2009 Greenhouse Gas Emissions from Selected Iowa Source Categories

August 31, 2010

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Acronyms and Key Terms

AR4	Fourth Assessment Report from IPCC
ASTM	American Society for Testing and Materials
CAMD	Clean Air Markets Division
CCS	Center for Climate Strategies
CEEE	Center for Energy and Environmental Education
CEM	Continuous Emissions Monitor
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
DGS	Distillers Grain with Solubles
DNR	Iowa Department of Natural Resources
DOE	Department of Energy
DOT	Department of Transportation
DSCFM	Dry Standard Cubic Feet per Minute
EIA	Energy Information Administration
ECOS	Environmental Council of the States
EIIP	Emission Inventory Improvement Program
EPA	Environmental Protection Agency
EtOH	Ethanol
GHG	Greenhouse Gas
GWP	Global Warming Potential
HAP	Hazardous Air Pollutant
HFC	Hydrofluorocarbons
HFE	Hydrofluorinated ethers
IAC	Iowa Administrative Code
ICCAC	Iowa Climate Change Advisory Council
IPCC	Intergovernmental Panel on Climate Change
IPT	Integrated Project Team
IRS	Internal Revenue Service
LPG	Liquefied Petroleum Gas
MMBtu	Million British Thermal Units
MMcf	Million Cubic Feet
MMscf	Million Standard Cubic Feet
MMTCE	Million Metric Tons of Carbon Equivalent
$MMtCO_2e$	Million Metric Tons of Carbon Dioxide Equivalent
$MtCO_2e$	Metric Tons of Carbon Dioxide Equivalent
N_2O	Nitrous Oxide
NF_3	Nitrogen Trifluoride
NO_X	Nitrogen Oxides
ODS	Ozone Depleting Substance
PFC	Perfluorocarbons
PM_{10}	Particulate Matter Less Than 10 Microns in Aerodynamic Diameter
RCI	Residential, Commercial, Industrial

RFA	Renewable Fuels Association
SAR	Second Assessment Report from IPCC
SF_6	Sulfur Hexafluoride
SIC	Standard Industrial Classification
SIT	State Inventory Tool
SO_2	Sulfur Dioxide
TAR	Third Assessment Report from IPCC
Tg CO_2 Eq.	Teragrams of Carbon Dioxide Equivalents
TTB	Alcohol and Tobacco Tax and Trade Bureau
UNI	University of Northern Iowa
USDA	United States Department of Agriculture
VCU	Vapor Combustion Unit
VEETC	Volumetric Ethanol Excise Tax Credit
VMT	Vehicles Mile Traveled
VOC	Volatile Organic Compounds
WBSCD	World Business Council for Sustainable Development
WRI	World Resources Institute
WWTP	Wastewater Treatment Plant

Executive Summary

Background

This is the third greenhouse gas (GHG) inventory that has been prepared by the Iowa Department of Natural Resources (DNR) as required by legislation passed by the Iowa General Assembly in 2007. The legislation, SF 485, requires that “By September 1 of each year, the department shall submit a report to the governor and the general assembly regarding the GHG emissions in the state during the previous calendar year and forecasting trends in such emissions. The first submission by the department shall be filed by September 1, 2008, for the calendar year beginning January 1, 2008.”[1] The legislation allows “a series of reporting requirements to be phased in over a period of time and may provide for phasing in by producer sector, geographic area, size of producer, or other factors.”[2]

Similar to the Department’s previous inventories, *2007 and 2008 Greenhouse Gas Emissions from Selected Sources,* this inventory for 2009 is fairly narrow in scope and is a *refinement* of previous statewide inventories. It is a bottom-up inventory of ethanol production plants and major sources with federally-enforceable operating permits (also known as Title V operating permits). These facilities were required to estimate and report calendar year 2009 emissions from several processes – fossil fuel combustion, ethanol fermentation, cement manufacturing, lime manufacturing, ammonia production, nitric acid production, iron and steel production, and soda ash consumption. They were also required to calculate and report emissions of hydrofluorocarbons (HFC), perfluorocarbons (PFC), and sulfur hexafluoride (SF_6).

In a bottom-up inventory, facility-specific activity data is used to calculate emissions. In a top-down inventory, aggregate activity data is used to calculate emissions. For example, this bottom-up inventory calculates GHG emissions from the fossil fuel combustion at each individual facility instead of using the total amount of fossil fuel combusted state-wide, which would be a top-down inventory method. The advantage to a bottom-up inventory is that the calculations are more accurate than a top-down inventory. However, because the two methods differ, the results from a bottom-up inventory are not directly comparable to a top-down inventory. The Department would prefer to conduct both top-down and bottom-up inventories in the future for a more comprehensive view of Iowa GHG emissions, but currently does not have the resources to do so. This is further discussed in Chapter 7 of this report.

On October 30, 2009, the United States Environmental Protection Agency (U.S. EPA) finalized its Mandatory Reporting of Greenhouse Gases Rule[3] that requires mandatory reporting of GHG emissions from large sources in the United States. This federal rule generally requires reporting of annual GHG emissions from fossil fuel suppliers, industrial GHG suppliers, vehicle and engine manufacturers, and facilities that emit 25,000 $mtCO_2e$ or more per year of GHG emissions. The Department estimates that approximately 80 – 100 Iowa facilities currently reporting GHG emissions to the Department will be subject to federal reporting starting with calendar year 2010 emissions. The implications of this rule are further discussed in Chapter 7 of this report.

[1] Iowa Code 455B.851
[2] Iowa Code 455B.152
[3] Federal Register, Vol. 74 No. 209, October 30, 2009.

Revisions to 2008 GHG Emissions

The Department finalized its report *2008 Greenhouse Gas Inventory for Selected Iowa Source Categories* on August 31, 2009. After the report was finalized, eleven companies submitted corrections totaling 0.47 $MMtCO_2e$ to their 2008 GHG emissions from fossil fuel combustion as shown in Appendix A of this report.

In addition, the 2008 GHG emissions from fossil fuel combustion for four dry ethanol plants that are also major sources were not counted toward the major source GHG emissions total. However, the 0.66 $MMtCO_2e$ of emissions was correctly counted toward the ethanol plant GHG emissions total.

Together, these corrections added an additional 1.13 $MMtCO_2e$ of emissions to the reported total of 55.48 $MMtCO_2e$, bringing the total 2008 GHG emissions from fossil fuel combustion at major sources to 56.61 $MMtCO_2e$.

The Department has also made corrections to 2008 GHG emissions for two industrial sources, increasing the total industrial GHG emissions from 2.75 $MMtCO_2e$ to 3.10 $MMtCO_2e$. These corrections are noted in Chapter 5 of this report.

2009 GHG Emissions Totals

2009 GHG emissions from fossil fuel combustion at federally-recognized major sources were calculated to be 51.44 $MMtCO_2e$[4] and 4.06 $MMtCO_2e$ from Dry Mill Ethanol Plants. GHG emissions from ethanol plant fermentation processes were estimated to be 7.19 $MMtCO_2e$ from dry mills and 1.46 $MMtCO_2e$ from wet mills. Another 0.05 $MMtCO_2e$ of GHG emissions from use of fluorinated gases and 2.56 $MMtCO_2e$ from industrial processes were reported as shown in Figure 1 on the next page.

EPA's Greenhouse Gas Equivalencies Calculator [5] estimates that the total 2009 GHG emissions fossil fuel combustion, F-gases, and industrial sources (56.69 $MMtCO_2e$[6]) are equivalent to:

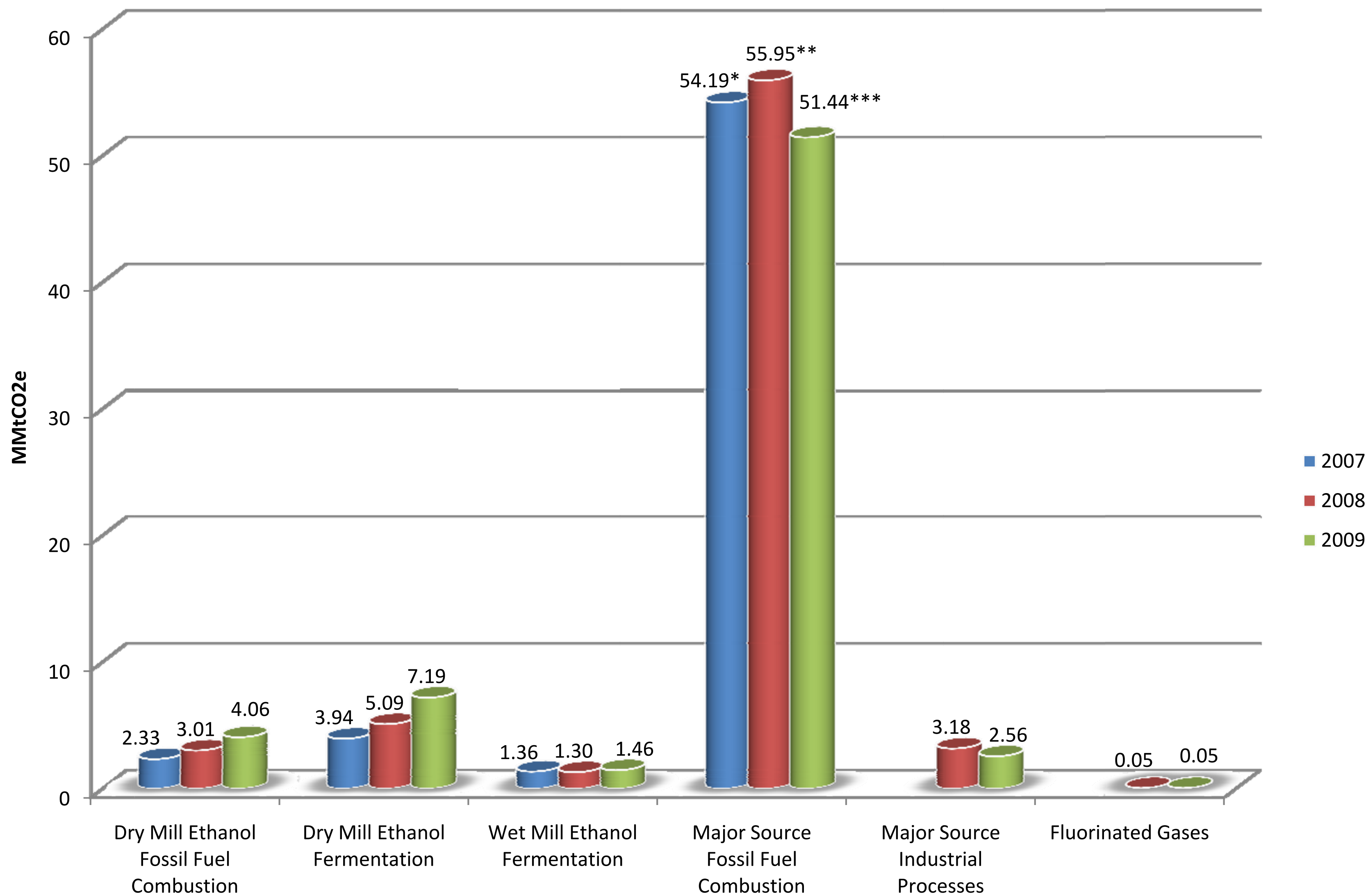
- Annual GHG emissions from 10.8 million passenger vehicles
- CO_2 emissions from the electricity use of 6.9 million homes for one year
- CO_2 emissions from the energy use of 4.8 million homes for one year
- Carbon sequestered by 1.5 billion tree seedlings grown for 10 years
- CO_2 emissions from 2.4 billion propane cylinders used for home barbeques
- GHG emissions avoided by recycling 19.1 million tons of waste instead of sending it to the landfill

[4] Includes 1.42 $MMtCO_2e$ from 10 dry mill ethanol plants that are also classified as major sources.

[5] http://www.epa.gov/cleanenergy/energy-resources/calculator.html

[6] Does not include GHG emissions from ethanol fermentation, which are considered to be biogenic, and not counted towards the total. To avoid double counting, 1.42 MMtCO2e from 10 dry mill ethanol plants that are also classified as major sources was subtracted from the total. 56.69 MMtCO2e = 51.44 from major source fossil fuel combustion + 4.06 from dry mill ethanol plant fossil fuel combustion + 2.56 from industrial sources + 0.05 from fluorinated gases – 1.42 from ethanol plants that are classified as major sources.

Figure 1 – GHG Emissions by Sector 2007 – 2009



** Includes 0.60 MMtCO2e from 5 dry mill ethanol plants that are also classified as major sources.*
*** Includes 1.06 MMtCO2e from 7 dry mill ethanol plants that are also classified as major sources.*
****Includes 1.42 MMtCO$_2$e from 10 dry mill ethanol plants that are also classified as major sources.*

GHG Emissions Trends 2008 – 2009

1. Total GHG emissions **decreased** 8%[7] from 2008.

2. Total GHG emissions from fossil fuel combustion at major sources **decreased** ;
   - CO_2 decreased 9%.
   - CH_4 decreased 8%.
   - N_2O decreased 7%.

3. GHG emissions from ethanol production **increased** because ethanol production increased 32%;
   - GHG emissions from fossil fuel combustion at dry mill plants increased 35%
   - GHG emissions from fermentation at dry mill plants increased 41%
   - GHG emissions from fermentation at wet mill plants increased 12%

4. 96% of the GHG emissions from fossil fuel combustion were from facilities in three source categories:[8]
   - Electric, Gas, and Sanitary Services – 75%
   - Chemical and Allied Products (includes ethanol production) – 11%
   - Food and Kindred Products – 10%

5. GHG emissions from industrial sources **decreased** 20%.

6. GHG emissions from use of fluorinated gases **decreased** 12%.

Forecasting

The Department's 2009 inventory does not include any direct forecasting, but can use forecasts for fossil fuel combustion from the U.S. Energy Information Administration (EIA) to help identify future trends in GHG emissions. The latest information released by EIA in its August 10, 2010 *Short-Term Energy Outlook* indicates:

> "Estimated U.S. carbon dioxide (CO_2) emissions from fossil fuels, which declined by 7.0 percent in 2009 are expected to increase by 3.4% and 0.8% in 2010 and 2011, respectively, as economic growth spurs higher energy consumption. However, even with these increases, projected emissions remain below their level in any year from 1999 through 2008."[9]

EIA's projections may hold true for Iowa GHG emissions as the 9% decrease in GHG emissions from fossil fuel combustion at major sources in 2009 is similar to the 7% decrease in national fossil fuel GHG emissions during the same time period.

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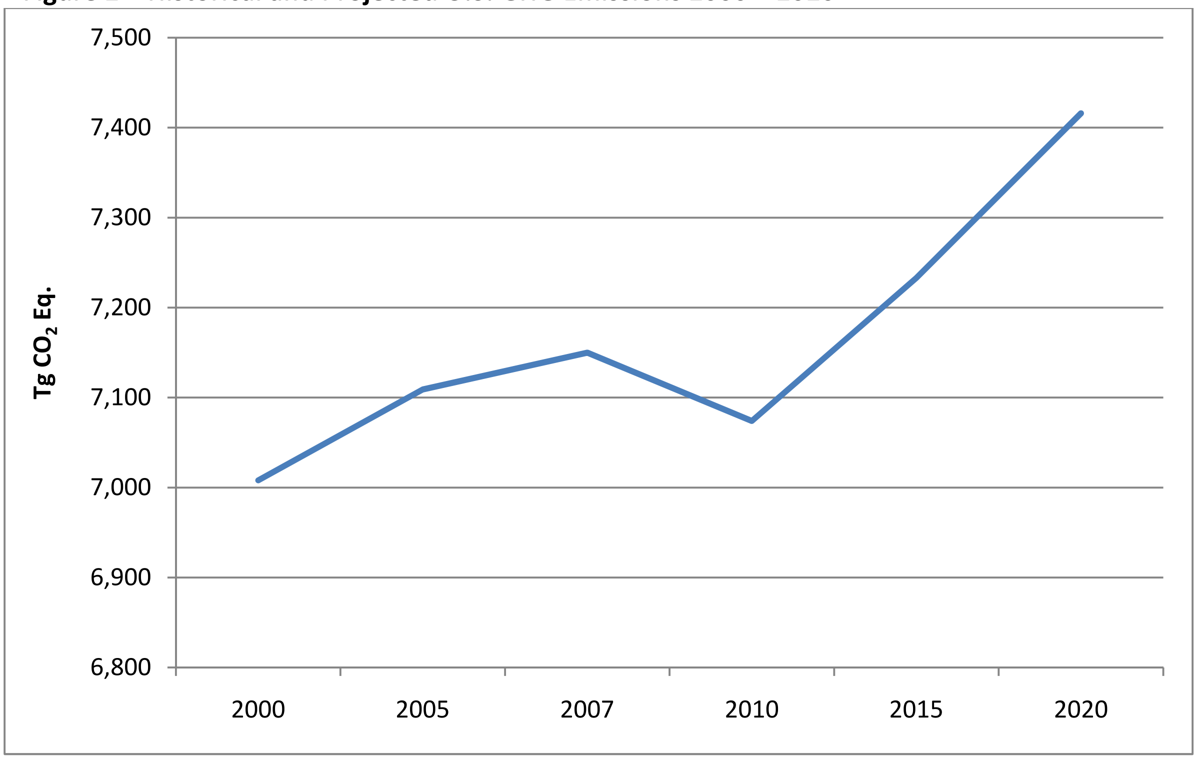
[7] Does not include GHG emissions from ethanol fermentation, which are considered to be biogenic, and not counted towards the total.

[8] The full listing of fossil fuel emissions from all source categories is in Appendix B of this report.

[9] Energy Information Administration, August 10, 2010. *Short-term Energy Outlook*, Internet address: http://www.eia.doe.gov/emeu/steo/pub/contents.html.

In addition, the U.S. Department of State released new projections in its *U.S. Climate Action Report 2010* in June 2010. This report includes projections from 2005 – 2020 that reflect the CO_2 emissions predictions from EIA. The report finds that "total gross U.S. GHG emissions are expected to drop slightly below 2005 emissions in the short term, but will rise steadily in the long term as populations and total economic activity grow,"[10] and "Between 2005 and 2020, total gross U.S. greenhouse gas emissions are expected to grow by 4 percent"[11] as shown in Figure 2 below.

