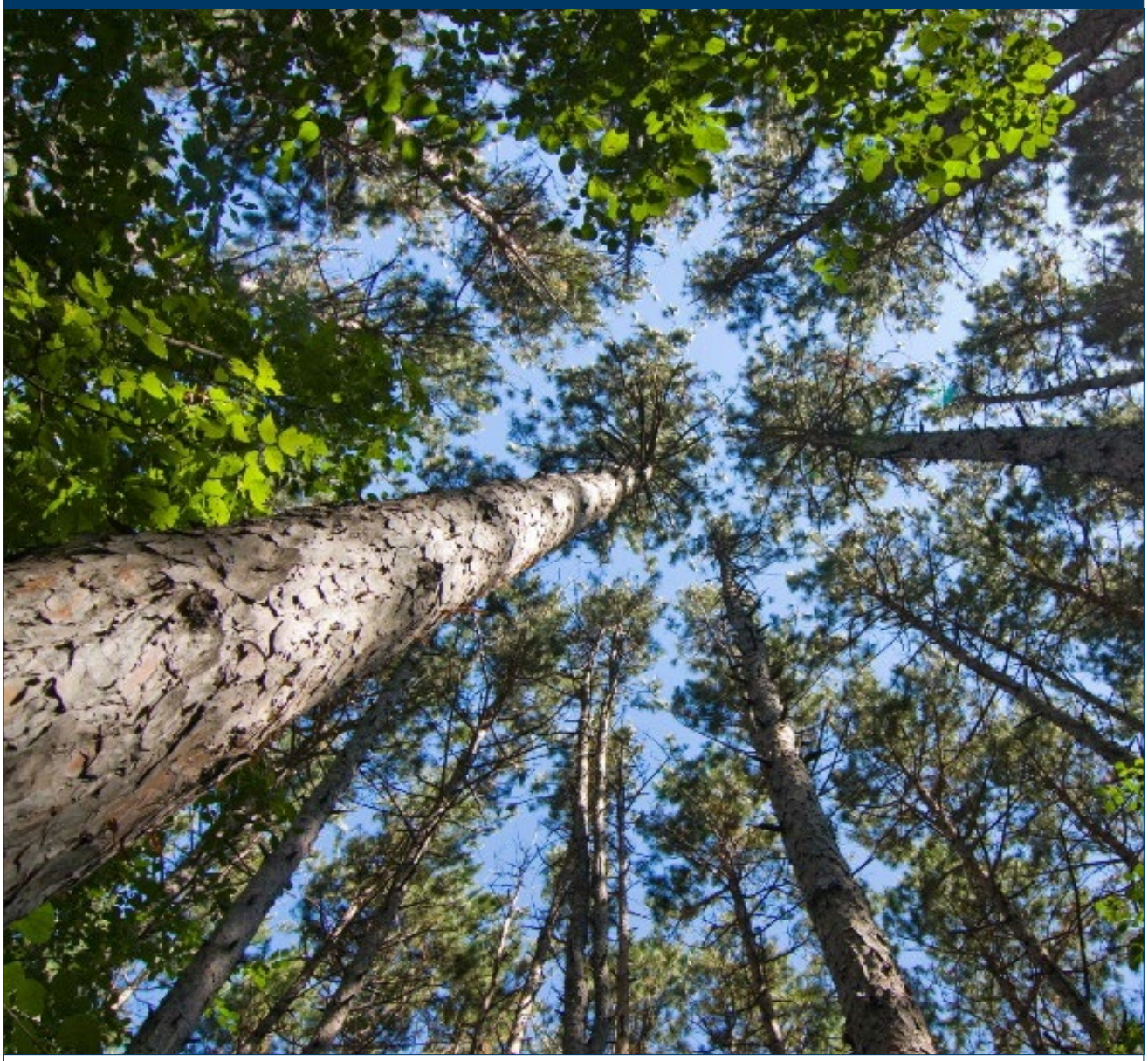
Greenhouse Gas Emissions: 1990-2014

Progress toward Next Generation Energy Act goals

Biennial report to the Minnesota Legislature

January 2017



Minnesota Pollution Control Agency

Minnesota Department of Commerce

Legislative charge

Minn. Statutes § 216H.02 Greenhouse gas emissions control; Subd. 1. Greenhouse gas emissions-reduction goal.

