and that commercial floorspace increases at the same rate as the national average growth rate (~2%). The discount rate used is 5%.

Key Uncertainties

Number and square footage of state buildings.

Rate of achievement of energy efficiency goals.

Additional Benefits and Costs

Reduced local air pollution, good indoor air quality, reduction in material costs, improved productivity.

Feasibility Issues

This is an ongoing project. The guidelines have been published initially and in a revised version to minimize feasibility issues.

Status of Group Approval

Approved.

Level of Group Support

Existing policy; not applicable.

Barriers to Consensus

None.

Annex 1. Methodology for the Quantification of RCI Mitigation Options

This annex outlines key elements of the methodology used for quantifying the GHG impacts and costs for the RCI policy recommendations considered to be amenable to quantification. The list of topics addressed in this memo is summarized below.

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

A. Premises

The analysis was based on the following key premises:

- *CCS role*—Unless a member of the RCI TWG offered to undertake an analysis of any of the options, it was assumed that CCS would undertake the analysis of the RCI options. Where an RCI TWG member offered to undertake the analysis of one or more options, CCS provided analytical support (e.g., review and technical feedback) as needed.
- *Transparency*—Data sources, methods, key assumptions, and key uncertainties are clearly indicated.
- *Analytical approach*—CCS adopted the general approach of cost-effectiveness (and NPV) analysis, as widely applied to GHG mitigation policy options,[8] and included 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*— CCS adopted 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, were noted qualitatively where studies or other information were available.

B. Outputs

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

- *Net GHG reduction potential* in million metric tons of carbon dioxide equivalent ($MMtCO_2e$), using the Intergovernmental Panel on Climate Change's 100-year global warming potential, reported annually for 2015, 2020, and 2025, as cumulatively for the

[8] For more discussion of various economic analysis approaches, see, for example, Section 2.4 of B. Metz, O. Davidson, P. Bosch, R. Dave, and L. Meyer, eds., *Climate Change 2007: Mitigation of Climate Change*, Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, New York, NY: Cambridge University Press, 2007, available at: http://www.mnp.nl/ipcc/pages_media/AR4-chapters.html

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 were indicated as appropriate.

- *Net present value cost* (or cost savings) for 2008–2025 in 2006 constant dollars, using a 5% real discount rate.[9] 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 ($/tCO$_2$e). 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 used simple spreadsheet modeling techniques in which assumptions were transparent and readily accessible to any TWG member for review and adjustment. To ensure consistent results across options, common factors and assumptions were used for such items as:

- *Electricity avoided costs and emissions*—Common values ($/MWh and tCO$_2$/MWh) were developed based on available studies. Once a complete set of options was identified, each option was first be analyzed individually, and then addressed as part of an overall integrated analysis.
- *Fuel costs and projected escalation*—Fuel cost estimates were based on common sources wherever possible. For example, fossil fuel price escalation was indexed to DOE projections, as indicated in its most recent *Annual Energy Outlook*.[10]
- *Overlap with other TWGs*—Some RCI recommendations may overlap with Energy Supply (ES) TWG recommendations. The analysis for these recommendations was closely coordinated with the assumptions and other inputs used in the ES TWG recommendations.
- *Full-fuel-cycle approach*—Related to the previous point, a fuel cycle analysis was applied wherever emission impacts upstream (e.g., production, extraction) or downstream (e.g., waste disposal) from a specific activity constituted a significant fraction of a policy recommendation's emission impacts *and* studies were sufficient to enable estimation.

D. Assumptions

As much as possible, the analysis relied on data sources that are Minnesota-specific, and that TWG members were in a good position to obtain and provide. The success of this approach depended on how accessible the information was to TWG members and the timeliness with which it could be provided to the CCS analytical team. Where Minnesota-specific information could not be readily obtained, the analysis relied on published data from the DOE, DOE national laboratories, and other state climate change processes.

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[9] To avoid "end effects," capital investments with lifetimes longer than 2025 were represented in terms of levelized or amortized costs.

[10] U.S. DOE, EIA, *Annual Energy Outlook 2007: With Projections to 2030*, IDOE/EIA-0383(2007), February 2006. Available at: http://tonto.eia.doe.gov/ftproot/forecasting/0383(2007).pdf

E. Cost Inclusion

Several types of costs were explicitly considered in and excluded from the analysis, as summarized below.

- Costs included:
  - Capital costs levelized (amortized) where appropriate (e.g., for new energy-efficient equipment);
  - Operations and maintenance 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; and
  - Macroeconomic impacts related to the impacts 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
1	Use 80%
2	User-defined

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

Annual percentage of the existing building stock subject to renovation

	1
1	Use 5%
2	User-defined

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

Percentage of annual rennovated building stock subject to the new guidelines

	1
1	Use 50%
2	User-defined

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

Real discount rate

	1
1	Use 5%
2	User-defined

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

Payback period for efficient equipment (years)

	1
1	Use 14
2	User-defined

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

Lifespan for efficient equipment (years)

	1
1	Use 30
2	User-defined

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%