Figure 2 – Historical and Projected U.S. GHG Emissions 2000 – 2020[12]

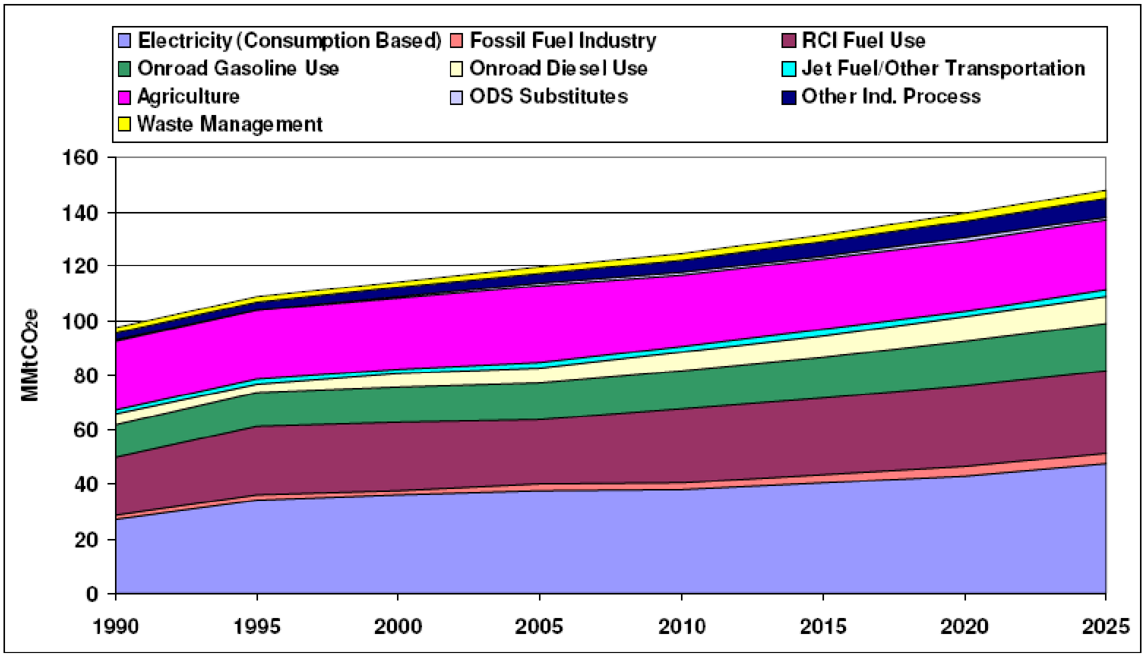


In past years, the Department has also used the GHG emissions projections prepared in 2008 by the Center for Climate Strategies (CCS) for the Iowa Climate Change Advisory Council. Their report, *Iowa Greenhouse Gas Inventory and Reference Case Projections 1990 – 2025,*[13] is the most recent complete top-down inventory and forecast prepared for the state.

[10] U.S. Department of State. June 2010. *U.S Climate Action Report 2010*, p. 78. Internet address: http://www.state.gov/documents/organization/140636.pdf..
[11] Ibid., Table 5-1, p. 78.
[12] The report states GHG emissions in units of Tg CO_2 Eq. One Tg CO_2 Eq. equals 1 $MMtCO_2e$.
[13] Center for Climate Strategies. 2008. *Iowa Greenhouse Gas Inventory and Reference Case Projections 1990 – 2025.* Internet address: http://www.iaclimatechange.us/Inventory_Forecast_Report.cfm.

The CCS report shows that Iowa's gross GHG emissions increased by 20% from 1990 to 2005. It estimates that assuming a business-as-usual scenario, Iowa's gross GHG emissions will continue to grow, increasing 51% from 1990 levels by 2025[14] as shown in Figure 3 and Appendix C of this report.

Figure 3 - Iowa Gross GHG Emissions by Sector, 1990-2025: Historical and Projected



[14] However, the CCS projections were prepared in early 2008 and do not account for decreased GHG emissions resulting from the economic recession.

Chapter 1: Historical GHG Emissions

Iowa GHG Emissions

Four top-down inventories of Iowa GHG emissions have been conducted from 1996 – 2008. In 1996, the Department published a GHG emission inventory for 1990 using U.S. EPA inventory tools as part of an Iowa Greenhouse Gas Action Plan.[15] The 1990 inventory was prepared in partnership with the Center for Global and Regional Environmental Research (CGRER) at the University of Iowa and reported gross GHG emissions of 86,745,131 tons of carbon dioxide equivalent or 78.7 million metric tons of carbon dioxide equivalent (MMtCO$_2$e). [16]

In 2005, the Department published a 2000 GHG inventory that was completed by the Center for Energy & Environmental Education (CEEE) at the University of Northern Iowa (UNI) on behalf of the Department and was funded by a grant from EPA.[17] This report recalculated the data from the 1990 CGRER inventory using new methods, reporting gross GHG emissions of 21.1 million metric tons of carbon equivalent (MMTCE) or 77.4 MMtCO$_2$e in 1990. Calendar year 2000[18] GHG emissions were calculated to be and 26.2 MMTCE or 96.07 MMtCO$_2$e for as shown in Table 1.

In October 2007, the World Resource Institute (WRI) released a GHG inventory, *Charting the Midwest: an Inventory and Analysis of Greenhouse Gas Emissions in America's Heartland,*[19] which summarized 1990 -2003 GHG emissions trends for Iowa and other Midwestern states. WRI found that 2003 Iowa gross GHG emissions totaled 108 MMtCO$_2$e and that GHG emissions from agriculture were 22% of total GHG emissions, the highest percentage of any state in the Midwest and the second highest in the nation.

In 2008, the Center for Climate Strategies (CCS) finalized their GHG inventory and forecast, *Iowa Greenhouse Gas Inventory and Reference Case Projections 1990 – 2025,*[20] that they conducted for the Iowa Climate Change Advisory Council (ICCAC). Results from this inventory are also shown in Table 1 and were slightly lower than previous inventories which is likely due to more refined calculation methods and Iowa specific-activity data being used. The full results from the *Iowa Greenhouse Gas Inventory and Reference Case Projections 1990 – 2025,* including GHG emissions by sector from 1990 – 2025 are provided in Appendix C of this report.

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[15] Iowa Department of Natural Resources and University of Iowa Center for Global and Regional Environmental Research (CGRER). 1996. *Iowa Greenhouse Gas Action Plan.* Internet address: http://www.iowadnr.gov/air/prof/ghg/files/1990%20Iowa%20Greenhouse%20Gas%20Action%20Plan.pdf

[16] Ibid., Table A.1.

[17] Iowa Department of Natural Resources and University of Northern Iowa Center for Energy and Environmental Education. 2005. *Year 2000 Iowa Greenhouse Gas Emission Inventory.* Internet address: http://www.iowadnr.gov/air/prof/ghg/files/Iowa2000inventory.pdf.

[18] http://www.epa.gov/climatechange/emissions/downloads/IAInventorySummary_11-16b.pdf

[19] World Resources Institute. 2007. *Charting the Midwest: An Inventory and Analysis of Greenhouse Gas Emissions in America's Heartland.* Internet address: http://www.wri.org/publication/charting-the-midwest.

[20] Center for Climate Strategies. 2008. *Iowa Greenhouse Gas Inventory and Reference Case Projections 1990 – 2025.* Internet address: http://www.iaclimatechange.us/Inventory_Forecast_Report.cfm.

Table 1 - Historical Iowa State-wide GHG Emissions

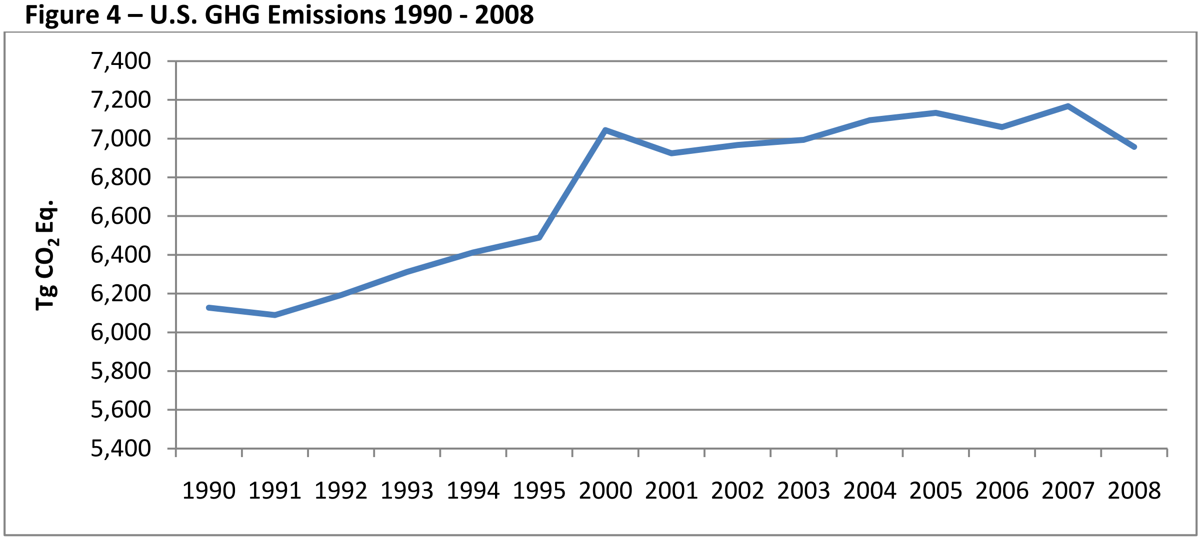
Emissions Year	Gross $MMtCO_2e$ (excludes sinks[21])	Net $MMtCO_2e$ (includes sinks)	Prepared By	Year Prepared
1990	78.7	NA	U of Iowa CGRER / DNR	1996
1990	83.6	77.4	UNI CEEE / DNR	2005
2000	120.3	96.1	UNI CEEE / DNR	2005
2003	108	NA	WRI	2007
1990	97.3	75.4	CCS for ICCAC	2008
2000	114.2	94.3		
2005	119.5	92.2		

National GHG Emissions

EPA develops the official GHG inventory for the nation each year. The national inventory is a top-down inventory and is submitted to the United Nations in accordance with the Framework Convention on Climate Change. The latest version, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2008,*[22] was released in April 2010 and found overall total US GHG emissions increased 14% from 1990 – 2008, but decreased 2.9% from 2007 – 2008 to 6,957 Tg CO_2 Eq. (1 Tg CO_2 Eq. = 1 $MMtCO_2e$)as shown in Figure 4. EPA explains the decrease from 2007 – 2008 as follows:

> "This decrease is primarily a result of a decrease in demand for transportation fuels associated with the record high costs of these fuels that occurred in 2008. Additionally, electricity demand declined in 2008 in part due to a significant increase in the cost of fuels used to generate electricity. In 2008, temperatures were cooler in the United States than in 2007, both in the summer and the winter. This lead to an increase in heating related energy demand in the winter, however, much of this increase was offset by a decrease in cooling related electricity demand in the summer." [23]

Figure 4 – U.S. GHG Emissions 1990 - 2008



[21] A sink is a natural system that takes in carbon dioxide and stores it for an indefinite period of time such as plants, trees, oceans and soils.

[22] U.S. EPA. 2010. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2008.* Internet address: http://www.epa.gov/climatechange/emissions/usinventoryreport.html.

[23] Ibid., p. ES-3.

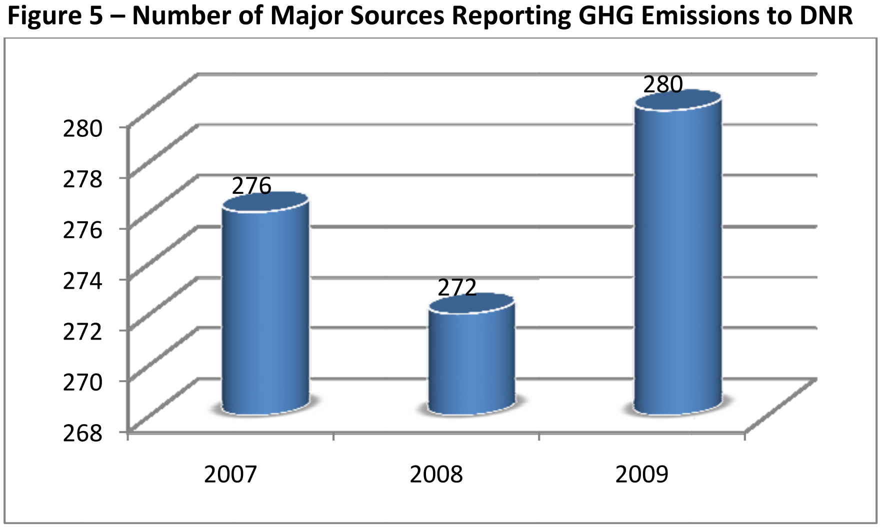
Chapter 2: 2009 GHG Emissions from Fossil Fuel Combustion at Major Sources

Overview

Title V of the 1990 federal Clean Air Act Amendments created a national operating permit program to standardize applicable requirements for major sources of air pollution. Facilities subject to this program are the largest federally-recognized sources of air pollution and are commonly referred to as major sources. In general, a facility is subject to the Title V operating permit program if it has an annual potential to emit[24] greater than 100 tons of either particulate matter less than 10 microns in aerodynamic diameter (PM_{10}), sulfur dioxide (SO_2), nitrogen oxides (NO_X), carbon monoxide (CO), or volatile organic compounds (VOC); or greater than ten tons per year of a single hazardous air pollutant (HAP); or greater than twenty-five tons of a combination of HAPs. EPA finalized its Prevention of Significant Deterioration (PSD) and Title V Tailoring Rule for greenhouse gases on May 13, 2010. Under this rule, facilities with the potential to emit 100,000 tons per year CO_2e or more will become subject to the Title V operating permit program on July 1, 2011. The Department estimates approximately sixty-five facilities will be reclassified as major sources due to their potential GHG emissions. The majority of the sixty-five sources fall into the three highest GHG-emitting SIC groups shown Appendix B of this report – electric, gas and sanitary services; chemical and allied products (include ethanol production); food and kindred products.

The number of facilities subject to the Title V operating permit program fluctuates as shown in Figure 5. This fluctuation occurs as facilities close, facilities open, or in some cases, facilities voluntarily reduce their emissions through construction permit limits so they are no longer subject to the program. In 2009, 280 facilities were subject to the Department's major source GHG reporting requirements, a slight increase from previous years. All 280 facilities were required to estimate and submit their calendar year 2009 GHG emissions to the Department by March 31, 2010.

Figure 5 – Number of Major Sources Reporting GHG Emissions to DNR

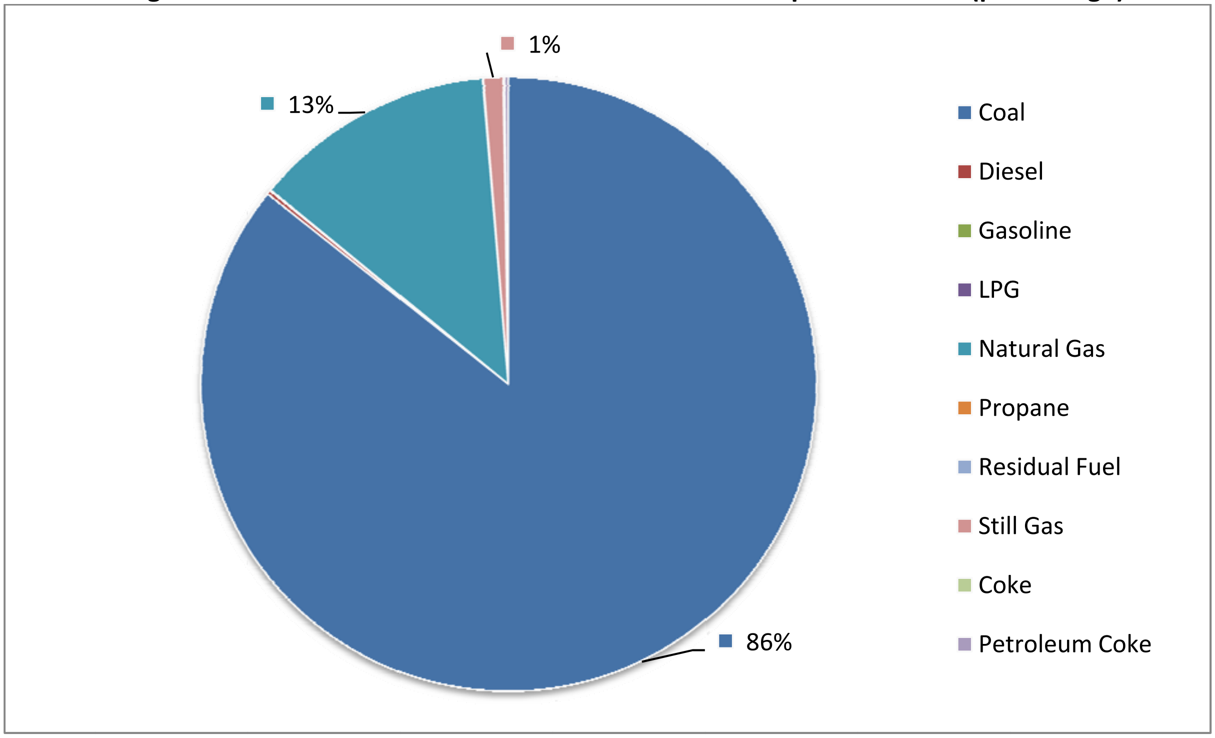


[24] See 567 IAC 22.100 for the complete definition of "potential to emit".

GHG Emissions

Total GHG emissions from fossil fuel combustion at major sources were calculated to be 51.44 $MMtCO_2e$,[25] a decrease of 9.1% from 2008 and a decrease of 2.7% from 2007. The combustion of two fuels – coal (85.7%) and natural gas (12.7%) continue to be the largest sources of GHG emissions, accounting for 98.4% of the GHG emissions. The remaining 1.6 percent of GHG emissions were from combustion of a variety of fuels such as diesel, gasoline, liquefied petroleum gas (LPG), propane, residual fuel, still gas, coke, and petroleum coke. Figure 6 shows the ratio of GHG emissions from each fossil fuel that was combusted. GHG emissions from the combustion of butane, crude oil, and kerosene rounded to 0.00 $MMtCO_2e$ and are not included in Figure 6.

Figure 6 – 2009 Fossil Fuel Combustion GHG Emissions per Fossil Fuel (percentage)



GHG Emissions from Coal Combustion

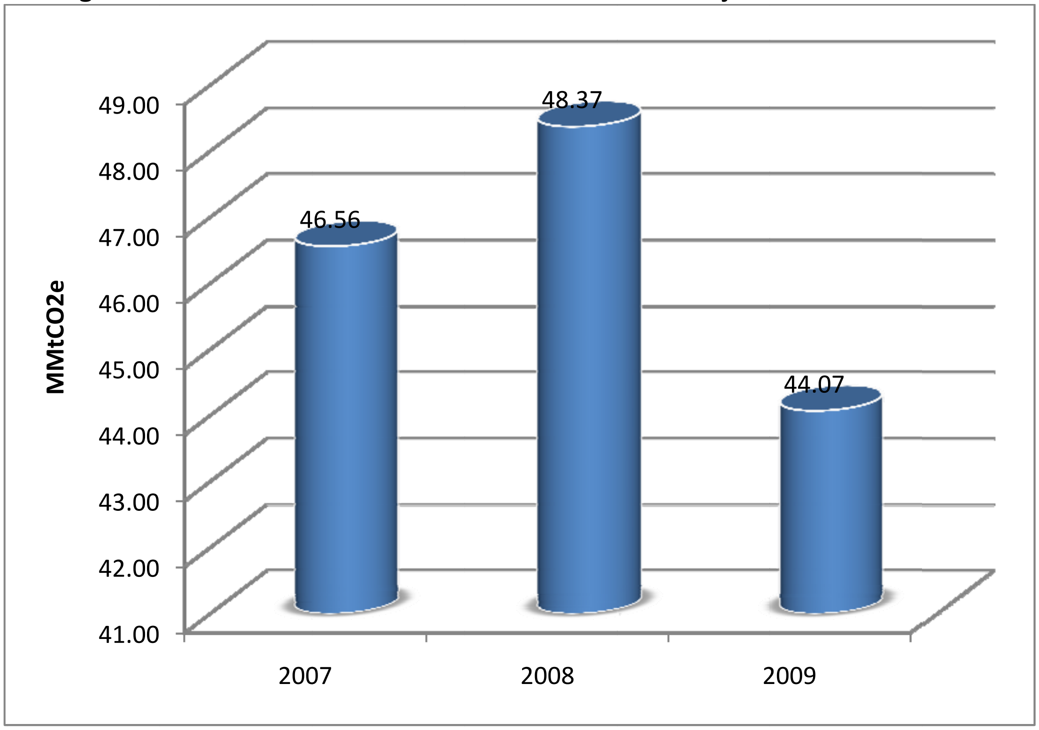
GHG emissions from coal combustion at major sources decreased 9% from 2008 – 2009 to 5% below 2007 levels as shown in Figure 7 on the next page. This correlates to a 7% reduction in the amount (in units of MMBtu) of coal combusted in 2009. The economic recession of 2009 and the rising price of coal compared to natural gas may have contributed to this decrease as discussed earlier in the Executive Summary. According to the Energy Information Administration, "the price of coal rose 6.8% from 2008 to 2009 while the comparable price of natural gas fell 48% on a per Btu basis."[26] For instance, Corn Belt Power Cooperative's Wisdom Generating Station in Spencer combusted 94% less coal in 2009 because they were able to purchase electricity more

[25] Includes fossil fuel combustion emissions from five ethanol wet mills and ten ethanol dry mills that are major sources.