It is the goal of the state to reduce statewide greenhouse gas emissions across all sectors producing those emissions to a level at least 15 percent below 2005 levels by 2015, to a level at least 30 percent below 2005 levels by 2025, and to a level at least 80 percent below 2005 levels by 2050.

Minn. Statutes § 216H.07 Emissions-Reduction Attainment; Policy development process; Subd. 3. Biennial report.

(a) By January 15 of each odd-numbered year, the commissioners of Commerce and the Pollution Control Agency shall jointly report to the chairs and ranking minority members of the legislative committees with primary policy jurisdiction over energy and environmental issues the most recent and best available evidence identifying the level of reductions already achieved and the level necessary to achieve the reductions timetable in section 216H.02.

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Acknowledgements

Peter Ciborowski

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Estimated cost of preparing this report (Minn. Stat. § 3.197)

Total staff time: 80 hours	$4,575
Printing:	$12
Total:	$4,587

The MPCA is reducing printing and mailing costs by using the Internet to distribute reports and information to a wider audience.

MPCA reports are printed on 100% post-consumer recycled content paper manufactured without chlorine or chlorine derivatives.

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This report is available online at www.pca.state.mn.us and in alternative formats upon request.

Document number: lraq-2sy17

Cover photo: MPCA

Greenhouse Gas Emissions in Minnesota

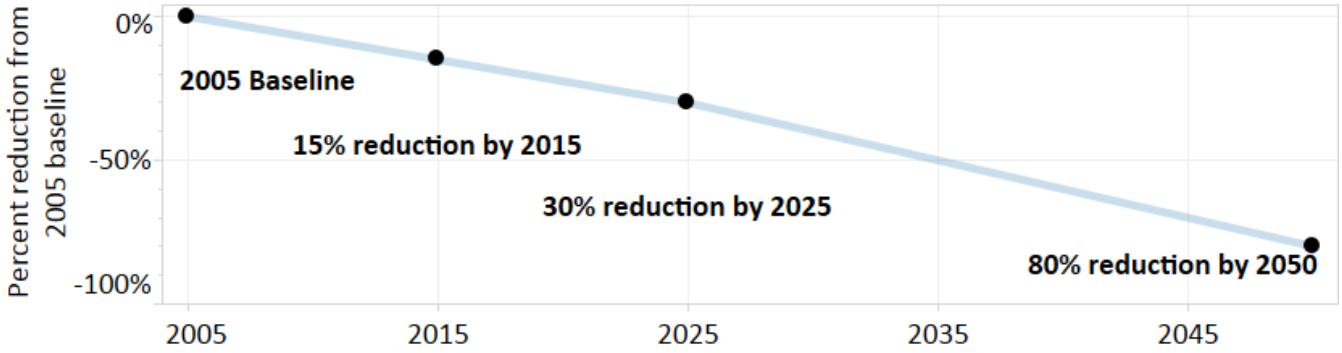
Overall, greenhouse gas emissions from activities throughout the state have decreased slightly, about 4%, from 2005 to 2014. It is unlikely that we have achieved the 2015 emissions reduction goal. Without significant effort, Minnesota will not reach future emissions reduction goals. There have been significant emissions reductions in some areas, especially in electricity generation where emissions decreased 17% from 2005 to 2014, but emissions have increased in other areas.

Not meeting goals

Greenhouse gas emission inventory background

Estimating greenhouse gas (GHG) emissions is important for protecting and improving the environment and enhancing human health because it provides data to inform policy decisions that reduce Minnesota's contribution to global air pollution. In 2007, the Minnesota Legislature passed the Next Generation Energy Act, which set goals for reducing GHG emissions in the state.

Next Generation Energy Act goals (Minn. Stat. § 216H.02)



Minnesota greenhouse gas emissions in 2014

GHGs are gases that warm the atmosphere and surface of the planet, leading to changes in the earth's climate. The conventional GHGs are carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), sulfur hexafluoride (SF_6), and two classes of compounds known as hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). Most GHG emissions are CO_2, but the other GHGs have very strong warming effects. To compare all the GHGs in common terms to CO_2, emissions are multiplied by their global warming potential (GWP) to produce CO_2-equivalent (CO_2-e) emissions.

