

Appendix E. Fossil Fuel Production Industry

Overview

The inventory for this subsector of the Energy Supply sector includes methane (CH₄) emissions associated with the transmission and distribution (T&D) of natural gas in Minnesota, as well as carbon dioxide (CO₂) emissions associated with the combustion of natural gas in compressor engines (referred to as pipeline fuel). There is no oil or natural gas production or processing, and no coal mining in Minnesota. In 2005, emissions from natural gas T&D accounted for an estimated 2.25 million metric tons (MMt) of CO₂ equivalent (CO₂e) of greenhouse gas (GHG) emissions in Minnesota, and are estimated to increase to about 3.5 MMtCO₂e by 2020.

Natural Gas T&D Emissions and Reference Case Projections

The Minnesota Pollution Control Agency (MPCA) has prepared a detailed inventory of GHG emissions for this subsector covering the years 1970 through 2004. The MPCA inventory follows the United States Environmental Protection Agency's (US EPA) methods provided in the Emission Inventory Improvement Program (EIIP) guidance document for natural gas T&D systems and the combustion of fossil fuels.^{1,2}

For the natural gas distribution system, annual CH₄ emissions were estimated for each year using US EPA emission factors and (1) the miles of distribution pipeline constructed of cast iron, unprotected steel, protected steel, and plastic; (2) the number of protected and unprotected steel, copper, and plastic service connections; (3) the number of metering and pressure regulating stations; and (4) the number of residential and commercial customer meters. For the transmission system, CH₄ emissions were estimated for each year using US EPA emission factors and the (1) the total miles of pipeline; (2) the total number of pipeline interconnects, direct industrial customers, transmission pipeline and storage compressor stations, and storage wells; and (3) the amount of gas withdrawn from storage. The MPCA obtained the annual amount of natural gas pipeline fuel combusted in compressor engines from the United States Department of Energy (US DOE), Energy Information Administration (EIA), *Natural Gas Annual*.³

For the natural gas distribution system, a compound annual average growth rate of 1.6% was applied to forecast emissions from 2006 through 2020. This annual growth assumption is based on the historical annual average growth rate in CH₄ emissions associated with the natural gas distribution system in Minnesota. This historical growth rate is slightly higher than the 1.5% annual growth rate calculated from the EIA's AEO2007 forecast for natural gas consumption for all sectors for the West North Central region of the US for 2005 through 2020.

For the natural gas transmission system and for pipeline fuel use, a compound annual average growth rate of 3.3% was applied to forecast emissions from 2006 through 2020. This annual growth assumption is based on the historical annual average growth rate in CH₄ emissions associated with the gas transmission system in Minnesota.

¹ Emission Inventory Improvement Program (EIIP), *Volume VIII*: Chapter 5. "Methods for Estimating Methane Emissions from Natural Gas and Oil Systems", March 2005.

² EIIP, *Volume VIII*: Chapter 1 "Methods for Estimating Carbon Dioxide Emissions from Combustion of Fossil Fuels", August 2004.

