

Chapter 4 Energy Supply

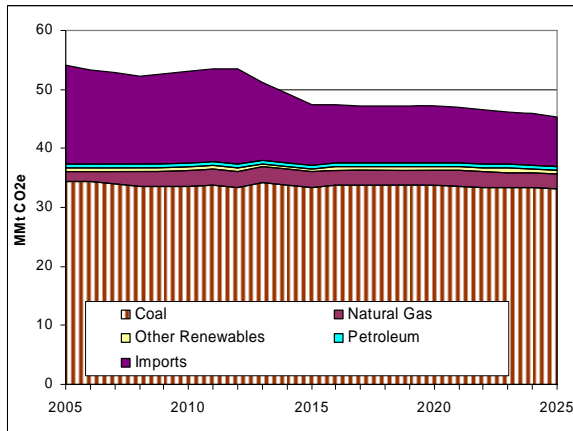
Overview of GHG Emissions

Greenhouse gas (GHG) emissions from Minnesota’s energy supply sector include emissions from electricity generation and represent a substantial portion of the state’s overall GHG emissions (approximately 35% of gross emissions in 2005). A significant portion of Minnesota’s gross GHG emissions is associated with electricity imports: roughly 31% of the state’s electricity-related fossil fuel emissions were associated with imports in 2005. This percentage is expected to be relatively stable through 2025 based on the reference case forecast.

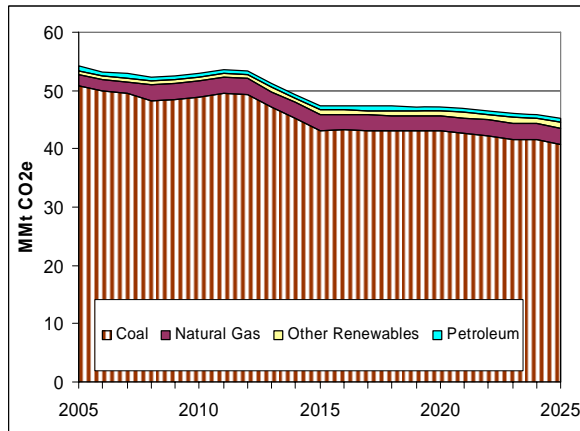
Overall, emissions from Minnesota’s energy supply sector are expected to decrease from 2005 base year levels of 54 million metric tons (MMt) of carbon dioxide equivalent (CO₂e) to about 45 MMtCO₂e by 2025, or by approximately 16% on a consumption basis. It is important to note that these GHG reduction trends are evident prior to the implementation of any of the energy supply mitigation measures discussed in this chapter, thanks in large part to recent actions taken by the state, such as the Renewable Energy Standard (RES) and the Conservation Improvement Program (CIP), both enacted in 2007. These trends are summarized in Figure 4-1a and 4-1b.

Figure 4-1. Recent and projected GHG emissions from the Electricity Sector, Minnesota, 2005–2025 (consumption basis)

4-1a. In-state and imports



4-1b. In-state and imports broken out



MMtCO₂e = million metric tons carbon dioxide equivalent

Key Challenges and Opportunities

The key challenge in addressing GHG emissions from Minnesota’s energy supply sector is the state’s continued reliance on coal-fired generation from both inside and outside Minnesota. Despite significant additions of renewable energy in Minnesota resulting from an aggressive RES, the share of GHG emissions from coal-fired generation will drop only slightly—from 94% in 2005 to about 90% in 2025.

Unlike many other states, large growth in electricity sales is not the primary driver for Minnesota's GHG emissions. The projected average annual growth rate of electricity sales in Minnesota between 2005 and 2025 is modest—about 0.82%. This reflects the impact of the newly enacted CIP, one of the most aggressive conservation improvement programs in the nation.¹

Minnesota has several opportunities for reducing the growth in GHG emissions attributable to energy production and supply. For example, the carbon intensity of existing coal-fired electricity generation could be decreased through biomass co-firing and carbon capture and storage technologies for new and existing (through retrofits) coal-fired stations in the state. Significant opportunities to reduce GHG emissions through options to further reduce electricity consumption also exist, and can often provide net cost savings to Minnesota consumers and the state. The Minnesota Climate Change Advisory Group (MCCAG) has identified several demand-side management, energy efficiency, and conservation measures in the residential, commercial, and industrial sector; these are detailed in Chapter 3 of this report.