Fossil fuel use is the largest source of CO_2 emissions and also emits CH_4 and N_2O. Most fossil fuel is used for generating electricity and fueling vehicles. Animal and crop agriculture emit most of the CH_4 and N_2O emissions. Landfills are also a source of CH_4. Most of the HFC emissions are from air conditioning. PFCs and SF_6 are a small portion of GHG emissions, and are from technical applications.

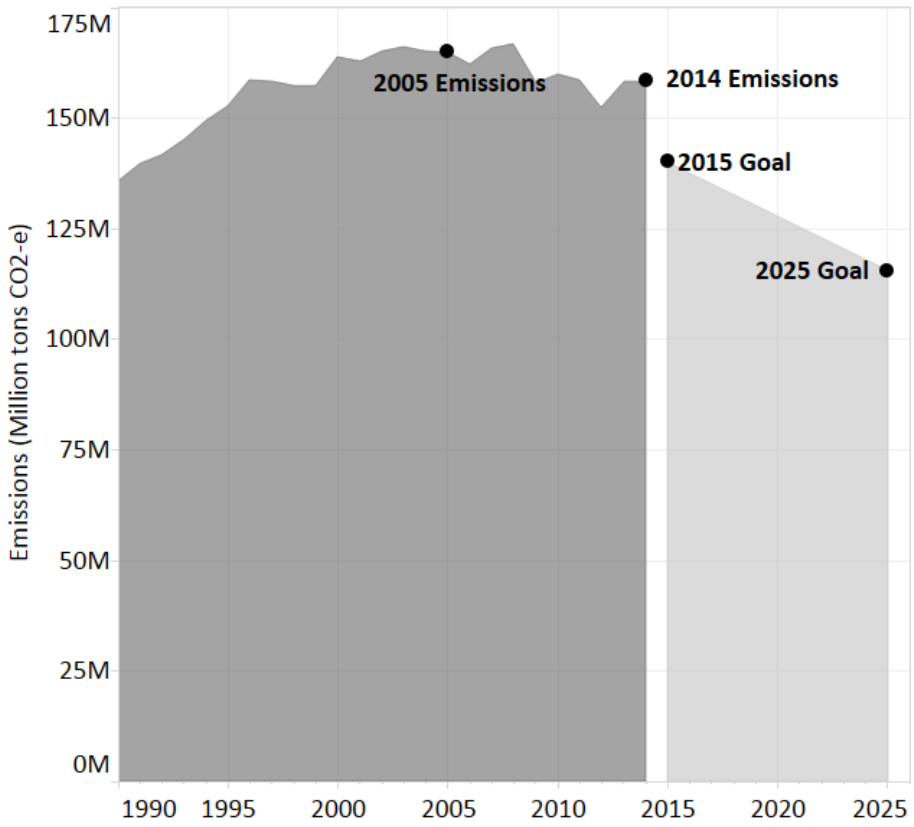
Progress toward Next Generation Energy Act GHG emission reduction goals

The 2005 GHG emissions were about 164.8 million tons CO_2-e and GHG emissions in 2014 were about 158.3 million tons CO_2-e. The 2014 GHG emissions were only about 4% lower than GHG emissions in 2005. The 2015 data is still incomplete, but it is unlikely that the 15% reduction goal was met.[1] The 2015 GHG emissions level to meet the goal would be about 140 million tons CO_2-e, or a reduction of about 25 million tons CO_2-e from 2005.[2]

GHG emissions have declined 4% since 2005, far short of our goals.

Our actions have prevented the increase in emissions that would have occurred if we had continued business as usual. However, without significant additional effort, Minnesota will not achieve the second Next Generation Energy Act goal — a 30% reduction in GHG emissions by 2025.