[26] EIA, *U.S. Carbon Dioxide Emissions in 2009: A Retrospective Review*, May 5, 2010, http://www.eia.doe.gov/oiaf/environment/emissions/carbon/?featureclicked+2&

economically than operating their coal-fired boiler.[27] In addition, one coal-fired generating station, IPL – Sixth Street in Cedar Rapids did not combust any coal in 2008. It has not been operating since it was damaged in the Cedar Rapids flood of 2008.

Figure 7 – GHG Emissions from Coal Combustion at Major Sources 2007 – 2009



The ten largest sources of GHG emissions from fossil fuel combustion continue to be facilities with coal-fired units as shown in Table 2 on the next page. This is because the carbon content of coal is approximately 45% higher than the carbon content of natural gas.[28] There has been little change in the top ten lists over the past three years as shown in the rankings below. Nine of the ten facilities are electricity generating facilities. The other facility, ADM Corn Processing, operates coal-fired boilers to generate steam for their industrial processes. The GHG emissions from these ten facilities account for 73% of the total GHG emissions from fossil fuel combustion at major sources in 2009.

[27] March 8, 2010 email from Mike Thatcher, Corn Belt Power Cooperative, to Tim Grotheer, Iowa DNR.
[28] EIA, *U.S. Carbon Dioxide Emissions in 2009: A Retrospective Review*, May 5, 2010, http://www.eia.doe.gov/oiaf/environment/emissions/carbon/?featureclicked+2&

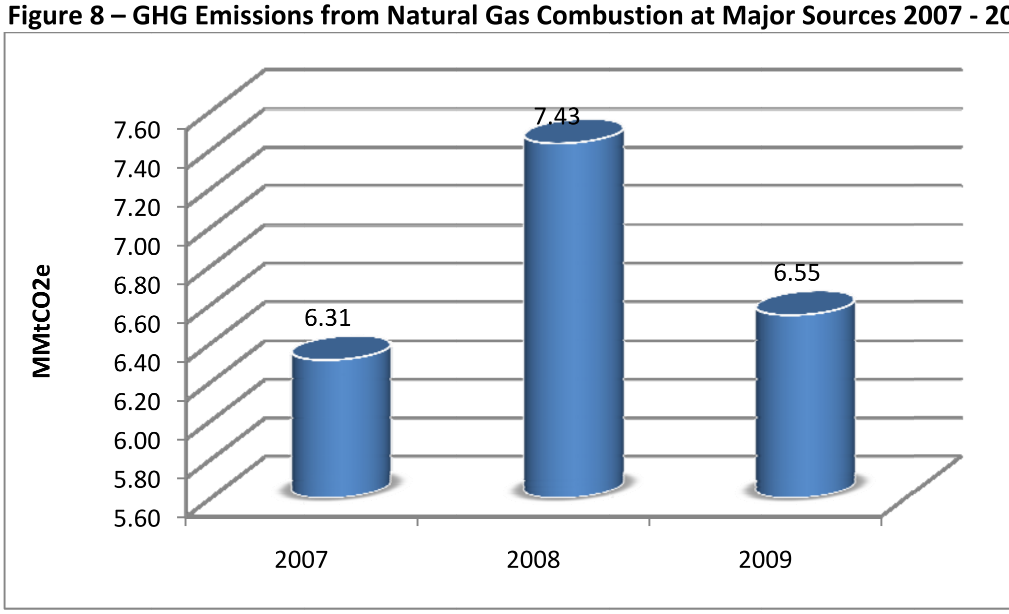
Table 2 - Ten Largest Sources of 2009 GHG Emissions from Fossil Fuel Combustion

Facility Name	City	2009 $MMtCO_2e$	2008 $MMtCO_2e$	2007 $MMtCO_2e$	2009 Rank	2008 Rank	2007 Rank
MidAmerican Energy Co. - Walter Scott Jr. Energy Center	Council Bluffs	10.58	10.94	9.14	1	1	1
MidAmerican Energy Co. - George Neal North	Sergeant Bluff	6.35	6.16	6.28	2	2	2
IPL - Ottumwa Generating Station	Ottumwa	4.52	4.93	4.26	3	3	4
MidAmerican Energy Co. - Louisa Station	Muscatine	4.43	4.70	3.66	4	4	5
MidAmerican Energy Co. - George Neal South	Sergeant Bluff	4.08	4.59	4.46	5	5	3
ADM Corn Processing	Cedar Rapids	2.21	2.39	2.38	6	6	6
Muscatine Power & Water	Muscatine	1.62	2.00	2.19	7	8	7
IPL - Lansing Generating Station	Lansing	1.44	2.05	1.91	8	7	8
IPL - Burlington Generating Station	Burlington	1.39	1.35	1.42	9	9	10
ADM Clinton Cogeneration	Clinton	1.10	0.80	NA[29]	10	14	NA
Total		**37.71**	**39.91**	**35.70**			

GHG Emissions from Natural Gas Combustion

Despite natural gas being less expensive in 2009 than 2008, the overall combustion of natural gas decreased 12% in 2009, resulting in a 12% reduction in GHG emissions as shown in Figure 8 below. This is most likely due to the economic recession leading to less demand for natural gas.

Figure 8 – GHG Emissions from Natural Gas Combustion at Major Sources 2007 - 2009

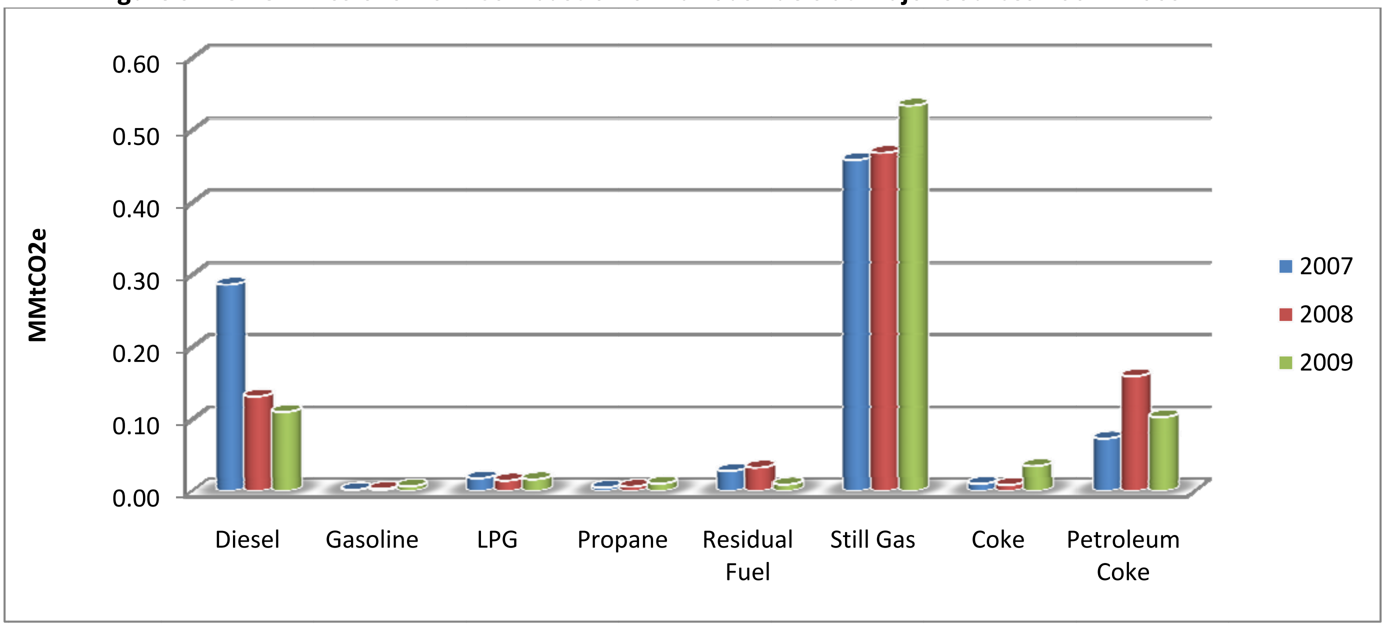


[29] New facility not operating until 2008.

GHG Emissions from Combustion of Other Fossil Fuels

As discussed in the overview for this chapter, 0.82 $MMtCO_2e$ or 1.6% of the GHG emissions from fossil fuels were from lesser-used fuels such as diesel, gasoline, liquefied petroleum gas (LPG), propane, residual fuel, still gas, coke, and petroleum coke. There is more variation in GHG emissions from these fuels as shown in Figure 9. GHG emissions from gasoline, LPG, propane, still gas, and coke increased while GHG emissions from diesel, residual fuel, and petroleum coke decreased.

Figure 9 – GHG Emissions from Combustion of Various Fuels at Major Sources 2007 - 2009



GHG emissions from combustion of combustion of coke increased 0.03 $MMtCO_2e$ or 308% from 2009. This is because a facility that had not reported GHG emissions from coke in previous years reported 0.03 $MMtCO_2e$ of GHG emissions from coke combustion in 2009. The Department's reporting form does not include a field to report calculate GHG emissions from coke, so the facility had not been reporting the resulting GHG emissions. This issue should be alleviated in the GHG reporting software for the federal Mandatory Reporting of Greenhouse Gases Rule.

Method

The Department developed reporting forms that were pre-filled with emission factors and calculations. The facilities entered their 2009 fossil fuel combustion. The reporting forms also allowed the facility to report CO_2 stack test data or CO_2 continuous emissions monitor (CEM) data if applicable.

GHG emissions from fossil fuel combustion were calculated using emission factors from the California Climate Action Registry's *General Reporting Protocol, Version 2.2* Tables C.5 and C.6 which is consistent with Intergovernmental Panel on Climate Change (IPCC) guidance. Copies of the reporting forms, including emission factors, are available at the Department's GHG website http://www.iowadnr.gov/air/prof/ghg/ghg.html. Stack test results, when available, were used in lieu of emissions factors because source-specific stack test results are typically more accurate than emission factors which are averaged from multiple stack test results. In general, emission factors are developed from source test data from facilities in an industrial category.

Continuous Emissions Monitor (CEM) Data

The Department used CEM data when it was available, and verified all CEM data submitted by comparing it to the values posted on EPA's Clean Air Markets Division (CAMD) website.[30] CEM data is more accurate than emissions calculated using emission factors because CEM data is continuously measured and verified annually through relative accuracy tests. Many of the units with CEMs combusted more than one fuel type. In order to calculate a total CO_2 value for each fuel type, the Department calculated the CO_2 emissions from each fuel using the appropriate emission factor, then applied the ratio of those emissions to the total CEM value. This ratio is further discussed in Chapter 3 under the heading "Key Uncertainties".

Conversion to Million Metric Tons of CO_2 Equivalent ($MMtCO_2e$)

Total GHG emissions were converted to $MMtCO_2e$ as shown below in Equation 1 using global warming potentials (GWPs) from the IPCC Second Assessment Report (SAR) (1996). The IPCC released its Fourth Assessment Report (AR4) in 2008 with new GWPs, but has not updated the GWPs in its published inventory method. The Department chose to use the GWPs from the SAR as shown in Table 3 because it is the nationally-accepted methodology, used by EPA in their national inventory and in the federal Mandatory Reporting of Greenhouse Gases Rule.[31]

Equation 1: $MMtCO_2 = 1\ ton\ \times \frac{9.072\ e^{-7}\ MMt}{1\ ton}$

$$MMtCO_2e = (MMtCO_2 \times GWP) + (MMtCH_4 \times GWP) + (MMtN_2O \times GWP)$$

$$MMtCO_2e = (MMtCO_2\ \times 1) + (MMtCH_4 \times 21) + (MMtN_2O\ \ \times 310)$$

Table 3 - Global Warming Potentials (GWP)

Pollutant	GWP
Carbon Dioxide	1
Methane	21
Nitrous Oxide	310
Fluorinated Gases (HFC, PFC, SF_6)	See Table 6 and Appendix F

Quality Assurance

The Department compared the reported 2009 and 2008 GHG emissions. If the GHG emissions increased or decreased significantly from 2008, the reason for the change in GHG emissions was further investigated per the Department's 2009 Greenhouse Gas (GHG) Inventory Preparation Plan. In 2009, over fifty GHG inventories were reviewed in-depth. In most cases, the reason for the significant change in GHG emissions could be determined by comparing the trend in GHG emissions to trends in the facility's criteria pollutant and HAP emissions, or by

[30] http://camddataandmaps.epa.gov/gdm/

[31] Federal Register, Vol. 74 No. 209, Table A-1 to Subpart A of Part 98, October 30, 2009.

looking at an existing emission inventory audit conducted by the DNR staff. In a few cases, the facility was contacted to verify the change or correct their GHG inventory.

Key Uncertainties

1. For 2008 and 2009, the Department updated the GHG reporting form to allow facilities to report their facility-specific heating value from their fuel supplier. This improved on a key uncertainty in 2007 when the Department assumed that facilities used a heating value of 1,050 million Btu (MMBtu) per million cubic feet (MMcf) of natural gas from Appendix A of EPA's AP-42 Compilation of Air Pollutant Emission Factors[32] for all facilities.

2. The Department applied a ratio of CO_2 emissions calculated using the emission factor for each fuel to CEMS data to determine the total CO_2 emissions from each fuel combusted. This method assumes that the emission factor for each fuel is of the same accuracy, when this is likely not the case. However, no alternative method was available.

3. GHG emissions from combustion of fossil fuels at Iron and Steel production facilities may be double-counted in this Chapter and in Chapter 5 – 2009 GHG Emissions from Industrial Sources. This is further discussed in Chapter 5 under the heading "Key Uncertainties".

4. The Department has been unable to determine the most accurate method to calculate GHG emissions from vapor combustion units (VCU) on loading racks at petroleum bulk terminals. VCUs are control devices used to combust vapors that escape when tanker trucks are filled with fuels such as diesel and gasoline. Several petroleum bulk terminals in Iowa are major sources required to report GHG emissions to the Department. They are currently using the emission factor for gasoline to calculate CO_2 emissions. This assumes that the vapors have the same CO_2 emissions as liquid gasoline, and does not account for any CH_4 or N_2O, if any, emitted.

   Neither EPA nor The Climate Registry has any specific guidance on calculating GHG emissions from this activity, and this activity is not included in the federal Mandatory Reporting of Greenhouse Gases rule. Both organizations directed the Department to the American Petroleum Institute's *2009 Compendium of Greenhouse Gas Emission Methodologies for the Oil and Natural Gas Industry* for guidance. The *Compendium* does provide an example calculation for a thermal oxidizer from crude oil loading at a terminal,[33] but does not provide an example calculation for a VCU at a gasoline loading rack. It also indicates that CH_4 is emitted and can be calculated using the CH_4 content of the fuel and the CH_4 destruction efficiency.

5. The Department's GHG reporting form for major source facilities does not include a calculation for combustion of petroleum coke, but does include calculations for various subtypes of coal such as

[32] www.epa.gov/ttn/chief/ap42

[33] American Petroleum Institute. 2009. *Compendium of Greenhouse Gas Emission Methodologies for the Oil and Natural Gas Industry,* pp. 4-52 – 4-53.

commercial, industrial, industrial coking, institutional, and utility. In some cases, facilities that are actually using petroleum coke have been reporting it instead as industrial coal or industrial coking. Any resulting difference in emissions in CO_2 emissions is not significant as the CO_2 emission factors vary by less than 1%. This issue should be alleviated next year in the GHG reporting software for the federal Mandatory Reporting of Greenhouse Gases Rule.

Chapter 3: 2009 GHG Emissions from Ethanol Production

Overview

Direct GHG emissions from ethanol production come from two primary sources – fermentation and fossil fuel combustion. During the dry mill process the corn kernels are ground into flour before processing. Bi-products created are distillers grain with solubles (DGS), which may be sold as livestock feed, and CO_2, which may be sold for use in food processing and bottling. In wet mill production, the corn is steeped before processing. Wet mills often produce other co-products such as starches, corn syrups, feeds, and oils.

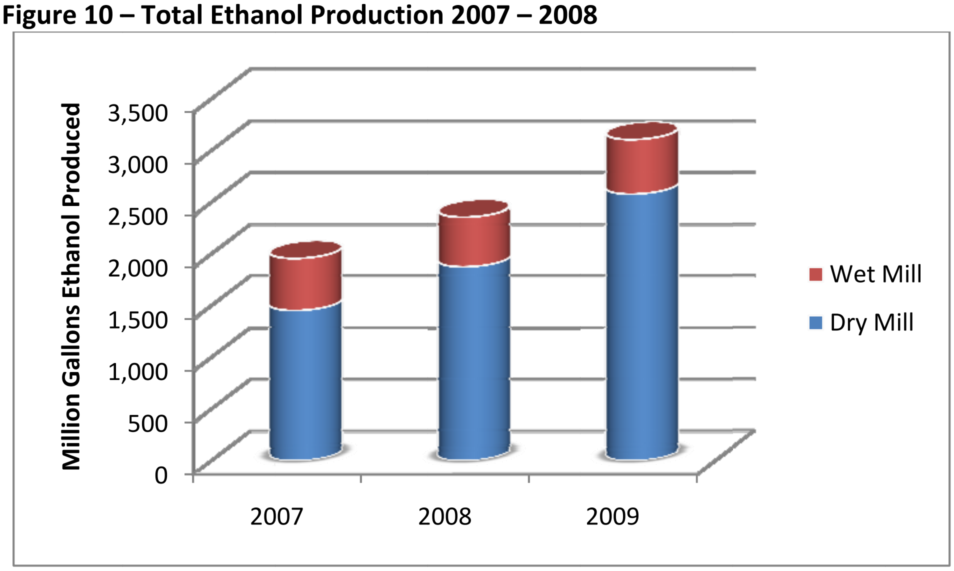
Dry mills and wet mills are evaluated separately in this chapter because wet mill plants are not able to definitively calculate the amount of fossil fuels combusted solely for ethanol production versus the amount used to produce co-products.