Overview of Policy Recommendations and Estimated Impacts

The MCCAG analyzed and is recommending six policy options and three existing actions for the energy supply (ES) sector that offer the potential for significant GHG emission reductions, as summarized in Table 4-1. All policy recommendation totals are relative to the underlying assumption that electricity expansion in Minnesota proceeds with the recently legislated CIP, RES, and all planned additions, including the Mesaba and Big Stone 2 stations. As noted in the Executive Summary and Chapter 2, in making this assumption, the MCCAG is not recommending for or against the need for or merits of the addition of these units in Minnesota. The forecast also assumes a backing down of existing units if the Big Stone 2 and Mesaba units come on line in order to balance the supply of electricity with demand in Minnesota. It is possible that instead of backing down, the existing units that formerly supplied power in Minnesota could be used to supply power in other states which, in turn, could lead to backing down less efficient units in other states. If built, these two units would have the potential to emit approximately 5.1 million tons of CO₂e per year. (MCCAG has recommended that future analyses reexamine these assumptions.)

¹ An accurate estimate of the electricity sales growth rate was a subject of much discussion, with some members of the Minnesota Climate Change Advisory Group (MCCAG) advocating a higher rate (i.e., 1.0%–1.5% per year), and others advocating a lower rate (i.e., about 0.5% per year). The final value used in the analysis of options represents a central estimate, though it may be still objectionable to some MCCAG members.

Table 4-1. Summary results for energy supply policy recommendations and existing actions

Policy No.	Policy Recommendations	GHG Reductions (MMtCO ₂ e)			Net Present Value 2008–2025 (Million \$)	Cost-Effectiveness (\$/tCO ₂ e)	Level of Support
		2015	2025	Total (2008–2025)			
ES-1	Generation Performance Standard	0.0	0.0	0.0	\$0.0	\$0.0	Majority (16 objections)
ES-3	Efficiency Improvements, Re-Powering and Other Upgrades to Existing Plants	1.8	3.0	33.3	\$554.4	\$16.7	Unanimous
ES-4	Transmission System Upgrading, Including Reducing Transmission Line and Distribution System Loss	0.2	0.4	3.9	–\$92.2	–\$26.1	Unanimous
ES-5	Renewable and/or Environmental Portfolio Standard*	<i>Quantified as a “Recent Action”</i>					Enacted
ES-6	Nuclear Power Support and Incentives	<i>Recommended for further study.</i>					Unanimous
ES-8	Advanced Fossil Fuel Technology Incentives, Support, or Requirements, Including Carbon Capture and Storage	<i>Recommended for further study.</i>					Unanimous
ES-10	Voluntary GHG targets	<i>Not quantified</i>					Unanimous
ES-12	Distributed Renewable Energy Incentives and/or Barrier Removal	0.021	0.023	0.37	\$29.1	\$78.1	Unanimous
ES-13	Technology-Based Approaches, Including Research and Development, Fuel Cells, Energy Storage, Distributed Renewable Energy Technologies, etc.	<i>Not quantified</i>					Unanimous
	Sector Total After Adjusting for Overlaps	2.0	3.4	37.5	\$462.2	\$12.3	
	Reductions From Recent Actions	12.8	20.8	225	\$10,116	\$45.0	
	<i>Biomass for Electricity</i>	0.60	0.60	11.4	\$285.3	\$25.0	
	<i>Metro Emissions Reduction Project</i>	4.52	4.52	80.4	\$2,330	\$29.0	
	<i>ES-5: Renewable Energy Standard*</i>	7.72	15.7	133.1	\$7,502	\$56.4	
	Sector Total Plus Recent Actions	14.8	24.2	262.5	\$10,578.8	\$40.3	

GHG = greenhouse gas; MMtCO₂e = million metric tons of carbon dioxide equivalent; \$/tCO₂e = dollars per metric ton of carbon dioxide equivalent. (ES Policy Options 2, 7, 9 and 11 were either dropped or merged during the process.)