Minnesota's GHG emissions 1990-2014 and Next Generation Energy Act goals



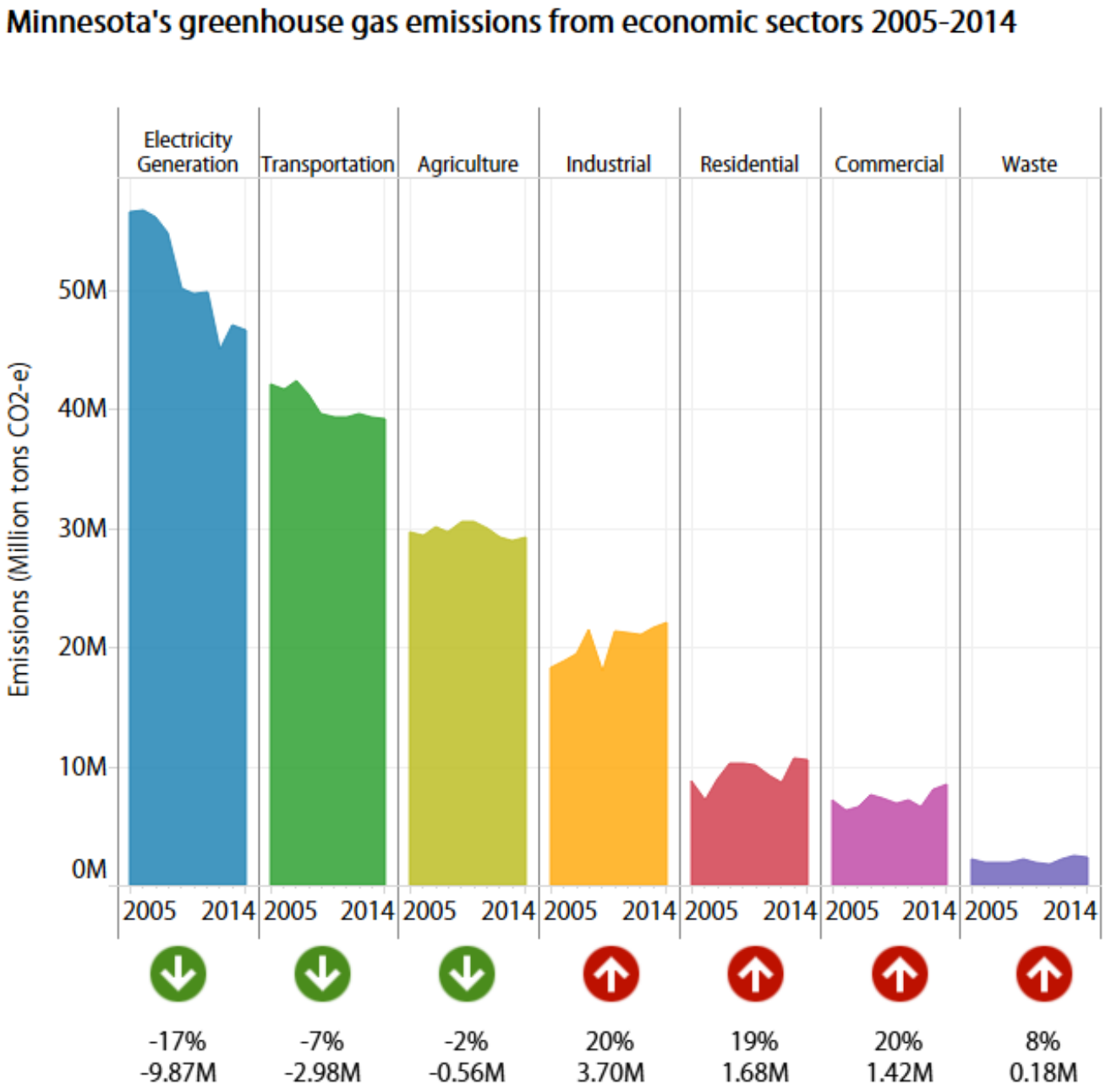
Actual Emissions			Goal Emissions		
2005	164.8 Million tons CO2-e	Baseline[2]	**2015**	140 Million tons CO2-e	15% reduction
2014	158.3 Million tons CO2-e	4% reduction	**2025**	115 Million tons CO2-e	30% reduction
			2050	33 Million tons CO2-e	80% reduction

[1] Current data availability results in a two-year delay in estimating emissions.
[2] Data revisions and changes in methodology cause the baseline to change, but provide continuity for relative comparisons.