This inventory does not include any type of life-cycle analysis for ethanol production. More information on life cycle analysis can be found on EPA's web site at http://www.epa.gov/otaq/fuels/renewablefuels/index.htm.

Ethanol Production

Total ethanol production has increased steadily from 2007 – 2009 as new plants have come online. Dry mill ethanol production increased 38% from 2008 to 2009. Three new dry mill plants began production in 2009 and one ceased production, raising the number of operating dry mill plants in 2009 to thirty-four, and increasing production from 1,877 million gallons to 2,581 million gallons (38%) as shown in Figure 10. Five wet mill ethanol plants operated in Iowa in 2009. There were 527 million gallons of denatured ethanol produced at wet mills in 2009, a 10% increase in production from 2008.

Figure 10 – Total Ethanol Production 2007 – 2008



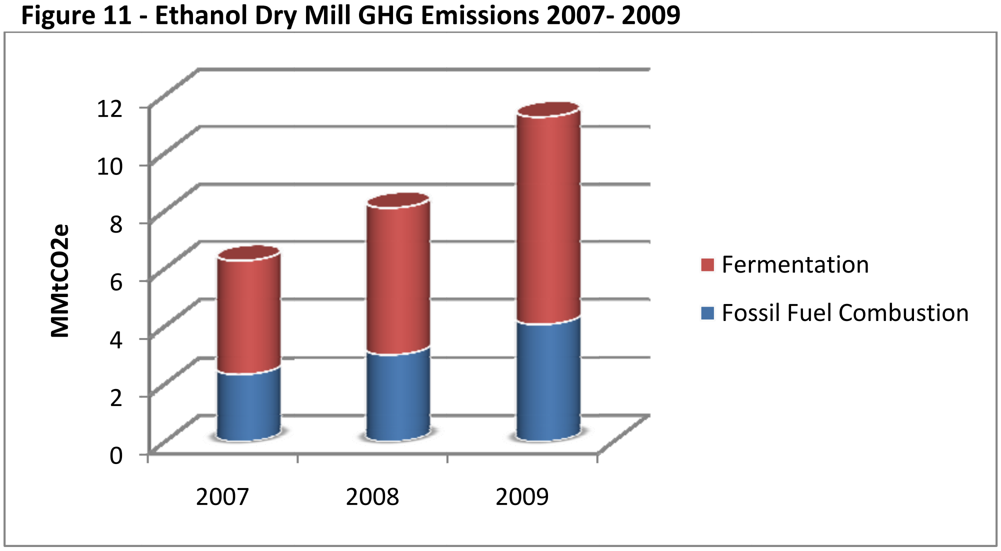
Ethanol Dry Mill GHG Emissions

GHG emissions from dry mill ethanol production come from two primary sources – fermentation and fossil fuel combustion. Fossil fuels are combusted for various activities such as the drying of DGS and the heating of process water.

CO_2 emissions from fermentation are reported separately in this inventory because they are biogenic emissions. According to The Climate Registry's General Reporting Protocol, they are considered biogenic "because the carbon in biomass is of a biogenic origin—meaning that it was recently contained in living organic matter—while the carbon in fossil fuels has been trapped in geologic formations for millennia."[34] Because of this biogenic origin, the Intergovernmental Panel on Climate Change (IPCC) *Guidelines for National Greenhouse Gas Inventories* requires that biogenic CO_2 emissions be counted separately. The fermentation and fossil fuel GHG emissions for all Iowa dry mill ethanol plants can be found in Appendix E of this report.

Total GHG emissions from dry mill ethanol production were calculated to be 11.25 $MMtCO_2e$. Fermentation GHG emissions accounted for 7.19 $MMtCO_2e$ of the total GHG emissions as shown in Figure 11 below, an increase of 41% from 2008. This includes 0.05 $MMtCO_2e$ that one dry mill plant reported they captured and sold to a neighboring CO_2 recovery plant.

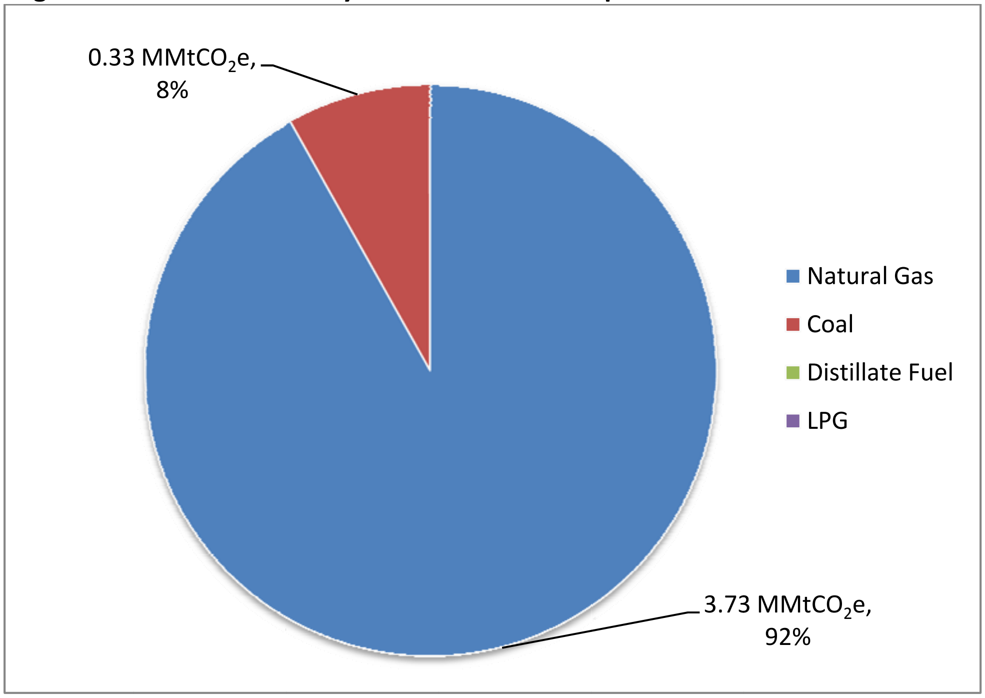
Figure 11 - Ethanol Dry Mill GHG Emissions 2007- 2009



Fossil fuel combustion accounted for 4.06 $MMtCO_2e$ of the total GHG emissions as shown in Figure 11 above, a 35% increase from 2008. Two dry mill plants combust coal as their primary fuel. The other thirty-two dry mill plants combust natural gas as their primary fuel, accounting for 92% of the total fossil fuel GHG emissions as shown in Figure 12 on the next page. GHG emissions from combustion of LPG (146.14 metric tons CO_2e) and diesel fuel (322.15 metric tons CO_2e) calculated to be less than 0.00 $MMtCO_2e$ and are not shown in Figure 12.

[34] *The Climate Registry General Reporting Protocol*, Version 1.1, p. 33, May 2008.

Figure 12 - 2009 Ethanol Dry Mill GHG Emissions per Fossil Fuel



The GHG emissions from all thirty-four dry mill ethanol plants are included in this report as Appendix E, but the ten largest GHG-emitting dry mill ethanol plants are shown in Table 4 below. Except in one case, Big River Resources, the facilities producing the largest amounts of ethanol also emit the most greenhouse gases. Big River Resources reported combusting more natural gas in 2009 than other plants producing similar amounts of ethanol, resulting in higher GHG emissions from fuel combustion.

Table 4 - Ten Largest Sources of 2009 Ethanol Dry Mill GHG Emissions

Facility Name	City	2009 Million Gallons Produced	2009 $MMtCO_2e$ from Fermentation	2009 $MMtCO_2e$ from Fuel Combustion	2009 Rank	2008 Rank
Valero Renewable Fuels Company, LLC	Charles City	126.5	0.35	0.19	1	3
Platinum Ethanol	Arthur	117.5	0.33	0.17	2	29[35]
Valero Renewable Fuels Company, LLC	Hartley	111.6	0.31	0.18	3	23[35]
Valero Renewable Fuels Company, LLC	Fort Dodge	112.4	0.31	0.18	4	4
Hawkeye Shell Rock LLC	Shell Rock	110.4	0.31	0.17	5	28[35]
Hawkeye Menlo, LLC	Menlo	110.1	0.31	0.16	6	26[35]
Big River Resources, LLC	W. Burlington	101.6	0.28	0.18	7	7
Hawkeye Renewables, LLC	Fairbank	109.2	0.30	0.16	8	1
Golden Grain Energy	Mason City	108.0	0.30	0.16	9	2
Hawkeye Renewables, LLC	Iowa Falls	106.0	0.29	0.17	10	6
Total		**1,113.3**	**3.09**	**1.72**	**Rank**	

[35] Facility did not begin production until late 2008.

Ethanol Wet Mill GHG Emissions

In wet mill production, the corn is steeped before processing. Wet mills often produce other co-products such as starches, corn syrups, feeds, and oils. Five wet mill ethanol plants operated in Iowa in 2009 as shown in Table 5. GHG emissions are directly correlated to the amount of ethanol produced. There were 527 million gallons of denatured ethanol produced in 2009, resulting in 1.46 $MMtCO_2e$ of GHG emissions from the fermentation process. This is a 10% increase in production and a 12% increase in fermentation GHG emissions from 2008 as shown in Figure 13. When compared to 2007, production increased 5% and fermentation GHG emissions increased 7%. As discussed earlier in this chapter, the Department was not able to quantify the amount of fossil fuels combusted solely for wet mill ethanol production versus the amount used to produce co-products.

Figure 13 - Ethanol Wet Mill Fermentation GHG Emissions 2007 – 2009

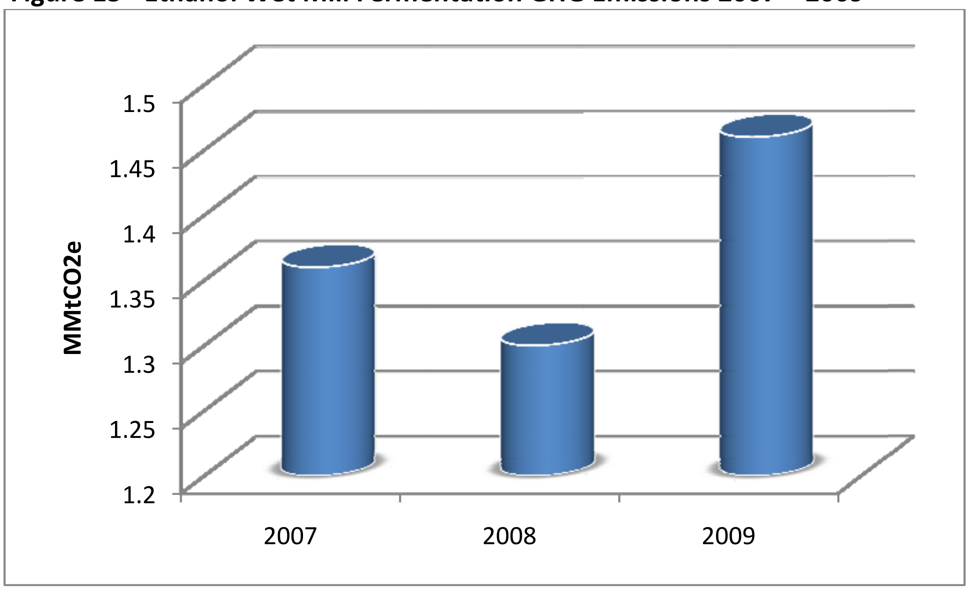


Table 5 - 2009 Ethanol Wet Mill Production and GHG Emissions

Facility Name	City	2009 Million Gallons Produced	2009 $MMtCO_2e$ from Fermentation	2009 Rank	2008 Rank
ADM Corn Processing	Cedar Rapids	250	0.70	1	1
ADM	Clinton	153	0.43	2	2
Grain Processing Corporation	Muscatine	49	0.13	3	3
Penford Products	Cedar Rapids	39	0.11	4	5
Cargill	Eddyville	35	0.10	5	4
Total		**527**	**1.46**		

Method

GHG emissions data was collected from fossil fuel combustion as described under the Method section of the "Summary of Findings" of this inventory. Methods specific to the ethanol sector included the following:

Fermentation

CO_2 emissions from fermentation for each dry mill ethanol facility are shown in detail in Appendix E. CO_2 emissions from the five wet mill ethanol plants are shown earlier in Table 5. CO_2 emissions were calculated using mass balance equations that derive CO_2 emissions from the gallons of denatured ethanol (EtOH) produced.

In 2007 and 2008, CO_2 emissions were calculated assuming that the ethanol produced contained 5% denaturant. However, the Department learned that 5% was no longer an accurate denaturant content because several entities have various requirements for denaturant content. Using 5% resulted in fermentation GHG emissions being under-estimated. According to the Renewable Fuels Association (RFA), requirements for denaturant content include:

- The Alcohol and Tobacco Tax and Trade Bureau (TTB) allows differing denaturant amounts depending on whether the ethanol plant is permitted as a distilled spirits or alcohol fuel plant;
- The American Society for Testing and Materials (ASTM) restricts the maximum amount to 5% per a letter they received from the TTB;
- The 2008 Food Conservation and Energy Act of 2008 restricts the full Volumetric Ethanol Excise Tax Credit (VEETC) amount to ethanol that has no more than 2% denaturant content; and
- The Internal Revenue Service's (IRS) interpretation of the restriction on denaturant content and impact to tax credit eligibility has in essence moved the ethanol industry to no more than 2.49% denaturant content.

So today, the industry is restricted to 1.96% denaturant as a minimum to avoid liquor tax and 2.49% denaturant as a maximum for full VEETC.[36] For 2009, the Department refined its fermentation GHG emissions estimation by allowing facilities to use their facility-specific denaturant percentage. The values used ranged from 0.975 (2.5%) – 0.980 (2%), with an average value of 0.976 (2.4%).

The equations used were:

Equation 2: $C_6H_{12}O_6 + yeast = 2\ CH_3CH_2OH + 2\ CO_2$
sugar + yeast = ethanol + carbon dioxide

Assumptions:

$$gallons\ denatured\ EtOH\ produced\ \times ((100 - \%\ denaturant) \div 100) = gallons\ 200\ proof\ EtOH$$[37]

[36] August 24, 2010 email from Kristy Moore, Renewable Fuels Association, to Marnie Stein, Iowa DNR.

[37] For instances where the facility-specific denaturant content was unknown, the Department assumed denatured ethanol typically is 2.5% gasoline and 97.5% 200 proof ethanol.

Equation 3: $gallons\ 200\ proof\ EtOH \times \frac{0.789g\ EtOH}{1\ cm^3} \times \frac{3785.41cm^3}{gallons} \times \frac{1\ mol\ EtOH}{46.06844g\ EtOH} \times \frac{2\ mol\ CO_2}{2\ mol\ EtOH} \times \frac{44.0095g\ CO_2}{mol\ CO_2} \times \frac{1\ lb}{453.59g} \times \frac{1\ ton}{2000\ lbs} = tons\ CO_2$

Key Uncertainties

The Department periodically requires stack tests to be conducted by various stationary sources to determine compliance with applicable air emission limits. The percentage of CO_2 in the exhaust stream is sometimes measured during the tests. The Department compared the total amount of CO_2 calculated with emission factors and the mass balance equation to the percentage of CO_2 measured during stack testing conducted at each facility using the following equation to correct for ambient CO_2:

Equation 4: *CO_2 (lbs/hr) = (CO_2%-0.03)*0.001142*flowrate in dscfm*60*

The results showed that the GHG emissions calculated using test data varied widely per facility, both higher and lower, from the Department's calculations using Equations 2 and 3. Reasons for these deviations may include:

Uncertainty in Emission Testing Data

1. Operating capacity and flow rate during stack test vs. typical operations:
   The Department requires that the units being tested should be operated in a normal manner at its maximum continuous output as rated by the equipment manufacturer, or the rate specified by the owner as the maximum production rate at which this units will be operated. Based on conversations with several operating ethanol facilities, plants typically run one boiler at 50-60% capacity and have the second boiler produce the remainder of the steam necessary. The second boiler typically operates between 30 to 50% capacity, depending on the plant needs and a number of other variables including number of fermentation vessels operating, stage of fermentation, ambient temperature, etc. Since the conversion from percentage CO_2 during the test is dependent on flow rate, if the flow rate during normal operation varies during the test, the calculated CO_2 emissions will also vary.

2. Fermentation stage:
   The stack test reports do not document which stages of fermentation the test was conducted. CO_2 emissions during fermentation are not constant. They increase to a peak and then decrease during the cycle and also change with temperature. It is unknown if tests were conducted during the low or high points of this emission curve.

Uncertainty in the Calculation Methods Used

1. The Department used the best available emission factors, but emission factors for fossil fuel combustion were not developed from data collected from testing preformed at ethanol plants.

2. Equation 3 assumes all carbon not converted to alcohol was converted to CO_2 and is therefore a conservative estimate. It does not account for carbon that may have formed other pollutants such as

acetaldehyde, formaldehyde, etc. Some yeast is less tolerant to heat and other conditions and may produce more off-products such as acetaldehyde and less ethanol.

Next Steps or Future Improvements

The Department continues to investigate the differences between fermentation GHG emissions calculated by mass balance and GHG emissions calculated from test data. One improvement would be to record information regarding the status of the fermentation cycle when the stack test is conducted.

Chapter 4: 2009 Emissions of Fluorinated Gases (HFC, PFC, and SF_6)

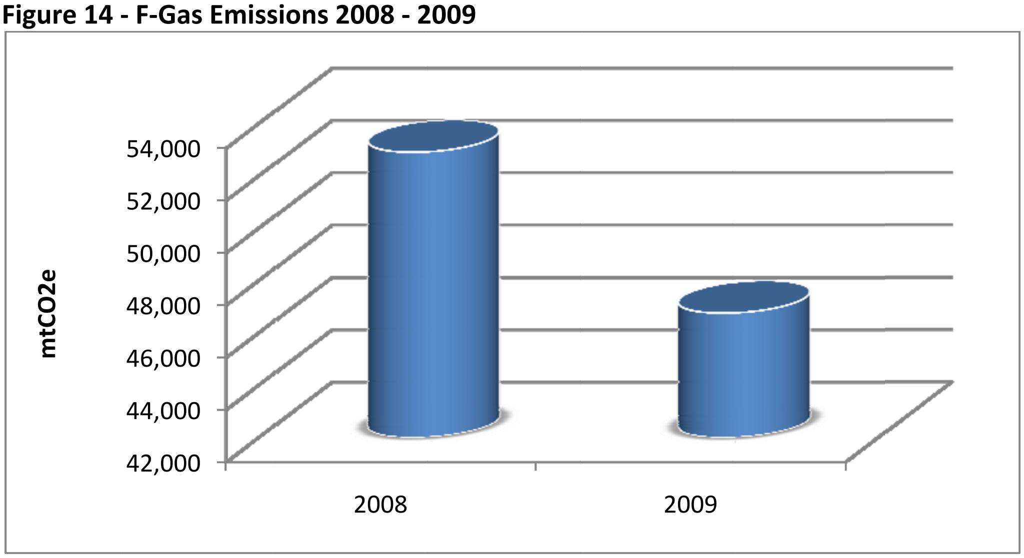
Overview

Two years ago the Department expanded the scope of its GHG inventory to include emissions of three additional GHGs – hydrofluorocarbons (HFC), perfluorocarbons (PFC), and sulfur hexafluoride (SF_6), also known as fluorinated gases or "F-gases". All facilities with major source operating permits were required to complete a spreadsheet to calculate emissions from HFC, PFC, and SF_6. The spreadsheet is available at the Department's GHG website http://www.iowadnr.gov/air/prof/ghg/ghg.html. HFC and PFC may be emitted from refrigerants, air conditioning systems, fire suppression and explosion protection, and solvent cleaning. HFC may also be emitted from foam blowing and aerosols. Sources of SF_6 may include blanketing molten magnesium, aluminum recycling, thermal and sound insulation, high voltage insulation, etc. However, the majority of SF_6 emissions come from electricity transmission lines and distribution, which was not included in the inventory. The Department did not include SF_6 emissions from electricity transmission lines and distribution in the 2008 or 2009 inventories because SF_6 emissions are usually attributed to electricity companies, not individual generation facilities, and the Department did not have the resources to develop specific reporting forms for this sector.