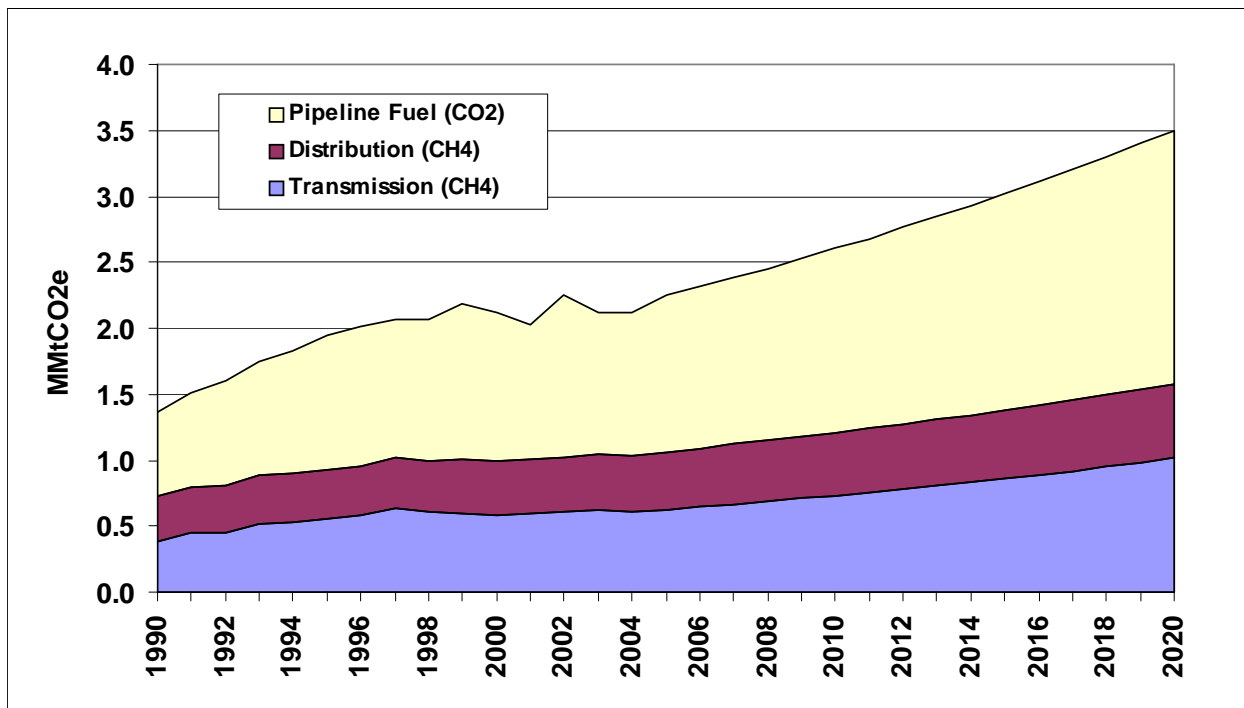
³ http://tonto.eia.doe.gov/dnav/ng/ng_sum_snd_dc_u_SMN_a.htm.

Results

Figure E1 displays the estimated GHG emissions associated with natural gas T&D system and pipeline fuel use in Minnesota from 1990 to 2004, with projections to 2020. Figure E1 was developed from the emissions data in Table E1. Table E2 shows the relative contributions of emissions associated with the distribution and transmission systems and pipeline fuel use to total subsector emissions.

Emissions associated with this subsector were estimated to be about 1.37 MMtCO₂e in 1990 and 2.25 MMtCO₂e in 2005, and are projected to total 3.5 MMtCO₂e in 2020. From 1990 through 2004, natural gas companies in Minnesota reduced the rate of CH₄ emissions from the distribution system by replacing cast iron and unprotected steel distribution pipe with protected steel and plastic pipe. Gas companies also replaced unprotected steel service connections with protected steel and plastic service connections that helped reduce emissions during this 14-year period.

Figure E1. Methane Emissions and Projections from the Fossil Fuel Industry



Source: Calculations based on approach described in text.

Table E1. Emissions Inventory and Reference Case Projections (MMtCO₂e)

Fuel Type	1990	1995	2000	2005	2010	2015	2020
Transmission (CH ₄)	0.39	0.55	0.59	0.62	0.73	0.86	1.01
Distribution (CH ₄)	0.35	0.37	0.41	0.44	0.48	0.52	0.56
Pipeline Fuel (CO ₂)	0.63	1.02	1.12	1.18	1.39	1.64	1.93
Total	1.37	1.95	2.12	2.25	2.60	3.02	3.50

Table E2. Proportions of Total Subsector Emissions by Type and Source (%)

Fuel Type	1990	1995	2000	2005	2010	2015	2020
Transmission (CH ₄)	28	28	28	28	28	29	29
Distribution (CH ₄)	25	19	19	20	18	17	16
Pipeline Fuel (CO ₂)	46	52	53	53	54	54	55

Key Uncertainties

The main uncertainties in estimating emissions for the natural gas T&D subsector are associated with the reference case projection assumptions. For this preliminary forecast, it was assumed that emissions would increase at the historical rate of emissions growth for the T&D system and pipeline fuel use. Market factors (e.g., price of natural gas relative to other available energy sources) could have a significant impact on the growth for this sector. In addition, neither potential future application of improvements to pipeline technologies that can yield emission reductions nor the potential effect of demand-side management programs in reducing gas consumption have been accounted for in the emissions projections shown here.