Emission sources and changes in Minnesota

GHG emissions from electricity generation have declined 17%.

There is evidence of progress in some areas. Electricity generation remains the biggest emitter of GHGs in the state, emitting 29% of the state's GHGs, but since 2005, GHG emissions from electricity generation have decreased by 17% due to reduced coal use. In Minnesota and surrounding states, coal is being replaced by renewable wind and solar power and by relatively cleaner natural gas. Our electricity generation portfolio and the mix of imported electricity to meet our demand have much lower GHG emissions per MWh, or lower GHG intensity. It is important to note that emissions from using electricity are counted in the electric utility sector rather than distributed to the consumers in the other sectors.

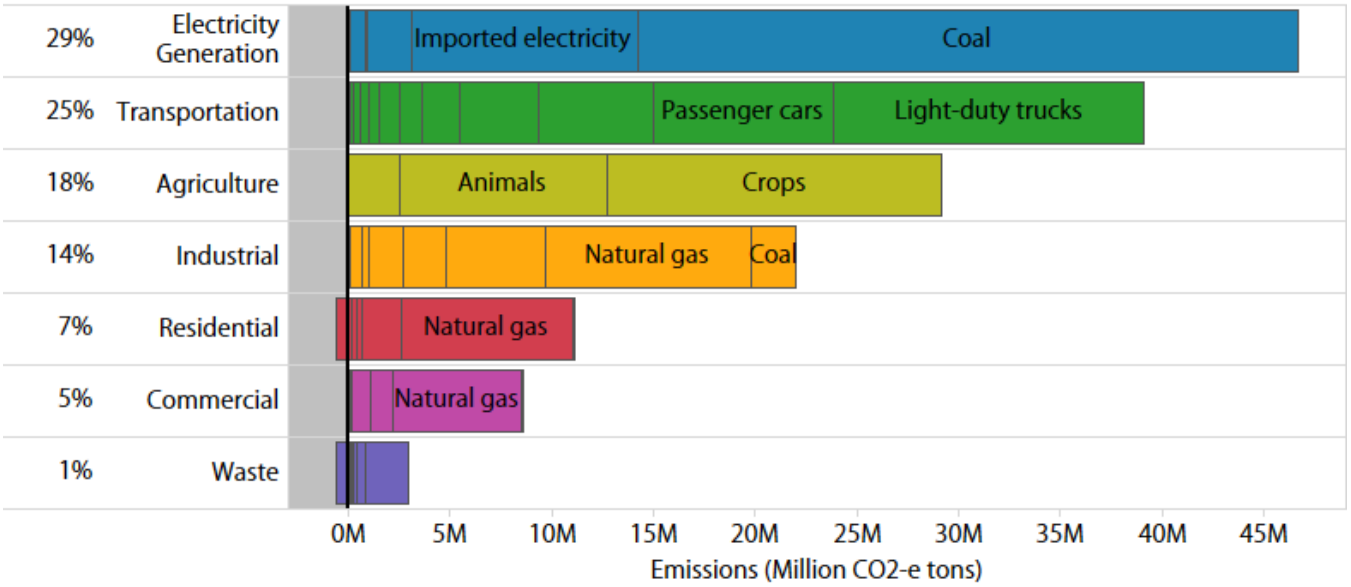


Transportation GHG emissions are 25% of the state's total GHG emissions, and have decreased about 7% since 2005. While newer vehicles are more efficient and more biofuels are available and replacing fossil fuels, consumers have been choosing to replace smaller cars with larger vehicles. Light-duty truck numbers have been steadily increasing and now outnumber smaller passenger cars. The resulting emissions increase from these vehicles offsets other reductions from passenger cars, aviation, and natural gas transmission.

The residential and waste sectors each contribute to carbon storage, or negative emissions. Some carbon is stored in wood housing materials and in demolition and construction landfills for long enough that it is effectively taken out of the carbon cycle. Storage of additional carbon is decreasing because new construction has slowed and less wood is used per square foot in new housing.