PFC, HFC, and SF_6 Emissions

A list of each facility and its reported F-gas emissions is included in this report as Appendix F. No facilities reported emissions of PFC in either 2008 or 2009, but sixteen facilities reported emissions of five different HFC in 2008 and twenty-one facilities reported emissions of six different HFC in 2009. Two facilities reported emissions of SF_6 in 2009, while no SF_6 emissions were reported in 2008. Total F-gas emissions decreased 12% from 2008 – 2009 as shown in Figure 14 below and Table 6 on the next page.

Figure 14 - F-Gas Emissions 2008 - 2009



Other trends in F-gas emissions were:

- Emissions of HFC-245a decreased by 48,565.55 metric tons carbon dioxide equivalents ($mtCO_2e$) from 2008 – 2009 as shown in Table 6 below. This is because the largest user of HFC-245a, Whirlpool Corporation in Amana, consumed all of the HFC-245a (1,220,865.31 $mtCO_2e$) they added to their manufacturing processes in 2009, while in 2008 they emitted 48,636.22 $mtCO_2e$. Whirlpool manufactures appliances such as refrigerators.

- 32,490.60 $mtCO_2e$ of SF_6 was emitted in 2009, while no emissions of SF_6 were reported in 2008. Two facilities, Curwood, Inc. in Centerville and Bridgestone Americas Tire Operations in Des Moines use this potent greenhouse gas that is 23,600 times more heat-absorptive than carbon dioxide per unit of weight. Because SF_6 is an inert gas, both facilities use SF_6 to prevent explosions and arcing in their curing processes.

Table 6 – Fluorinated Gas Emissions 2008 - 2009

Common Name	Name	2009 $mtCO_2e$[38]	2008 $mtCO_2e$	% Change
HFC-125	pentafluoroethane	811.38	0	NA
HFC-134	1,1,2,2-tetrafluoroethane	0.00	396.9	-100%
HFC-134a	1,1,1,2-tetrafluoroethane	13,344.88	3,852.03	246%
HFC-143a	1,1,1-trifluoroethane	24.13	0	NA
HFC-152a	1,1-difluoroethane	0.07	3.22	-98%
HFC-23	trifluoromethane	1.58	5.31	-70%
HFC-245fa	1,1,1,3,3-pentafluoropropane	86.18	48,651.73	-100%
SF6	sulfur hexafluoride	32,490.60	0	NA
	TOTAL	**46,758.81**	**52,909.19**	**-12%**

Method

Emissions were calculated using a mass balance equation that derives emissions from a facility's inventory of HFC, PFC, and SF_6, subtracting the quantity consumed and quantity recovered as shown in Equation 5 below. Emissions were then converted to metric tons (mt) using Equation 6, $mtCO_2e$ using Equation 7, and $MMtCO_2e$ using Equation 8.

Equation 5: $\text{Emissions (lbs.)} = \text{Quantity Added (lbs.)} - \text{Quantity Consumed (lbs.)} - \text{Quantity Recovered (lbs.)}$

Equation 6: $mt\ HFC = lbs.Fgas \times \frac{1\ ton}{2000\ lbs} \times \frac{0.9072\ mt}{ton} \times \frac{MMt}{1{,}000{,}000}$

Equation 7: $mtCO_2e = mt\ Fgas \times GWP$

Equation 8: $MMtCO_2e = mtCO2e \times \frac{MMtCO2e}{1{,}000{,}000\ mtCO2e}$

[38] F-gas emissions are reported in this chapter in units of metric tons of carbon dioxide equivalents ($mtCO_2e$) because the emission from a majority of the F-gases would round to less than 0.00 $MMtCO_2e$.

Key Uncertainties

1. The number of facilities reporting emissions of an F-gas increased from sixteen in 2008 to twenty-three in 2009. However, it is uncertain if this increase is because facilities that did not previously emit F- gases began emitting F-gases, or because more facilities became aware of the new F-gas reporting requirements. Unlike throughputs from fossil fuel combustion, industrial processes, and ethanol production, F-gas throughputs cannot be verified by comparing them to a facility's Title V criteria pollutant and HAP emission inventory because they are not otherwise required to be reported.

2. Again this year, several facilities stated that they do not keep records of F-gas emissions of less than fifty pounds, and several also indicated that they used R-22, a chemical that is not subject to the inventory reporting requirements.

Chapter 5: 2009 GHG Emissions from Industrial Sources

Overview

GHG emissions are released as a by-product of many industrial processes such as production or manufacturing of adipic acid, aluminum, ammonia, cement, electronics, ethanol, ferroalloys, fluorinated greenhouse gases, glass, HCFC-22, hydrogen, iron and steel, lead, lime, magnesium, nitric acid, phosphoric acid, soda ash, semi-conductors, titanium dioxide, and other products. However, many of these products are not manufactured in Iowa. A review of Iowa industries showed seven industrial source categories that may emit GHG emissions: ammonia production and urea application (SIC 2873), cement manufacturing (SIC 3241), ethanol production (SIC 2869), iron and steel production (SIC 3312), lime manufacturing (SIC 3274), nitric acid production (SIC 2873), and soda ash consumption (SIC 2046, 284, 2819, 32).

In December 2008, the Department expanded the scope of Iowa's mandatory reporting program to include all seven of these source categories. The Department created a reporting spreadsheet for soda ash consumption, but for the other five categories the Department required affected facilities to use calculation tools provided by the *Greenhouse Gas Protocol* (GHG Protocol)- (http://www.ghgprotocol.org/calculation-tools/all-tools). A partnership between two reputable groups, the World Resources Institute (WRI) and World Business Council for Sustainable Development (WBSCD), the *GHG Protocol* is used internationally by governments, companies, and organizations such as The Climate Registry to quantify GHG emissions and is consistent with IPCC methods. In general, the GHG emissions reported in this chapter do not include GHG emissions from fossil fuel combustion as they are already reported in Chapter 2. However, GHG emissions from fossil fuel combustion at Iron and Steel facilities may be double-counted in Chapter 2 and this chapter. This is further discussed in the "Key Uncertainties" section at the end of this chapter.

Total GHG emissions from the six industrial source categories decreased 0.62 MMtCO2e, or 20%, from 2008 as shown in Figure 15 below. The emissions from each individual source category are shown in Figure 16 on the next page.

Figure 15 – GHG Emissions from Industrial Sources 2008 - 2009

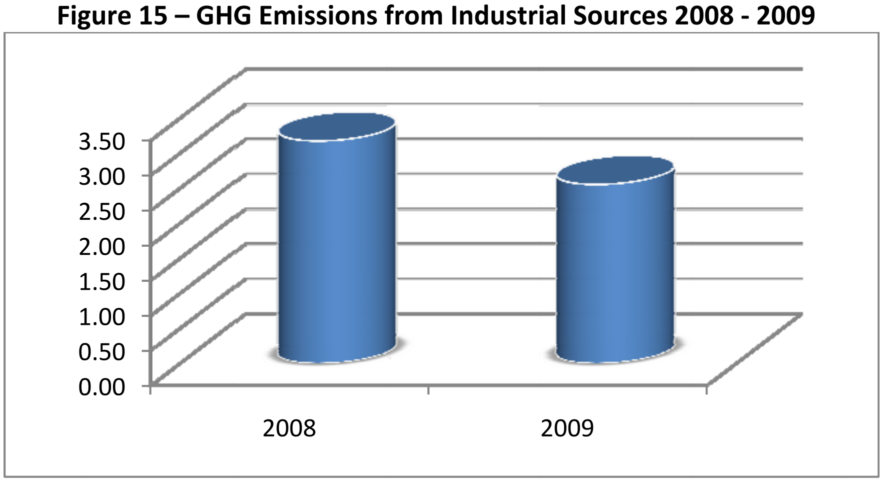
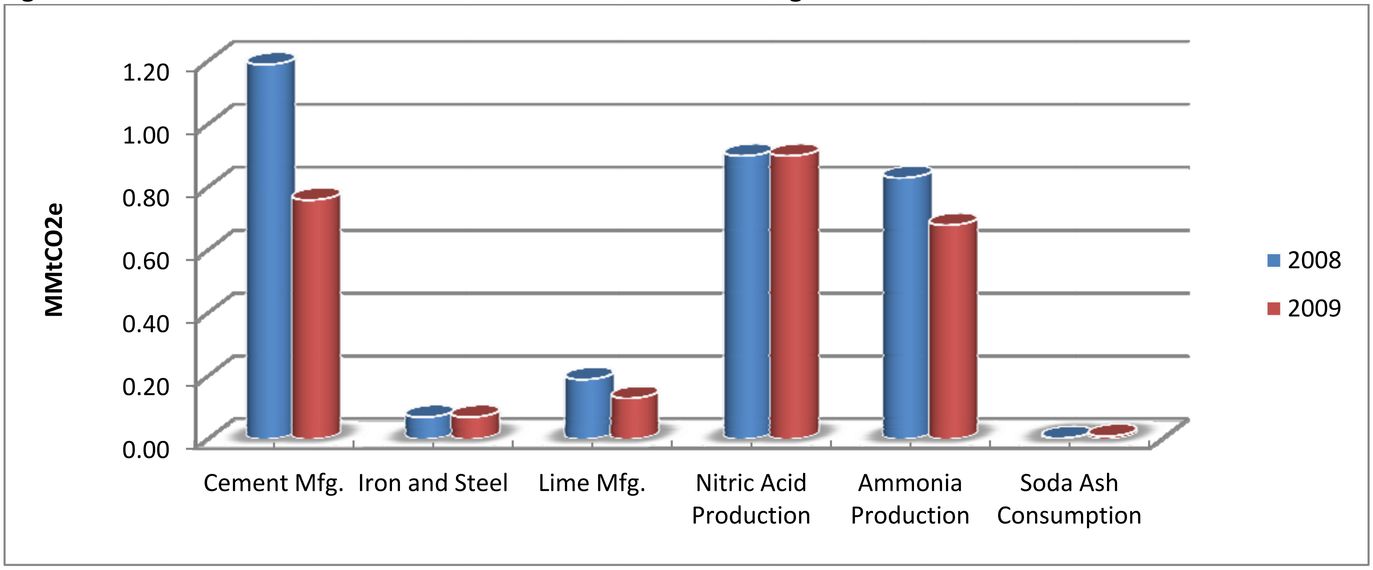


Figure 16 – GHG Emissions from Individual Industrial Source Categories 2008 – 2009



Cement Manufacturing

CO_2 is emitted during a process called calcining when limestone ($CaCO_3$) is heated in a cement kiln to form lime (CaO) and CO_2.

$$CaCO_3 + Heat \rightarrow CaO + CO_2$$

The lime is then mixed with silica-containing materials such as clay "to form dicalcium or tricalcium silicates, two of the four major compounds in cement clinker, an intermediate product from which finished Portland and masonry cement are made (Griffin 1987), while the CO_2 is released into the atmosphere."[39]

For the 2007 inventory, the Department calculated CO_2 emissions from cement kilns by applying an emission factor of 1,800 lb CO_2/ton of clinker from EPA's Web FIRE emission factor database to the clinker production reported by the three manufacturers in their annual major source inventories, resulting in total GHG emissions of 2.21 $MMtCO_2e$. This emission factor is rated "poor" by EPA because the factor is developed from average and below-average test data from a small number of facilities that may not be an adequate sample of the source category.[40] For 2008 and 2009, the Department required the facilities to calculate and report their facility-specific GHG emissions using worksheets from the *GHG Protocol*. These worksheets use a more refined mass balance calculation method that calculates GHG emissions using the clinker to cement ratio. Lafarge North America Inc. and the Lehigh Cement Company used the *GHG Protocol*, while Holcim (US) Inc. used their own custom worksheet that was developed by WBSCD but calculates GHG emissions similarly. The total GHG emissions reported in 2009 were 36% lower than 2008 as shown in Table **7** on the next page.

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[39] STAPPA/ALAPCO and U.S. EPA. 2004. *Emission Inventory Improvement Program (EIIP) Volume VIII: Greenhouse Gases*, p. 6-4.1.

[40] U.S. EPA, January 1995. *AP-42 Compilation of Air Pollutant Emission Factors*, Introduction, p. 10.

Table 7 - Cement Manufacturing GHG Emissions 2008 – 2009

Facility ID	Facility Name	2009 $MMtCO_2e$	2008 $MMtCO_2e$	2007 $MMtCO_2e$	% Change 2008 - 2009
17-01-009	Holcim (US) Inc.	0.16	0.46	0.82	- 65%
82-04-005	Lafarge North America Inc.	0.41	0.44	0.81	-7 %
17-01-005	Lehigh Cement Company	0.19	0.29	0.59	-35%
	Total	**0.76**	**1.19**	**2.21**	**-36%**

Iron and Steel Mills

Iron and steel production is an energy-intensive process that also generates process-related GHG emissions. Steel is produced from pig iron in a variety of specialized steel-making furnaces, including electric arc furnaces (EAFs) and basic oxygen furnaces (BOFs).[41] Two iron and steel facilities, Gerdau Ameristeel US, Inc. and SSAB Iowa Inc., operate in Iowa and use EAFs to produce steel. These furnaces use carbon electrodes, coal, natural gas, and other substances such as limestone and dolomite to aid in melting scrap and other metals, which are then improved to create the preferred grade of steel. In EAFs, CO_2 emissions result primarily from the consumption of carbon electrodes and also from the consumption of supplemental materials used to augment the melting process.[42] GHG emissions from iron and steel mills were calculated using the iron and steel worksheet from *the GHG Protocol.*

In the 2008 GHG inventory, the 2008 GHG emissions for Gerdau Ameristeel Us, Inc were misreported by DNR as 0.01 $MMtCO_2e$. The correct value was 0.03 $MMtCO_2e$. After making that adjustment, GHG emissions were calculated to have increased 3% from 2008 – 2009. While the total amount of steel produced decreased 25% in 2009, the overall GHG emissions slightly increased as shown in Table 8. This is due to consumption of supplemental materials in the EAF at one of the facilities.

Table 8 - Iron and Steel Production GHG Emissions 2008 - 2009

Facility ID	Facility Name	2009 $MMtCO_2e$	2008 $MMtCO_2e$	% Change
70-03-003	Gerdau Ameristeel US Inc.	0.03	0.03[43]	-8%
70-08-002	SSAB Iowa Inc	0.05	0.04	+10%
	Total	**0.07**[44]	**0.07**	**+3%**

Lime Manufacturing

Similar to cement manufacturing, lime is produced by heating limestone in a kiln, creating lime (CaO) and CO_2.

$$CaCO_3 + Heat \rightarrow CaO + CO_2$$

[41] U.S. EPA. April 2009. *2009 U.S. Greenhouse Gas Inventory Report,* p. 4-35 – 4-36.
[42] U.S. EPA. April 2009. *2009 U.S. Greenhouse Gas Inventory Report,* p. 4-35 – 4-36.
[43] DNR misreported 2008 value as 0.01 $MMtCO_2e$. The correct value is 0.03 $MMtCO_2e$.
[44] Total does not match sum of individual values due to rounding.

The CO_2 is typically released to the atmosphere, leaving behind a product known as quicklime, which can then be used to produce other types of lime.[45] Iowa has one lime manufacturer, Linwood Mining & Minerals Corporation, in Buffalo, Iowa. Linwood used *the GHG Protocol's* lime manufacturing worksheet to calculate 0.13 $MMtCO_2e$ of GHG emissions from its manufacturing processes as shown in Table 9. Linwood produced 20% less lime in 2009, resulting in a 30% decrease in GHG emissions from 2008. The relationship between production and GHG emissions is not linear because the ratio of magnesium oxide (MgO) used in the GHG calculation can vary from year to year.

Table 9 - Lime Manufacturing GHG Emissions 2008 – 2009

Facility ID	Facility Name	2009 $MMtCO_2e$	2008 $MMtCO_2e$	% Change
82-01-015	Linwood Mining & Minerals Corporation	0.13	0.19	-30%

Nitric Acid Production

Nitrous oxide (N_2O) is produced when ammonia is oxidized to produce nitric acid. Two Iowa facilities produced a total of 446,447 metric tons of nitric acid in 2009, an increase of 1% from 2008. They calculated and reported their GHG emissions using mass balance equations in worksheets from *the GHG Protocol*. N_2O has a high GWP of 310, so the N_2O emissions were calculated first and then converted to units of CO_2e by multiplying the N_2O emissions by the GWP. GHG emissions from this source category increased 1% from 2008 – 2009 as shown in Table 10. This directly correlates to a 1% increase in production in 2009.

Table 10 - Nitric Acid Production GHG Emissions 2008 - 2009

Facility ID	Facility Name	2009 $MMtCO_2e$	2008 $MMtCO_2e$	% Change
94-01-005	Koch Nitrogen Company	0.47	0.48	-1
97-01-030	Terra Nitrogen - Port Neal Complex	0.43	0.42	+3%
	Total	**0.90**	**0.90**	**+1%**

Ammonia Production

CO_2 is released during the manufacture of ammonia. The chemical equations to show the release of CO_2 are fairly complicated, but in general anhydrous ammonia is synthesized by reacting nitrogen with hydrogen. The hydrogen is typically acquired from natural gas. The majority of direct CO_2 emissions occur when the carbon in the natural gas is then eliminated from the process by converting it to CO_2. Other emissions of CO_2 can occur during condensate stripping or regeneration of the scrubbing solution. CO_2 emissions may also be captured for use in urea synthesis.[46]

Three Iowa facilities produced at total of 791,368 metric tons of ammonia in 2009. All three facilities calculated and reported their GHG emissions using mass balance equations in worksheets from *the GHG Protocol*. Overall,

[45] STAPPA/ALAPCO and U.S. EPA. 2004. *Emission Inventory Improvement Program (EIIP) Volume VIII: Greenhouse Gases*, p. 6-4.5.

[46] World Resources Institute. *CO_2 Emissions from the Production of Ammonia – Guidance.* Internet address: http://www.ghgprotocol.org/calculation-tools/all-tools.

GHG emissions from ammonia production decreased 18% in 2009 as shown in Table 11. This percentage decrease is explained by the following:

- Green Valley Chemical Company did not report GHG emissions from ammonia production in 2008.
- Koch Nitrogen has corrected their 2008 GHG emissions from this source category after the 2008 inventory was published. The original 2008 value reported was 0.00 $MMtCO_2e$, and the corrected value is 0.41 $MMtCO_2e$.
- The GHG emissions from Terra Nitrogen decreased significantly by 53%.
- The amount of CO_2 recovered by Koch Nitrogen and Terra Nitrogen varied from 2008 – 2009.