Negative values in the Net Present Value 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.

All totals are relative to the underlying assumption that electricity expansion in Minnesota proceeds with the recently legislated Conservation Improvement Program (CIP), Renewable Energy Standard (RES), and all planned additions, including the Mesaba and Big Stone 2 stations.

* The RES considered here is based on the RES requirements included in the Next Generation Energy Act of 2007; therefore, the emission reductions and costs estimated are included under “recent actions.”

Note: A number of MCCAG members have raised concerns about the cost assumptions associated with wind power and believe the costs are too high. A lower wind cost assumption would lower the cost estimates for the Renewable Energy Standard (ES-5) and for the Cap-and-Trade analyses. Future analyses should reexamine the wind cost estimates.

These options include efforts to limit new coal-fired generation in Minnesota (ES-1), encourage efficiency improvements at existing coal-fired generating stations (ES-3), upgrade electricity and natural gas transmission facilities (ES-4), explore the role of nuclear energy (ES-6), implement carbon capture and storage technology on new coal-fired generation (ES-8), promote voluntary GHG reductions (ES-10), encourage distributed renewable generation through incentives and barrier removal (ES-12), and encourage the development and eventual deployment of advanced technologies (ES-13). Not all of these policy recommendations contribute to GHG emission reductions during 2007–2025—the period for which recent Minnesota actions and the MCCAG recommendations were estimated—as outlined below.

- **Generation Performance Standard (ES-1):** A strict application of this option would have eliminated any new power stations being built in Minnesota, unless they could meet a stringent GHG emission-intensity threshold. If applied to Minnesota’s new coal-fired stations (i.e., Big Stone 2 and Mesaba), the option would have yielded substantial GHG emissions. However, after a close vote, the MCCAG decided to exempt these new power stations, because they are currently undergoing regulatory review. At its final meeting MCCAG voted to recommend further study of this option. Therefore, the quantifications developed by the technical work group throughout the process are not included in the table above.
- **Nuclear Power Support and Incentives (ES-6):** The possibility of a new nuclear power station in Minnesota, though clearly advantageous from the perspective of comparing its GHG emissions to those from coal-fired generation, was an option that the MCCAG believed required more study. Hence, the MCCAG is recommending that the state commission a study on the costs and risks of installing a nuclear power station in Minnesota in the post-2025 period. Therefore, neither the GHG emission reductions achieved by this option over the period ending in 2025 nor the estimated costs for this option are not included here.
- **Advanced Fossil Fuel Technology (ES-8):** The possibility of a new coal-fired power station in Minnesota using carbon capture and storage technology was an option that the MCCAG believed required more study. Hence, the MCCAG is recommending that the state commission and facilitate a study on the viability of implementing this (as yet commercially unavailable) technology, including the use of biomass with carbon capture and storage. Since the MCCAG assumed this technology would not be implemented before 2025, no GHG emission reductions are achieved by this option over the planning period.

Overall, the ES mitigation option recommendations yield an annual GHG emission reductions from reference case projections of about 0.8 MMtCO₂e in 2025 and cumulative reductions of 8.4 MMtCO₂e from 2007 through 2025, at a net savings of approximately \$44 million through 2025 on a net present value (NPV) basis. The weighted-average cost of saved carbon for the ES measures is $-\$5.2/\text{tCO}_2\text{e}$ avoided.

The MCCAG has also analyzed a set of three existing state actions for the ES sector that will contribute to achieving long-term GHG emission reductions in Minnesota. These actions include a program for increasing biomass use for electricity generation, Xcel’s metro reduction project, and the recently enacted RES that calls for 25% of electricity sales in 2025 being met by renewable sources of energy. Starting with the RES, each of these existing actions contributes to substantial GHG emission reductions over the period through 2025, totaling just over 200 MMtCO₂e. In fact, the existing action that achieves the smallest level of cumulative GHG

reductions (i.e., 11.4 MMtCO₂e for biomass for electricity) exceeds the cumulative GHG reductions from all mitigation options (i.e., 8.4 MMtCO₂e).