Overall, emissions from agriculture are down slightly from 2005 because of decreased emissions from farming on peatlands. Emissions increased from fuel use, fertilizer use and raising animals, specifically from manure management and increasing hog populations.

2014 sector GHG emissions and storage sources and sector percent of total



Electricity Generation: Fuel combustion, emissions from electricity consumption in Minnesota, including electricity imported to meet demand

Transportation: Fuel combustion in gasoline and diesel vehicles, aviation, rail, air conditioning leakage, natural gas pipelines

Agriculture: Livestock flatulence, animal feedlots and manure management, fertilizer use, crop cultivation, fuel combustion

Industrial: Fuel combustion, taconite processing, petroleum refining, magnesium casting, lead recycling, and manufacturing steel, glass, insulating foam, and semiconductors

Residential: Fuel combustion (space and water heating, dryers), fertilizer and product use, carbon storage in housing material, air conditioner and refrigerator leakage

Commercial: Fuel combustion, solvent use, medical N2O, includes institutional sources

Waste: Waste processing and incineration, methane from landfill gas and wastewater, carbon storage in demolition landfills

GHG emissions from the industrial sector increased since 2005, mostly due to the increasing use of low-cost natural gas. In some cases, natural gas replaced other fossil fuels, but more energy overall is being used in the industrial sector. Emissions from natural gas use in the commercial and residential sectors similarly increased in response to low natural gas prices.

Emissions of high global warming potential (HGWP) GHGs increased across sectors because of their increased use in air conditioning and refrigeration. These HGWP GHGs are replacing ozone-depleting substances and are being phased out in favor of less polluting chemicals.

These results demonstrate that Minnesota's progressive energy laws and programs can work to reduce GHG emissions, but more must be done to address all sources in the state. Minnesota needs to remain a leader in GHG reductions, particularly in the next 10 years to meet the goals in the Next Generation Energy Act which will reduce Minnesota's contribution to global concentrations of GHGs.

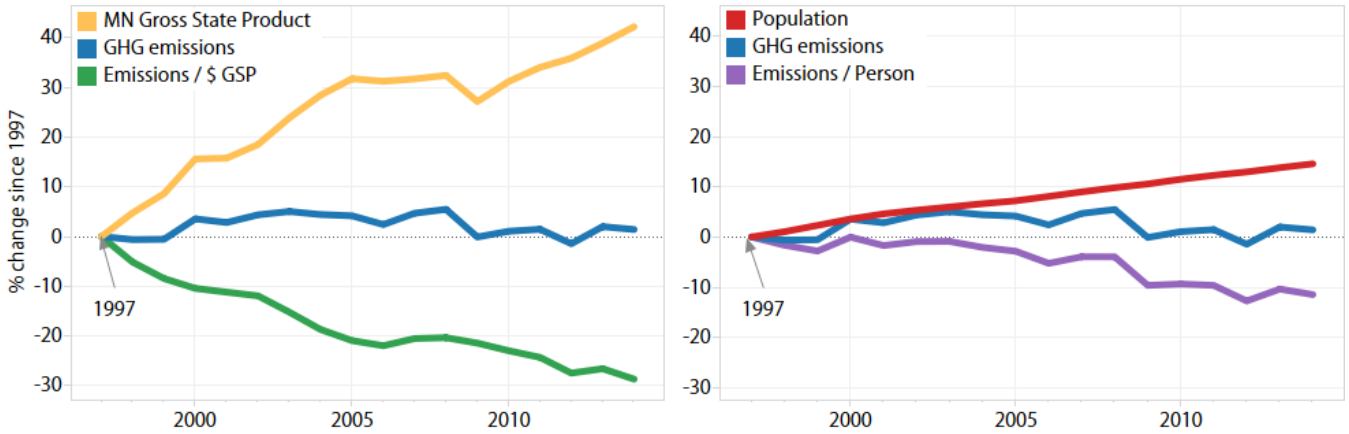
Indicators of greenhouse gas emission intensity

Measures of GHG emission intensity are useful in understanding how GHG emissions change in relation to other Minnesota trends. The changes in these indicators are shown as the relative change since 1997.[3] The state economy has grown while GHG emissions have declined, indicating a shift toward a less GHG intense economy. Our population also continues to grow while emissions decline.