Table 11 - Ammonia Production GHG Emissions 2008 - 2009

Facility ID	Facility Name	2009 $MMtCO_2e$	2008 $MMtCO_2e$	% Change
88-01-017	Green Valley Chemical Company	0.05	NA[47]	NA
94-01-005	Koch Nitrogen Company	0.19	0.41[48]	-53%
97-01-030	Terra Nitrogen - Port Neal Complex	0.44	0.42	+4%
	Total	**0.68**	**0.83**	**-18%**

Soda Ash Consumption

Six facilities reported GHG emissions from soda ash consumption to the Department. All six facilities are corn wet millers. A 2009 survey of their plant managers shows that corn wet mills use soda ash as pH control, in ion exchange regeneration, and in other operations. GHG emissions were calculated using an EPA emission factor of 830 lbs. CO_2/ton soda ash (0.415 metric ton CO_2/metric ton soda ash).[49] Although GHG emissions from soda ash consumption increased 189% from 2008 – 2009, they are significantly smaller than GHG emissions from other sectors as shown in Table 12 and Figure 1.

Table 12 - Soda Ash Consumption GHG Emissions 2008 - 2009

Facility ID	Facility Name	2009 Soda Ash Used (tons)	2009 CO_2 Metric Tons[50]	2008 CO_2 Metric Tons	% Change
23-01-006	ADM Clinton Corn Processing	5,561.57	2,093.86	2,093.86	0%
57-01-080	ADM Corn Processing	8,511.11	3,204.33	497.34	+544%
57-01-004	Cargill Inc	302.7	113.96	115.62	-1%
68-09-001	Cargill Inc	2,258	850.11	NA[51]	NA
57-01-025	Penford Products Co.	3,466.98	1,305.28	NA[42]	NA
56-01-009	Roquette America Inc	5,322	2,003.67	604.35	+231%
	Total	**25,422.36**	**9,571.21**	**3,311.17**	**+189%**

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[47] Facility did not report GHG emissions from ammonia production in 2008.

[48] Value has been corrected since publication of the 2008 GHG inventory. The original value reported was 0.00 $MMtCO_2e$.

[49] STAPPA/ALAPCO and U.S. EPA. 2004. *Emission Inventory Improvement Program (EIIP) Volume VIII: Greenhouse Gases*, p. 6-4.14.

[50] GHG emissions from soda ash consumption are reported in this chapter in units of metric tons of carbon dioxide equivalents ($mtCO_2e$) because the GHG emissions round to less than 0.00 $MMtCO_2e$.

[51] Facility did not report GHG emissions from soda ash consumption in 2008.

Key Uncertainties

GHG emissions from coal, natural gas, and fuel oil combustion are included in both the total GHG emissions from fossil fuel combustion at major sources (Chapter 2) and in the GHG emissions from iron and steel production total (this chapter). This is because the Department required iron and steel production facilities to fill out one reporting spreadsheet for fossil fuel GHG emissions and a separate reporting spreadsheet for GHG emissions from the electric arc furnace. On the fossil fuel spreadsheet, the facility reports the total amount of each fossil fuel (such as coal, natural gas, fuel oil, etc.) combusted at the facility. This includes fossil fuels burned in the EAF and in other units that the EAF such as ladle pre-heaters, re-heating furnaces, torches, dryers, generators, etc. The EAF reporting spreadsheet calculates GHG emissions from the EAF only, accounting for the portion of coal, natural gas, and fuel oil used only in the EAF.

Chapter 6: 2009 GHG Emissions from Other Sources

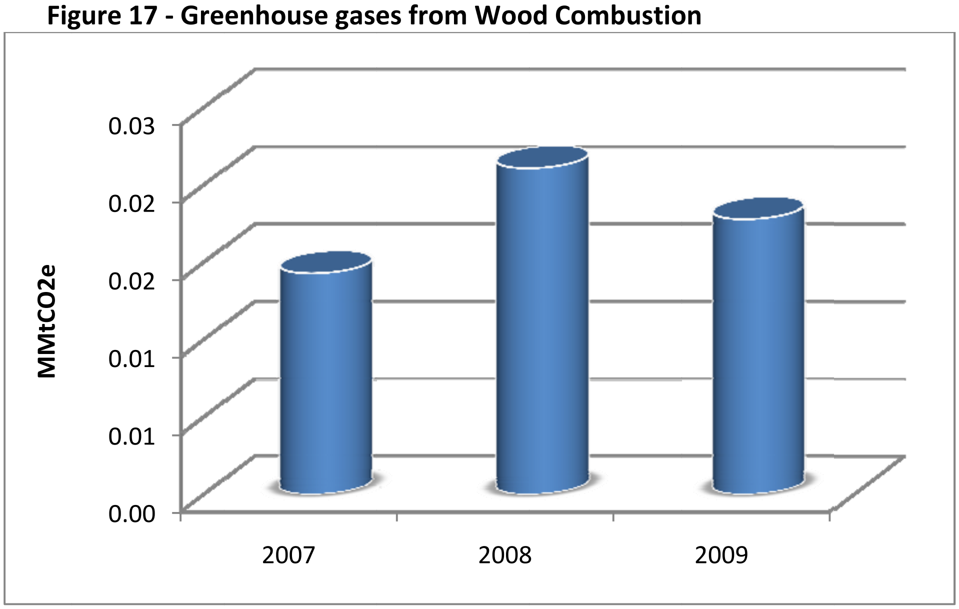
Biomass

The Department required that facilities also report any biomass they combusted in 2009. As shown in Table 13, six facilities reported combusting a total of 192,927 MMBtu of wood, resulting in 0.02 $MMtCO_2e$ of GHG emissions, a 16% decrease from 2008 and 24% increase from 2007 as shown in Table 13 and Figure 17 below.

Table 13 - 2009 Wood Combustion GHG Emissions

Facility ID	Facility Name	Wood Combusted MMBtu	2009 $MtCO_2e$	2009 $MMtCO_2e$
57-01-125	BFC Electric Company, LLC	1,589.83	144.12	0.00
10-02-008	Bertch Cabinet Mfg - Jesup	4,270.40	415.49	0.00
07-01-063	Bertch Cabinet Waterloo	33,075.20	3,218.05	0.00
31-01-021	JELD-WEN, inc. DBA JELD-WEN	141,442.00	12,821.96	0.01
07-01-061	Omega Cabinetry	6,445.00	584.25	0.00
63-02-005	Pella Municipal Power Plant	6,104.59	593.95	0.00
	Total	**192,927.02**	**17,777.8065**	**0.02**

Figure 17 - Greenhouse gases from Wood Combustion



Nine facilities reported combustion of other biomass materials such as seed corn, biogas, refuse derived fuel (RDF), wastewater treatment plant (WWTP) sludge, oat hulls, etc. as shown in Table 14. Emission factors for combustion of these materials are not available, so the facilities were not able to estimate their resulting GHG emissions. GHG emissions from the combustion of biomass are not included in the statewide GHG emissions total because like ethanol fermentation, they are considered biogenic emissions, meaning that the carbon in the biomass was recently contained in living organic matter. In its latest national GHG inventory, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2008,* EPA assumes that the carbon released during the burning of biomass is recycled as plants and trees regenerate, "causing no net addition of CO_2 to the atmosphere."[52]

Table 14 - 2009 Biomass Combustion

Facility ID	Facility Name	Fuel Type	Throughput	Units
23-01-006	ADM Cogeneration	WWTP Sludge	793.38	MMBtu
56-01-002	Archer Daniels Midland – Keokuk	Biogas	111.99	MMscf
77-01-010	Cargill - Des Moines	Biogas	131,467.56	MMBtu
85-01-006	City of Ames Steam Electric Plant	Refuse Derived Fuel (RDF)	345,743	MMBtu
17-01-005	Lehigh Cement - Mason City	Seed Corn	929,049.37	MMBtu
70-01-008	Monsanto Company	Seed Corn	4,142	tons
70-01-008	Monsanto Company	WWTP Sludge	302	tons (dry)
63-02-005	Pella Municipal Power Plant	Seed Corn	4,642.83	MMBtu
07-01-071	Tyson Fresh Meats, Inc.	Biogas	165,994	MMBtu
07-01-071	Tyson Fresh Meats, Inc.	Choice White Grease	8,500	gallons
52-01-005	University of Iowa Power Plant	Oat Hulls	387,628.73	MMBtu

Other GHG Emissions Reported to DNR

Legislation passed by the General Assembly in 2008 also required that "all applications for construction permits or prevention of significant deterioration permits shall quantify the potential to emit GHG emissions due to the proposed project."[53] The law became effective on July 1, 2008, and since that time the Department has received applications with potential GHG emissions as shown in Table 15 and Figure 18.

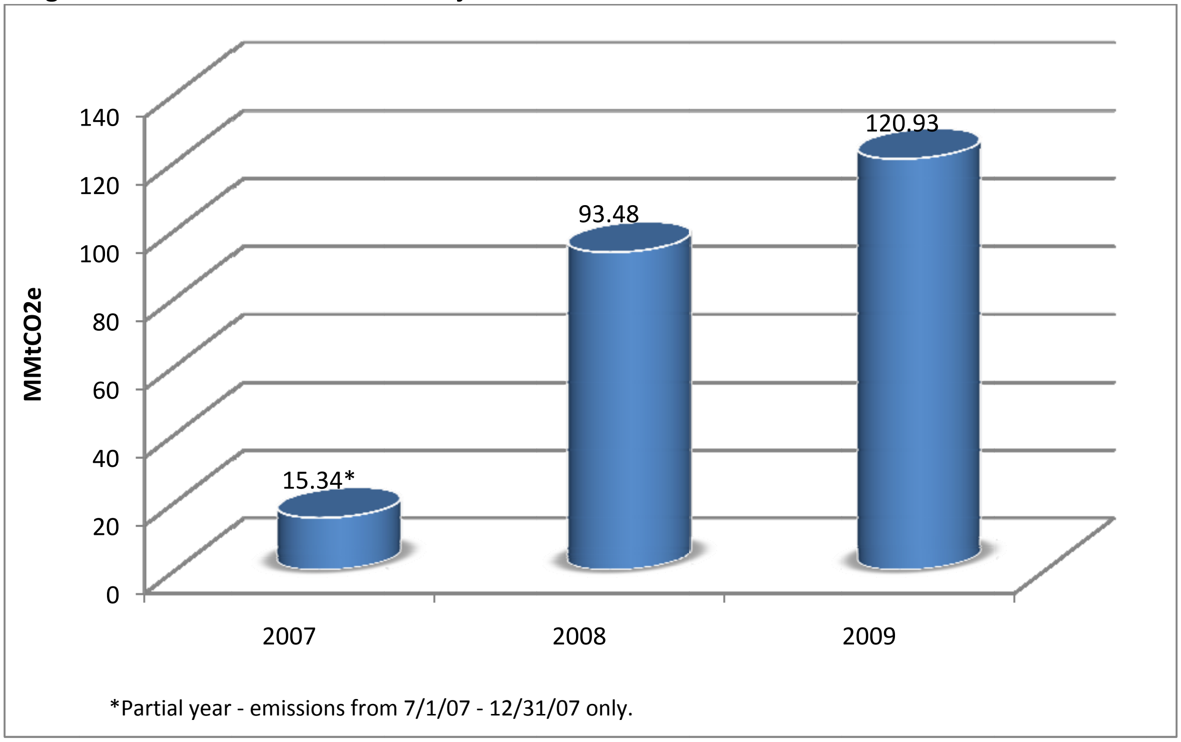
Table 15 – Construction Permit Projects - Potential GHG Emissions

Time Period	CO_2 (tons/yr)*	CH_4 (tons/yr)	N_20 (tons/yr)	SF_6 (lb/yr)	PFC (lb/yr)	HFC (lb/yr)	$MMtCO_2e$
7/1/07 - 12/31/07	16,791,813.90	1,820.89	243.60	3.42	0.00	0.0046	15.34
1/1/08 – 12/31/08	102,172,745.98	2,909.80	2,580.67	0.10	0.00	49,900.10	93.48
1/1/09- 12/31/09	132,952,399.24	4,970.64	800.51	0	0	0	120.93
Total	**251,916,959.12**	**9,701.33**	**3,624.78**	**3.52**	**0.00**	**49,900.10**	**229.75**

** includes biogenic emissions from ethanol fermentation*

[52] U.S. EPA. 2010. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2008,* p. 3-1. Internet address: http://www.epa.gov/climatechange/emissions/usinventoryreport.html.
[53] Iowa Code 455B.134

Figure 18 – Construction Permit Projects - Potential GHG Emissions 2007 – 2009



The GHG potential emissions reported on the construction permit applications currently undergo a cursory review by the Department. However, after GHGs become subject to regulation for PSD on January 2, 2011 construction projects that have increases in GHG emissions equal to or exceeding the GHG thresholds in the Tailoring Rule will be subject to additional review.

It should be noted that *potential emissions* are considered to be a theoretical maximum, whereas the emissions data collected for this inventory was calculated directly from the quantities of materials actually combusted and produced in 2009.

Chapter 7: Lessons Learned and Future GHG Inventories

Lessons Learned

Use of Collected Data
The Department has collected facility-specific GHG data for 2007 – 2009, so Iowa is ahead of the curve compared to many other states. This data has been used by the Department to help determine the applicability, implications, and potential cost of two federal GHG rules – the PSD and Title V GHG Tailoring Rule and the Mandatory Reporting of Greenhouse Gases Rule.

The 8% reduction in GHG emissions from 2008 – 2009 shows that reductions in industrial energy use result in significant GHG reductions. Policies and incentives to reduce and conserve energy use at residential, commercial, and industrial facilities should be developed and encouraged. In this spirit, the Department recently applied for a grant from EPA[54] to use the GHG data collected from this inventory to identify high GHG-emitting facilities to participate in the Department's Pollution Prevention program, developing practices to reduce GHG emissions.

GHG Inventory Refinements
The need for additional refinements to the Department's GHG reporting forms has been identified through the GHG data collection process. As mentioned earlier in this report, the Department's current forms do not allow for reporting of emissions from coke and petroleum coke combustion. The Department can also continue to improve its outreach and education regarding GHG emissions reporting, and further develop quantification methods for GHG emissions from new and emerging fuel technologies such as renewable fuels.

Future Inventories

Federal Mandatory Reporting of Greenhouse Gases Rule (MRR)
On October 30, 2009, the U.S. EPA finalized its Mandatory Reporting of Greenhouse Gases rule,[55] which in several ways duplicates the Department's mandatory reporting program. The federal reporting rule generally requires reporting of annual GHG emissions from fossil fuel suppliers, industrial GHG suppliers, vehicles and engine manufacturers, and facilities that emit 25,000 mtCO_2e or more per year of GHG emissions. Affected facilities are required to report emissions of nitrogen trifluoride (NF_3) and hydrofluorinated ethers (HFE) in addition to the six gases subject to Iowa's reporting program: CO_2, CH_4, N_2O, HFC, PFC, and SF_6.[56]

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[54] U.S. EPA Office of Atmospheric Programs. Greenhouse Gas Reporting Systems: Outreach to Reporting Facilities and Analysis of Greenhouse Gas Mitigation Opportunities. RFP# EPA-OAR-CCD-10-05. Internet address: http://www.epa.gov/air/grants_funding.html.
[55] Federal Register, Vol. 74 No. 209, October 30, 2009.
[56] §40 CFR 98.6

Nationally, U.S. EPA estimates the federal mandatory GHG reporting rule will affect 13,000 reporters while capturing 85% of U.S. emissions.[57] However, the Department estimates the percentage of GHG emissions required to be reported under the federal rule to be much higher for Iowa. Based on 2009 GHG emissions, 83 of 280 Iowa major source facilities will be required to report their GHG emissions directly to EPA under the new federal rule, totaling 50.62 $MMtCO_2e$ or 98% of the total 2009 GHG emissions from fossil fuel combustion at major sources. In addition, all thirty-four Iowa dry mill ethanol plants will be subject to the mandatory GHG reporting rule [58] as well as all of the facilities reporting GHG emissions from industrial processes in Chapter 5 of this report. EPA has also indicated that several municipal solid waste landfills will be subject to the federal mandatory GHG reporting rule, but the Department doesn't have sufficient data at this time to identify the specific landfills subject to the program.

Because the federal GHG reporting rule requires reporting from nearly all the sources included in the Department's mandatory GHG reporting program, the Department has opted to change its GHG reporting requirements. The Department will not require 2010 GHG emissions to be reported directly to the Department. Instead, facilities subject to the federal mandatory GHG reporting rule will begin reporting their GHG emissions directly to EPA by March 31, 2011. EPA will perform quality assurance checks on the GHG emissions data, and then provide the GHG emissions to the Department sometime in the summer of 2011. In 2010, the Iowa General Assembly passed legislation, SF 2088, allowing the Department to coordinate this GHG data collection with EPA and moving the due date for the annual GHG report to the Governor and General Assembly to December 31. This legislation amended Iowa Code 455B.104 to read:

> "By December 31 of each year, the department shall submit a report to the governor and the general assembly regarding the greenhouse gas emissions in the state during the previous calendar year and forecasting trends in such emissions. The first submission by the department shall be filed by December 31, 2011, for the calendar year beginning January 1, 2010."[59]

The Department is currently participating in an integrated project team (IPT) with EPA, the Environmental Council of the States (ECOS), and other states to standardize the method used to share GHG data. The IPT has two goals:

1. Phase I: Identify data elements for EPA to consider including in the mandatory GHG reporting schema;
2. Phase II: Plan, design, develop, and document a GHG Data Exchange that includes all of the components required by the Exchange Network.

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[57] Federal Register, Vol. 74 No. 68, April 10, 2009, p. 16467.

[58] The federal GHG reporting program does not requires ethanol plants to report biogenic GHG emissions from fermentation. However, reporting requirements for GHG emissions from stationary combustion, industrial wastewater, industrial waste landfills and other source categories may apply.

[59] Iowa Code 455B.104, subsection 4.

Goals

When the legislation requiring mandatory GHG reporting was passed in 2007, the Department developed both short-term and long-term goals for the GHG inventory. The short-term goal was to begin inventorying ethanol plants and fossil fuel combustion at major sources for calendar year 2007 because:

- The legislation requires mandatory reporting from individual affected entities.
- The legislation allows the inventory to phase in sectors over time.
- Iowa is a national leader in ethanol production, and no other states had yet calculated GHG emissions from ethanol production.
- Major sources with federally-enforceable operating permits are the largest industrial sources of air pollution in the state and include the largest electric generating units (EGUs) and major manufacturers.
- An existing regulatory program already exists for collecting annual inventories of other air pollutants from major facilities in Iowa.

The long-term goal is to continue to broaden the scope of the inventory, adding additional sectors each year to develop a complete statewide GHG inventory for all sectors. This may be more feasible for the 2010 GHG inventory as EPA will be collecting much of the data from individual facilities instead of the Department. However, a large percentage of the Department's GHG resources are currently being spent on implementing the PSD and Title V GHG Tailoring Rule. The Department also monitors and participates in the development of GHG emissions reporting protocols by several groups including U.S. EPA, The Climate Registry, and the Midwest Governors Association's Midwestern Regional Greenhouse Gas Reduction Accord. Few additional funds have been provided to the Department to conduct a full statewide top-down inventory, to improve the Department's current bottom-up inventory requirements, or to perform forecasting of GHG emissions.