Overall, the ES existing actions yield an annual GHG emission reduction from reference case projections of about 19.4 MMtCO₂e in 2025 and cumulative reductions of nearly 202 MMtCO₂e through 2025, at a net cost of approximately \$9.5 billion through 2025 on an NPV basis. The weighted-average cost of saved carbon for the ES measures is \$46.8/tCO₂e avoided.

Energy Supply Sector Policy Descriptions

The ES sector has several opportunities for mitigating GHG emissions from electricity generation, including mitigation activities associated with the generation, transmission, and distribution of electricity—whether generated through the combustion of fossil fuels, renewable energy sources in a centralized power station supplying the grid, distributed generation facilities, or imported into the state.

ES-1 Generation Performance Standard

The generation performance standard (GPS) is a mandate that requires entities that deliver electricity to acquire electricity or power plant developers to build and operate new base-load generation, with a per-unit emission rate below 1,100 pounds of CO₂ per megawatt-hour (MWh). For base-load projects that are part of a combined-heat-and-power project, the GPS would be raised to 1,300 pounds of CO₂/MWh. By MCCAG vote, the two proposed new coal stations for meeting Minnesota base-load demand—Big Stone 2 and Mesaba—were exempted from the GPS. At its final meeting, MCCAG decided that this policy required further study.

ES-3 Efficiency Improvements, Re-Powering and Other Upgrades to Existing Plants

This policy would promote the identification and pursuit of cost-effective emission reductions from existing generating units by improving their operating efficiency, adding biomass or other fuel changes, or adding carbon capture technology. This policy complements ES-1 (Generation Performance Standard), which applies to new plants and new units, by applying to existing units. The results reported for this option correspond to increasing the biomass share at existing coal power stations to 1% by 2025 on an energy/Btu basis.

ES-4 Transmission System Upgrading, Including Reducing Transmission Line and Distribution System Loss

This policy includes energy efficiency measures that can be implemented to reduce the transmission- and distribution-line losses of electricity; leaks during production, processing, and distribution of natural gas; methane and other GHG emissions to the atmosphere; and the waste of a valuable commodity. Regulations, incentives, and/or support programs can be applied to achieve greater efficiency of transmission and distribution system components. While the option

covers both electricity transmission/distribution and natural gas transmission/distribution, only the latter was quantified.

ES-5 Renewable and/or Environmental Portfolio Standard

The renewable portfolio standard requires utilities and other load-serving entities to supply a certain, generally fixed, percentage of electricity from eligible (i.e., low-GHG-emitting) renewable energy sources. Prior to this MCCAG process, Minnesota had adopted an RES of 25% of electricity sales by 2025.

ES-6 Nuclear Power Support and Incentives

The role of nuclear power in a GHG-constrained energy supply system is both important and controversial. Today, nuclear power plants provide about 20% of electric power both nationally and in Minnesota. The role of both existing and new nuclear units needs to be considered for a comprehensive climate change policy process. By MCCAG decision, this policy calls for a study on the role of new nuclear power in Minnesota as a GHG reduction option in the post-2025 time period.

ES-8 Advanced Fossil Fuel Technology Incentives, Support, or Requirements, Including Carbon Capture and Storage

For coal to play a significant role in Minnesota's future energy system, its overall environmental profile must improve and must come as close as possible to producing zero CO₂ emissions, while producing energy that is both affordable and reliable. MCCAG calls for a further study of the role of carbon capture and storage technology for new coal stations as a GHG reduction option in the post-2025 time period and also calls for examining the role of carbon capture and storage technology with biomass.

ES-12 Distributed Renewable Energy Incentives and/or Barrier Removal

Distributed renewable energy should be encouraged, as it plays a part in Minnesota's overall goal of reducing carbon emissions. This policy includes subsidies and incentives that encourage investment in small-scale distributed renewable energy resources.”