The recession can be seen in the emissions and economic activity in 2009. Industrial output and overall energy consumption declined, reducing greenhouse gas emissions. With economic recovery, the gross state product (GSP, chained 2009$) increased and the GHG intensity continued to decline.

While working toward reducing our contribution to global concentrations of greenhouse gases, Minnesota can support healthy communities and ecosystems, and a strong economy.

Indicators of GHG emissions intensity of the economy



[3] 1997 chosen as initial year for consistency with US Bureau of Economic Analysis data.

Other activities

As part of the Environmental Quality Board's (EQB) Climate Strategies and Economic Opportunities (CSEO) project during 2014, a forecast was developed estimating the state GHG emissions if Minnesota carried on with business as usual, implementing planned policies. The forecasted emissions show an overall slight decline to 2030, mostly in the electric utility and transportation sectors.

The forecasted emissions, without additional reduction efforts, fall short of the 2030 reduction goal. The CSEO project evaluated policies for their ability to reduce Minnesota's GHG emissions with consideration given to the cost of the reduction in emissions and opportunities for economic development and job creation in the state.

Further information: https://www.pca.state.mn.us/air/climate-change-initiatives

Greenhouse gas emission inventory methodology

A technical support document published in 2012 with the emissions report for 1970-2008 provides a more detailed discussion on the calculation methodology and is available at https://www.pca.state.mn.us/air/greenhouse-gas-emissions-minnesota-0.

Only emissions that occur within the geographical borders of the state are estimated, with two exceptions – net imports of electricity into the state to meet Minnesota demand and emissions from the combustion of aviation fuel purchased in Minnesota, but not necessarily combusted within Minnesota air space.

GHG inventory protocols require that evaluation of state-level GHG emissions take into account photosynthetically-removed CO_2 stored in biomass in forests, soils, landfills and structures. The carbon storage in forests and forest soils is tracked separately from the emissions inventory because it is less certain that the forest will continue to exist and store carbon over a long period of time and the storage cannot be expressed in CO_2-equivalent terms. Long-term storage of carbon in residential structures and demolition and construction landfills is included in statewide GHG emission totals because it is more certain that the materials will remain as carbon stores for a long time.

Emissions are estimated for all years from 1970 to 2014, though presented here in an abbreviated timeline. With a few exceptions, the methods used to develop these estimates are derived from the following sources:

- US Environmental Protection Agency (2016) Inventory of US greenhouse gas emissions and sinks: 1990-2014.
- California Air Resources Board, California Climate Action Registry, International Council for Local Environmental Initiatives, Local Governments for Sustainability, and The Climate Registry (2010) Local government operations protocol for the quantification and reporting of greenhouse gas emissions inventories, version 1.1.
- Intergovernmental Panel on Climate Change (2006) IPCC guidelines for national greenhouse gas inventories. Vol. 1-4.
- Radian Corporation (1996) Methane emissions from the natural gas industry. Volumes 1-15. Prepared for the US Environmental Protection Agency and the Gas Research Institute.
- The Climate Registry (2008) General reporting protocol, version 1.1.
- Minnesota Pollution Control Agency (January, 2012) Greenhouse gas emissions in Minnesota: 1970 – 2008.

Changes in methodology and data sources

Except for changes within the transportation sector, the methods used to develop the emission estimates are largely unchanged from previous reports. The methodological changes made since the last report were made to improve estimation of total emissions. To assure consistency, these changes were applied to all prior inventory years, when possible, including the baseline year of 2005. Revised data used as inputs for estimation were updated when available.

The emissions from the transportation sector had previously been estimated using fuel sales, with the emissions allocated to different modes of transportation using vehicle population, vehicle miles traveled, fuel efficiency, and other fleet statistics. The EPA has developed and improved their motor vehicle emissions simulator (MOVES) to estimate greenhouse gas emissions as well as criteria air pollutants. This model was used to estimate Minnesota's transportation GHG emissions for 2005-2014. The MOVES model uses the same types of fleet statistics, but estimates energy and fuel consumption as model outputs.