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Glossary

Anthropogenic – Caused or influenced by humans.

Biogenic - Produced by living organisms or biological processes. Examples of biogenic greenhouse gas emissions are CO_2 emissions from trees, vegetation, decomposition of solid waste, etc.

Biomass - Materials that are biological in origin, including organic material both living and dead such as trees, crops, grasses, tree litter, roots, and animals and animal waste.

Bottom-up Inventory – An emission inventory that calculates emissions based on source-specific activity data rather than aggregate data. For example, a bottom-up inventory of residential fuel emissions would calculate greenhouse gas emissions from the fuel use of each individual house instead of using the total fuel combusted state-wide.

Carbon Dioxide (CO_2) - A naturally occurring gas that is also a byproduct of burning fossil fuels and biomass, other industrial processes, and land-use changes.

Carbon Sinks – Carbon storage. The main natural sinks are the oceans and plants and other organisms that use photosynthesis to remove carbon from the atmosphere by incorporating it into biomass and release oxygen into the atmosphere.

Continuous Emission Monitor (CEM) – Equipment that measures the concentration or emission rate of a gas or particulate matter using analyzer measurements and a conversion equation, graph, or computer program. Installation and operation of a CEM may be required by EPA or DNR in order to determine compliance with specific standards. Operation of a CEM must meet performance specifications, certification procedures, and recordkeeping and reporting requirements as specified in applicable regulations.

Distillers Grain with Solubles (DGS) – A by-product of ethanol production consisting of protein, fiber, oil, and other nutrients.

Dry Mill Ethanol Plant – An ethanol production facility in which the entire corn kernel is first ground into flour before processing.

Emission Factor – The relationship between the amount of pollution produced and the amount of raw material processed. For example – pounds of CO_2 emitted per ton of coal combusted.

Fluorinated Gases "F-Gases"- Gases sometimes used as substitutes for ozone depleting substances. HFC, PFC, and SF6 are "F-gases" and are emitted from a variety of industrial processes. "F-gases" are commonly emitted in smaller quantities, but because they have high global warming potentials (GWP).

Global Warming Potential (GWP) – An index that allows for comparison of various greenhouse gases. It is the radioactive forcing that results from the addition of 1 kilogram (2.2 pounds) of a gas to the atmosphere, compared to an equal mass of carbon dioxide.

Greenhouse Gas (GHG) – Any gas that absorbs and re-emits infrared radiation into the atmosphere. Greenhouse gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFC), and perfluorocarbons (PFC).

Hydrofluorocarbons (HFC) – A group of human-made chemicals composed of one or two carbon atoms and varying numbers of hydrogen and fluorine atoms.

Hydrofluorinated ethers (HFE) – A group of refrigerant gases that have been developed as alternatives to chlorofluorocarbons and hydrofluorocarbons (HFC).

Major Source – A source subject to the federally enforceable operating permit program established by EPA as required by Title V of the 1990 federal Clean Air Act Amendments.

Mass Balance - A process of estimating emissions using knowledge of the process, process rate, material used, and material properties.

Methane (CH_4) – A colorless, flammable, odorless hydrocarbon that is a greenhouse gas.

Metric Tons of Carbon Dioxide Equivalent ($mtCO_2e$) - This measure aggregates different greenhouse gases into a single measure, using global warming potentials.

Million Metric Tons of Carbon Dioxide Equivalent ($MMtCO_2e$) – This measure aggregates different greenhouse gases into a single measure, using global warming potentials.

Nitrogen Trifluoride (NF_3) – A high-GWP gas used in the manufacture of flat panel televisions, computer displays and other products.

Nitrous Oxide (N_2O) – A greenhouse gas formed from soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.

Perfluorocarbons (PFC) – A group of human-made chemicals composed of carbon and fluorine. PFC have no commercial uses and are emitted as a byproduct of aluminum smelting and semiconductor manufacturing.

Potential to Emit (PTE) – The maximum capacity of a source to emit any air pollutant under its physical and operational design. For a more complete definition see 567 IAC 22.100.

Stack Test – A test that measures the concentration of pollutants in the exhaust stack. Measurements are performed following procedures specified and developed by the US EPA and/or Iowa DNR. Such testing is required by DNR to be conducted by various stationary sources to determine compliance with applicable air emission limits.

Standard Industrial Classification (SIC) – A United States government system for classifying industries by a four-digit code.

State Inventory Tool (SIT) – US EPA's Excel-based companion tool to the Emissions Inventory Improvement Program guidance documentation. SIT produces a state-wide top-down inventory.

Still Gas – Any form or mixture of gases produced in refineries by distillation, cracking, reforming, and other processes. The principal constituents are methane, ethane, ethylene, normal butane, butylene, propane, propylene, etc.

Sulfur Hexafluoride (SF_6) – A greenhouse gas used primarily to insulate high-voltage equipment and to assist in the manufacturing of cable cooling systems.

Teragrams of Carbon Dioxide Equivalent (Tg CO_2 Eq.) – Unit of measure for greenhouse gas emissions used by U.S. EPA in its annual national greenhouse gas inventory. One Tg CO_2 Eq. equals one $MMtCO_2e$.

The Climate Registry - A nonprofit partnership whose mission is to develop an accurate, complete, consistent and transparent greenhouse gas emissions measurement protocol that is capable of supporting voluntary and mandatory greenhouse gas emission reporting policies for its Members and Reporters – see www.theclimateregsitry.org. Iowa joined as a member state in July 2008.

Top-Down Inventory – An emission inventory that calculates emissions using aggregate activity data rather than source-specific activity data. For instance, a top-down inventory of residential fuel use would calculate greenhouse gas emissions using the total amount of fuel combusted state-wide instead of using the fuel combusted at each individual house.

Wet Mill Ethanol Plant – An ethanol production facility in which the corn is first steeped in water before processing.

Appendix A: Revisions to 2008 GHG Emissions from Fossil Fuel Combustion at Major Sources

Facility ID	Facility Name	2008 Reported Emissions ($mtCO_2e$)	2008 Corrected Emissions ($mtCO_2e$)	Change ($mtCO_2e$)	Change ($MMtCO_2e$)	Error Type
56-01-002	Archer Daniels Midland – Keokuk	17,003.83	10,247.62	-6,756.22	-0.01	4
29-02-012	Big River Resources, LLC	See Error Type 1	143,986.28	+143,986.28	+0.14	1
55-03-004	Brand FX Body Company	290.92	291.28	+0.36	+0.00	3
29-01-006	CNH America LLC	8.32	8,318.63	+8,310.31	+0.01	2
32-01-017	Electrimold	2.32	162.80	+160.48	0.00	2
55-09-003	Global Ethanol, LLC	See Error Type 1	147,339.48	+147,339.48	+0.15	1
17-01-100	Golden Grain Energy	See Error Type 1	177,815.66	+177,815.66	+0.18	1
56-02-035	Gregory Manufacturing Co, Inc.	256.99	2.57	-254.42	-0.00	2
52-01-053	Iowa City Sanitary Landfill	58.56	112.77	+54.21	+0.00	3
90-01-003	John Deere Ottumwa Works	633.82	8,794.37	+8,160.54	+0.01	2
18-02-006	Little Sioux Corn Processors, LP	See Error Type 1	191,547.70	+191,547.70	+0.19	1
11-01-029	Meridian Mfg. Group	1.42	14,193.96	+14,192.54	+0.01	2
77-14-003	Metro Park East Sanitary Landfill	172.51	48.22	-124.29	-0.00	4
30-01-012	Polaris Industries, Inc.	33.47	5,929.86	+5,896.39	+0.01	2
97-01-030	Terra Nitrogen – Port Neal Complex	238,587.19	682,214.85	+443,627.65	+0.44	3
	Total	**257,049.35**	**1,391,006.05**	**+1,133,956.70**	**+1.13**	

Error Types:

1. Emissions were included in the dry mill ethanol plant GHG total in the 2008 GHG inventory, but were not included in the fossil fuel combustion at major source GHG total value.
2. Error in converting units of measure for natural gas throughput.
3. Fuel use was under-reported.
4. Fuel use was over-reported.

Appendix B: 2009 GHG Emissions from Fossil Fuel Combustion (sorted by general industrial groupings)

Two-Digit SIC	SIC Division Description	Number of Facilities	$mtCO_2e$	$MMtCO_2e$	% of Total
49xx	Electric, Gas, and Sanitary Services	72	40,497,605	40.50	74.88%
28xx	Chemicals and Allied Products	47	5,894,713	5.89	10.90%
20xx	Food and Kindred Products	31	5,221,150	5.22	9.65%
82xx	Educational Services	6	691,086	0.69	1.28%
32xx	Stone, Clay, Glass, and Concrete Products	14	634,990	0.63	1.17%
33xx	Primary Metal Industries	18	545,245	0.55	1.01%
35xx	Industrial Machinery and Equipment	15	149,372	0.15	0.28%
30xx	Rubber and Miscellaneous Plastics Products	16	115,040	0.12	0.21%
97xx	National Security and International Affairs	1	59,470	0.06	0.11%
26xx	Paper and Allied Products	5	59,177	0.06	0.11%
87xx	Engineering and Management Services	2	39,716	0.04	0.07%
34xx	Fabricated Metal Products	17	31,969	0.03	0.06%
80xx	Health Services	1	27,253	0.03	0.05%
24xx	Lumber and Wood Products	13	22,977	0.02	0.04%
37xx	Transportation Equipment	13	21,893	0.02	0.04%
36xx	Electronic and Other Electrical Equipment and Components, Except Computer Equipment	4	21,011	0.02	0.04%
46xx	Pipelines, Except Natural Gas	12	18,836	0.02	0.03%
25xx	Furniture and Fixtures	3	16,600	0.02	0.03%
92xx	Justice, Public Order, and Safety	1	5,266	0.01	0.01%
27xx	Printing and Publishing	2	4,766	0.00	0.01%
47xx	Transportation Services	1	2,711	0.00	0.01%
63xx	Insurance Carriers	1	780	0.00	0.00%
75xx	Automotive Repair, Services, and Parking	1	719	0.00	0.00%
51xx	Wholesale Trade-Non-durable Goods	5	145	0.00	0.00%
39xx	Miscellaneous Manufacturing Industries	1	79	0.00	0.00%
50xx	Wholesale Trade Durable Goods	1	76	0.00	0.00%
95xx	Environmental Quality and Housing	1	35	0.00	0.00%
	Total	**304**	**54.08**	**54,082,683**	

Appendix C: Iowa Historical Greenhouse Gas Emissions and Forecast, by Sector

	$MMtCO_2e$[60]						
Sector	**1990**	**2000**	**2005**	**2010**	**2020**	**2025**	**Explanatory Notes for Projections**
Energy Use (CO_2, CH_4, N_2O)	**67.0**	**82.1**	**84.6**	**90.5**	**103.3**	**111.0**	
Electricity Use (Consumption)	**27.4**	**35.8**	**37.6**	**38.0**	**43.1**	**47.5**	Totals include emissions for electricity production plus emissions associated with net imported electricity.
Electricity Production (in-state)	26.7	36.7	36.3	41.8	41.8	41.8	*See electric sector assumptions in Appendix A of the CCS Inventory.*
Coal	26.5	36.3	34.9	40.4	40.4	40.4	
Natural Gas	0.17	0.24	1.15	1.15	1.15	1.15	
Oil	0.05	0.10	0.15	0.15	0.15	0.15	
MSW/Landfill Gas	0.01	0.02	0.06	0.06	0.06	0.06	
Imported Electricity	0.68	-0.87	1.33	-3.74	1.38	5.78	Negative values represent net exported electricity.
Residential/Commercial/ Industrial (RCI) Fuel Use	**21.3**	**25.3**	**24.1**	**27.0**	**29.7**	**30.2**	
Coal	5.53	6.42	6.22	6.45	6.82	6.83	Based on US DOE regional projections
Natural Gas	10.9	11.6	11.0	13.9	15.8	16.3	Based on US DOE regional projections
Petroleum	4.70	7.25	6.78	6.51	6.93	6.86	Based on US DOE regional projections
Wood (CH4 and N2O)	0.13	0.08	0.09	0.17	0.19	0.20	Based on US DOE regional projections
Transportation	**16.9**	**19.1**	**20.7**	**22.8**	**27.2**	**29.4**	
Onroad Gasoline	11.4	12.8	13.0	13.9	16.2	17.2	Based on linear regression of historical VMT and projected national fuel economy
Onroad Diesel	3.96	4.66	5.69	6.76	8.80	9.94	Based on linear regression of historical VMT and projected national fuel economy
Rail	0.31	0.26	0.56	0.56	0.56	0.56	Assumed no growth in activity
Marine Vessels, Natural Gas, LPG, other	0.81	1.07	1.04	1.08	1.22	1.29	Based on US DOE regional projections and historical trends in activity
Jet Fuel and Aviation Gasoline	0.39	0.34	0.45	0.48	0.45	0.42	Based on Iowa DOT operations projections
Fossil Fuel Industry	**1.49**	**1.81**	**2.25**	**2.61**	**3.32**	**3.78**	
Natural Gas Industry	1.48	1.81	2.25	2.61	3.32	3.78	Based on historical trends in activity
Oil Industry	0.00	0.00	0.00	0.00	0.00	0.00	No oil production in Iowa.
Coal Mining	0.01	0.00	0.00	0.00	0.00	0.00	No coal mining in Iowa since 1994

[60] CCS, *Iowa Greenhouse Gas Inventory and Reference Case Projections 1990 – 2005,* p. 4-5, Table 1. Totals may not equal exact sum of subtotals shown in this table due to independent rounding.

	MMtCO_2e						
Sector	**1990**	**2000**	**2005**	**2010**	**2020**	**2025**	**Explanatory Notes for Projections**
Industrial Processes	**2.74**	**3.82**	**4.59**	**5.35**	**7.04**	**8.14**	
Cement Manufacture (CO_2)	1.18	1.28	1.28	1.35	1.48	1.56	Based on 2004-2014 employment projections for Nonmetallic Mineral Production Manufacturing from Iowa Workforce Information Network
Lime Manufacture (CO_2)	0.06	0.06	0.09	0.11	0.14	0.17	Based on historical annual increase in Iowa state production from 1995-2005
Limestone and Dolomite Use (CO_2)	0.20	0.21	0.18	0.17	0.15	0.15	Based on historical annual decline in Iowa state consumption from 1994-2004
Soda Ash (CO_2)	0.03	0.03	0.03	0.02	0.02	0.02	Based on historical annual decline in Iowa state consumption from 1990-2005
Iron & Steel (CO2)	0.03	0.10	0.12	0.16	0.27	0.36	Based on historical annual increase in Iowa state production from 2000-2005
Ammonia and Urea (CO_2)	0.64	0.56	0.49	0.47	0.44	0.43	Based on historical annual decline in Iowa state production from 2000-2005
Nitric Acid Production (N_2O)	0.30	0.57	1.01	1.05	1.14	1.19	Based on US EPA projections for this industry.
ODS Substitutes (HFC, PFC)	0.00	0.83	1.23	1.87	3.25	4.15	Based on national projections (US EPA)
Electric Power T&D (SF_6)	0.29	0.17	0.15	0.14	0.13	0.13	Based on national projections (US EPA)
Waste Management	**2.18**	**2.27**	**2.40**	**2.57**	**2.95**	**3.16**	
Waste Combustion	0.07	0.07	0.06	0.06	0.05	0.05	Based on one half growth rate calculated for 1990-2005 emissions growth
Landfills	1.65	1.68	1.82	1.97	2.30	2.48	Based on growth rate calculated for 1995-2005 emissions growth
Wastewater Management	0.46	0.53	0.52	0.54	0.60	0.62	Based on growth rate calculated for 1990-2005 emissions growth
Agriculture	**25.4**	**26.0**	**27.9**	**26.0**	**25.8**	**25.6**	
Enteric Fermentation	5.04	4.39	4.26	3.81	3.27	2.98	Based on projected livestock population
Manure Management	4.49	6.02	6.64	6.55	6.86	7.01	Based on projected livestock population
Agricultural Soils	15.7	15.5	16.8	15.5	15.4	15.3	Used growth rate calculated for 1990-2005 emissions growth
Agricultural Burning	0.13	0.16	0.19	0.20	0.24	0.26	Used growth rate calculated for 1990-2005 emissions growth
Gross Emissions (Consumption Basis, Excludes Sinks)	**97.3**	**114.2**	**119.5**	**124.4**	**139.1**	**147.9**	
increase relative to 1990		*17%*	*20%*	*27%*	*43%*	*51%*	
Emissions Sinks	**-21.8**	**-19.9**	**-27.3**	**-27.3**	**-27.3**	**-27.3**	
Forested Landscape	-7.88	-7.88	-15.3	-15.3	-15.3	-15.3	
Urban Forestry and Land Use	-2.59	-0.65	-0.63	-0.63	-0.63	-0.63	Assumed no change after 2005
Forest Wildfires	0.00	0.00	0.00	0.00	0.00	0.00	
Agricultural Soils (cultivation practices)	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	Based on 2000 NRCS data
Net Emissions (Includes Sinks)	**75.4**	**94.3**	**92.2**	**97.1**	**111.8**	**120.6**	
increase relative to 1990		*25%*	*22%*	*29%*	*48%*	*60%*	

Appendix D: 2009 GHG Emissions from Fossil Fuel Combustion Per Major Source Facility

Bolded values were adjusted to use CEMS data.

Facility #	Facility Name	SIC	CO_2 (tons)	CH_4 (tons)	N_2O (tons)	$MMtCO_2e$
63-01-001	3M (Minnesota Mining & Manufacturing Co.)	2672	15,887.07	1.71	0.04	0.01
79-02-006	A-1 Fiberglass	3089	164.93	0.02	0.00	0.00
92-01-021	ACH Foam Technologies, LLC.	3086	1,459.99	0.16	0.00	0.00
82-16-002	ACO YP Inc	3059	142.84	0.02	0.00	0.00
23-01-006	ADM Clinton Cogeneration	4911	1,201,537.54	143.13	19.79	1.10
57-01-080	ADM Corn Processing	2046	2,413,356.65	286.40	37.63	2.21
23-01-006	ADM Corn Processing - Clinton	2046	204,013.08	22.78	0.39	0.19
23-01-006	ADM Polymer	2821	2,015.81	0.00	0.00	0.00
98-01-003	Advanced Component Technologies	3089	626.57	0.07	0.00	0.00
99-01-001	Ag Processing Inc. - Eagle Grove	2075	177,134.00	21.13	2.98	0.16
74-01-012	Ag Processing Inc. - Emmetsburg	2075	25,589.98	2.86	0.05	0.02
14-02-003	Ag Processing Inc. - Manning	2075	21,971.88	2.27	0.06	0.02
17-01-027	Ag Processing Inc. - Mason City	2075	23,572.77	2.59	0.05	0.02
97-04-005	Ag Processing Inc. - Sergeant Bluff	2075	11,398.08	1.27	0.02	0.01
71-01-001	Ag Processing Inc. - Sheldon	2075	24,084.12	2.60	0.05	0.02
68-09-002	Ajinomoto Heartland, LLC	2048	121,398.08	13.56	0.23	0.11
82-01-002	Alcoa, Inc.	3353	145,339.32	15.73	0.32	0.13
28-01-026	Alliance Pipeline L.P./Manchester 27-A Compressor Station	4922	84,241.55	9.41	0.16	0.08
70-01-050	Allsteel Muscatine Components Plant	2521	8,138.81	0.91	0.02	0.01
85-03-003	American Packaging Corporation	2759	2,509.35	0.28	0.00	0.00
56-01-023	Amsted Rail (Griffin Wheel)	3325	15,878.34	1.74	0.03	0.01
53-01-002	Anamosa State Penitentiary	9223	5,787.15	0.66	0.01	0.01
51-03-001	ANR Pipeline Company - Birmingham Compressor	4922	51,107.36	5.71	0.10	0.05
93-05-001	ANR Pipeline Company - Lineville Compressor	4922	50,062.01	5.59	0.09	0.05
82-02-031	Arch Mirror North	3231	180.51	0.02	0.00	0.00
77-01-045	Archer Daniels Midland - Des Moines Soybean	2075	147,864.54	17.61	2.43	0.14
56-01-002	Archer Daniels Midland - Keokuk	2041	16,934.34	1.89	0.03	0.02
20-01-018	Astoria Industries of Iowa, Inc.	3713	467.17	0.05	0.00	0.00
04-01-002	Bemis Co Inc. - Curwood Operation Centerville Facility	2673	1,812.70	0.20	0.00	0.00
10-02-008	Bertch Cabinet Mfg. - Jesup Facility	2434	332.61	0.04	0.00	0.00

Facility #	Facility Name	SIC	CO_2 (tons)	CH_4 (tons)	N_2O (tons)	$MMtCO_2e$
07-01-086	Bertch Cabinet Oasis	2434	210.62	0.02	0.00	0.00
33-01-020	Bertch Cabinet Oelwein	2434	221.40	0.02	0.00	0.00
07-01-063	Bertch Cabinet Waterloo	2434	1,246.92	0.14	0.00	0.00
08-01-002	Besser Quinn Machine & Foundry	3321	60.69	0.01	0.00	0.00
57-01-125	BFC Electric Company, L.L.C.	4931	127.09	0.01	0.00	0.00
29-02-012	Big River Resources	2869	201,913.31	22.55	0.38	0.18
07-01-121	Black Hawk County Sanitary Landfill	9511	37.77	0.01	0.00	0.00
82-01-004	Blackhawk Foundry & Machine Co.	3321	6,160.24	0.26	0.00	0.01
26-01-001	Bloomfield Foundry, Inc.	3321	1,063.58	0.12	0.01	0.00
82-02-024	BP - Bettendorf Terminal	5171	24.47	0.00	0.00	0.00
52-07-001	BP - Cedar Rapids Terminal	5171	7.45	0.00	0.00	0.00
77-01-158	BP - Des Moines Terminal	5171	54.86	0.01	0.00	0.00
55-03-004	Brand FX Body Company	3713	267.49	0.03	0.00	0.00
76-01-014	Brand FX Body Company	3713	499.15	0.06	0.00	0.00
77-01-022	Bridgestone Americas Tire Operations	3011	63,735.83	7.12	0.12	0.06
78-01-085	Bunge Corporation	2075	110,632.87	12.32	0.21	0.10
68-09-001	Cargill Corn Milling - Eddyville	2046	677,471.00	79.81	9.41	0.62
57-01-003	Cargill Soybean East Plant	2075	1,659.95	0.19	0.00	0.00
57-01-002	Cargill Soybean West Plant - Cedar Rapids	2075	16,008.07	1.79	0.03	0.01
57-01-004	Cargill, Inc.	2046	86,187.63	9.92	0.75	0.08
77-01-010	Cargill, Inc. - Des Moines, IA	2075	30,248.08	3.38	0.06	0.03
42-01-003	Cargill, Inc. - Iowa Falls	2075	49,117.15	5.49	0.09	0.04
97-01-001	Cargill, Inc. - Sioux City	2075	62,891.60	7.03	0.12	0.06
77-10-002	CB&I Constructors, Inc.	3443	659.70	0.07	0.00	0.00
95-01-012	CDI, LLC - Forest City	7532	789.75	0.09	0.00	0.00
44-01-024	Ceco Building Systems	3448	222.69	0.02	0.00	0.00
07-02-005	Cedar Falls Municipal Electric Utility	4911	**38,886.11**	4.61	0.61	0.04
07-02-005	Cedar Falls Municipal Electric Utility - CTS	4911	424.92	0.05	0.00	0.00
07-02-053	Cedar Falls Municipal Water Utility	4911	5.98	0.00	0.00	0.00
57-01-130	Cedar Rapids Linn County Solid Waste Agency - Site No. 1	4953	0.00	0.00	0.00	0.00
57-01-077	Cedar Rapids WPCF	4952	5,979.10	0.66	0.01	0.01
95-02-012	Central Disposal Systems, Inc.	4953	79.18	0.01	0.00	0.00
70-08-003	Central Iowa Power Coop - Fair Station	4911	**292,381.49**	32.74	4.67	0.27
88-01-004	Central Iowa Power Coop/Summit Lake Facility	4911	1,379.10	0.15	0.00	0.00
99-05-003	Central Iowa Renewable Energy (CORN) LP	2869	181,022.44	21.61	3.09	0.17

Facility #	Facility Name	SIC	CO_2 (tons)	CH_4 (tons)	N_2O (tons)	$MMtCO_2e$
94-01-002	CertainTeed Gypsum	3275	27,140.97	3.02	0.05	0.02
90-07-002	Chariton Valley Resource Conservation. & Development Inc.	4911	0.00	0.00	0.00	0.00
85-01-006	City of Ames Combustion Turbine	4911	**958.89**	0.03	0.01	0.00
85-01-006	City of Ames Steam Electric Plant	4911	**483,407.10**	50.36	7.21	0.44
56-02-021	Climax Molybdenum Company	3339	14,139.43	1.58	0.03	0.01
62-01-001	Clow Valve Company - Foundry	3494	2,981.66	0.33	0.01	0.00
62-01-001	Clow Valve Company - Machine Shop	3321	1,196.97	0.13	0.00	0.00
42-01-018	CMC Joist	3441	756.83	0.08	0.00	0.00
29-01-006	CNH America LLC	3531	6,667.18	0.74	0.01	0.01
77-01-109	Construction Products, Inc.	3441	553.08	0.06	0.00	0.00
21-01-003	Corn Belt Power Coop/ Wisdom Generation Station	4911	**7,681.44**	0.90	0.11	0.01
68-09-005	CR-1, L.P. (dba Cargill Nutri-Products)	2833	1,785.79	0.20	0.00	0.00
88-01-021	Creston Bean Processing, LLC	2075	14.34	0.00	0.00	0.00
57-01-082	Cryovac Inc., Sealed Air Corporation	2673	1,906.18	0.21	0.00	0.00
95-02-001	Cummins Filtration	3714	3,245.08	0.36	0.01	0.00
17-01-035	CURRIES Division of AADG, Inc. - 9th Street Facility	3442	1,833.33	0.20	0.00	0.00
17-01-087	CURRIES Division of AADG, Inc. - 12th Street NE Facility & 12th Street NW Facility	3442	2,401.33	0.27	0.00	0.00
29-02-010	Des Moines County Regional Sanitary Landfill	4953	27.47	0.00	0.00	0.00
51-01-005	Dexter Foundry, Inc.	3321	10,199.62	1.20	0.13	0.01
57-01-045	Diamond V Mills Inc.	2048	3,584.71	0.40	0.01	0.00
46-01-005	Dodgen Industries, Inc.	3711	345.19	0.04	0.00	0.00
45-01-003	Donaldson Company, Inc.	3599	1,695.37	0.19	0.00	0.00
31-01-035	Dubuque Water Pollution Control Plant	4952	1,360.77	0.06	0.01	0.00
56-02-005	DuPont Performance Coatings	2851	6,580.53	0.74	0.01	0.01
31-01-061	Eagle Window & Door, Inc.	2431	2,543.66	0.28	0.00	0.00
32-01-017	Electrimold (CDR Systems Corp/Division of Hubbell)	3089	229.26	0.02	0.00	0.00
40-01-002	Electrolux Home Products	3633	8,921.54	0.79	0.06	0.01
52-01-032	Enterprise NGL Pipeline LC. - Iowa City Terminal	4613	12,853.42	0.44	0.22	0.01
23-01-004	Equistar Chemicals, LP	2869	844,489.71	28.32	0.48	0.77
88-01-002	Fansteel/Wellman Dynamics	3365	3,555.92	0.40	0.01	0.00
45-01-009	Featherlite Inc.	3715	1,712.77	0.19	0.00	0.00
69-01-020	Fres-co System USA, INC.	2754	2,728.83	0.30	0.01	0.00
57-01-012	General Mills Operations, Inc.	2043	45,095.51	5.01	0.09	0.04
94-01-010	Georgia-Pacific Gypsum LLC	3275	21,324.37	2.36	0.04	0.02
70-03-003	Gerdau Ameristeel US Inc. - Wilton Mill	3312	22,881.46	2.61	0.11	0.02
32-02-004	GKN Armstrong Wheels	3714	794.29	0.09	0.00	0.00

Facility #	Facility Name	SIC	CO_2 (tons)	CH_4 (tons)	N_2O (tons)	$MMtCO_2e$
32-01-016	GKN Armstrong Wheels, Inc.	3523	3,435.25	0.38	0.01	0.00
25-05-008	Glen-Gery Corp./Redfield Plant	3251	4,668.49	0.51	0.01	0.00
55-09-003	Global Ethanol LLC - Lakota	2869	171,095.53	19.11	0.32	0.16
17-01-100	Golden Grain Energy	2869	177,583.60	19.84	0.34	0.16
70-01-004	Grain Processing Corporation	2046	711,773.49	84.20	10.56	0.65
56-02-047	Great River Regional Waste Authority Sanitary Landfill	4953	73.55	0.00	0.00	0.00
88-01-017	Green Valley Chemical Corporation	2873	33,189.91	3.71	0.06	0.03
56-02-035	Gregory Manufacturing Co., Inc.	3441	1.84	0.00	0.00	0.00
78-01-012	Griffin Pipe Products Company	3321	52,952.65	5.82	0.56	0.05
84-03-015	Groschopp, Inc.	3621	170.90	0.02	0.00	0.00
23-02-013	Guardian Industries Corporation	3211	78,817.91	8.80	0.15	0.07
70-01-005	H.J. Heinz Company, L.P.	2033	12,621.10	1.41	0.02	0.01
70-01-054	Harsco Metals	3295	205.41	0.01	0.00	0.00
56-01-008	Henniges Automotive Iowa	3061	3,601.11	0.39	0.01	0.00
17-01-009	Holcim (US) Inc. - Mason City Plant	3241	154,043.55	12.17	1.57	0.14
19-04-002	Homeland Energy Solutions, LLC	2869	136,002.19	15.19	0.26	0.12
70-01-006	Hon Company-Oak Steel Plant	2521	9,333.85	1.04	0.02	0.01
52-01-003	IACNA	3086	5,226.29	0.56	0.01	0.00
03-02-001	Industrial Laminates/Norplex, Inc.	3083	11,345.11	1.26	0.02	0.01
29-01-004	Iowa Army Ammunition Plant	9711	65,060.63	7.76	1.07	0.06
52-01-053	Iowa City Sanitary Landfill	4959	123.86	0.02	0.00	0.00
77-01-175	Iowa E.P.S. Products, Inc.	3086	1.09	0.00	0.00	0.00
77-01-142	Iowa Methodist Medical Center	8062	29,951.96	3.35	0.06	0.03
85-01-007	Iowa State University (Power Plant)	8221	340,186.09	40.05	5.72	0.31
85-01-007	Iowa State University Central Campus	8221	4,832.31	0.54	0.01	0.00
29-02-003	IPL - Burlington Agency Street Combustion Turbines Station	4911	562.74	0.06	0.00	0.00
29-01-013	IPL - Burlington Generating Station	4911	**1,525,142.87**	156.54	22.35	1.39
04-01-003	IPL - Centerville Combustion Turbines and Diesels Station	4911	246.43	0.01	0.00	0.00
31-01-017	IPL - Dubuque Generation Station	4911	**218,887.38**	29.39	3.39	0.20
17-02-016	IPL - Emery Generating Station	4911	**266,242.24**	29.26	0.50	0.24
79-01-022	IPL - Grinnell Combustion Turbines Station	4911	244.01	0.03	0.00	0.00
03-03-001	IPL - Lansing Generating Station	4911	**1,573,790.76**	182.91	26.14	1.44
17-01-066	IPL - Lime Creek Combustion Turbines Station	4911	**1,681.32**	0.06	0.02	0.00
23-01-014	IPL - M.L. Kapp Generating Station	4911	**948,534.11**	109.69	15.63	0.87
90-07-001	IPL - Ottumwa Generating Station	4911	**4,951,127.04**	513.64	73.42	4.52
57-01-042	IPL - Prairie Creek Generating Station	4911	**494,843.55**	57.18	5.85	0.45
57-01-040	IPL - Sixth Street Generating Station	4911	116,929.20	13.06	0.22	0.11

Facility #	Facility Name	SIC	CO_2 (tons)	CH_4 (tons)	N_2O (tons)	$MMtCO_2e$
64-01-012	IPL - Sutherland Generating Station	4911	**696,414.00**	69.40	9.69	0.64
31-01-021	JELD-WEN, inc.	2493	1,723.72	0.19	0.00	0.00
82-01-043	John Deere Davenport Works	3531	5,106.96	0.49	0.02	0.00
77-01-035	John Deere Des Moines Works	3523	18,962.77	1.99	0.04	0.02
31-01-009	John Deere Dubuque Works	3531	43,511.71	4.86	0.61	0.04
07-01-091	John Deere Engine Works	3519	5,977.64	0.46	0.03	0.01
07-01-010	John Deere Foundry Waterloo	3321	19,634.39	2.16	0.04	0.02
90-01-003	John Deere Ottumwa Works	3523	7,314.24	0.81	0.01	0.01
07-01-087	John Deere Product Engineering Center	3523	30,111.44	1.10	0.28	0.03
07-01-077	John Deere Waterloo Works	3523	20,177.45	2.19	0.04	0.02
07-01-085	John Deere Waterloo Works - DSS	3523	12,246.39	1.25	0.04	0.01
56-01-025	Keokuk Steel Castings, A Matrix Metals Company LLC	3325	7,140.20	0.80	0.01	0.01
41-03-003	Kiefer Built, LLC	3499	598.59	0.07	0.00	0.00
94-01-005	Koch Nitrogen Company	2873	250,304.85	27.96	0.47	0.23
82-04-005	Lafarge North America Inc.	3241	195,804.87	20.79	2.97	0.18
17-01-005	Lehigh Cement Company - Mason City	3241	73,785.37	7.74	1.04	0.07
64-01-009	Lennox Manufacturing, Inc.	3585	4,040.77	0.45	0.01	0.00
85-02-017	Lincolnway Energy, LLC	2869	181,169.32	21.64	3.09	0.17
82-01-015	Linwood Mining & Minerals Corporation	3274	47,993.92	5.69	0.75	0.04
18-02-006	Little Sioux Corn Processors, LP	2869	167,800.35	18.74	0.32	0.15
52-01-037	LOPAREX, Inc.	2672	19,085.49	2.13	0.04	0.02
52-02-006	Magellan Pipeline Company, L.P - Iowa City Terminal	4613	1,677.41	0.02	0.00	0.00
77-01-114	Magellan Pipeline Company, L.P. - Des Moines Terminal	4613	2,458.03	0.02	0.00	0.00
31-01-034	Magellan Pipeline Company, L.P. - Dubuque Terminal	4613	0.00	0.00	0.00	0.00
94-07-001	Magellan Pipeline Company, L.P. - Fort Dodge Terminal	4613	8.29	0.00	0.00	0.00
17-02-002	Magellan Pipeline Company, L.P. - Mason City Terminal	4613	816.56	0.11	0.01	0.00
30-02-004	Magellan Pipeline Company, L.P. - Milford Terminal	4613	0.00	0.00	0.00	0.00
97-01-118	Magellan Pipeline Company, L.P. - Sioux City Terminal	4613	1,679.04	0.23	0.02	0.00
07-01-040	Magellan Pipeline Company, L.P. - Waterloo Terminal	4613	1,170.37	0.15	0.01	0.00
15-01-014	MAHLE Engine Components USA, Inc.	3714	989.47	0.11	0.00	0.00
98-02-004	Manly Terminal	5171	72.07	0.00	0.00	0.00
49-01-013	Maquoketa Municipal Electric Utility	4911	342.28	0.03	0.00	0.00
70-01-025	McKee Button Company	3965	87.17	0.01	0.00	0.00
11-01-029	Meridian Mfg. Group	3443	17,149.82	1.92	0.03	0.02
07-02-023	MetoKote Corporation - Plant 15	3479	5.28	0.00	0.00	0.00
07-01-111	MetoKote Corporation - Plant 24	3479	3.33	0.00	0.00	0.00
77-14-002	Metro Methane Recovery Facility	4953	5.74	0.00	0.00	0.00

Facility #	Facility Name	SIC	CO_2 (tons)	CH_4 (tons)	N_2O (tons)	$MMtCO_2e$
77-14-003	Metro Park East Sanitary Landfill	4953	11.36	0.00	0.00	0.00
52-02-001	MidAmerican Energy Co. - Coralville Turbines	4911	1,694.69	0.19	0.00	0.00
07-01-038	MidAmerican Energy Co. - Electrifarm Turbines	4911	36,819.72	4.11	0.07	0.03
97-04-010	MidAmerican Energy Co. - George Neal North	4911	**6,948,665.27**	802.71	114.39	6.35
97-04-011	MidAmerican Energy Co. - George Neal South	4911	**4,464,849.47**	514.93	73.59	4.08
63-01-017	MidAmerican Energy Co. - Knoxville Power Station	4911	161.16	0.00	0.00	0.00
58-07-001	MidAmerican Energy Co. - Louisa Station	4911	**4,844,878.02**	607.45	86.68	4.43
34-01-023	MidAmerican Energy Co. - Merl Parr CTs	4911	59.62	0.01	0.00	0.00
77-13-002	MidAmerican Energy Co. - Pleasant Hill CTs/Greater Des Moines Energy Center	4911	**168,151.15**	18.09	0.31	0.15
77-01-054	MidAmerican Energy Co. - River Hills Turbines	4911	611.13	0.07	0.00	0.00
82-02-006	MidAmerican Energy Co. - Riverside Station	4911	**816,956.63**	103.94	14.49	0.75
73-01-018	MidAmerican Energy Co. - Shenandoah Power Station	4911	72.27	0.00	0.00	0.00
77-09-002	MidAmerican Energy Co. - Sycamore Turbines	4911	7,701.62	0.86	0.01	0.01
78-01-026	MidAmerican Energy Co. - Walter Scott Jr. Energy Center	4911	**11,568,855.94**	1,365.39	195.13	10.58
07-01-133	MidAmerican Energy Co. - Waterloo Lundquist Power Station	4911	72.32	0.00	0.00	0.00
31-02-002	Modernfold Inc.	2542	772.24	0.09	0.00	0.00
70-01-008	Monsanto Company - Muscatine (3670)	2879	7,373.25	0.82	0.01	0.01
70-01-008	Monsanto Company - Muscatine (6909)	2879	91,231.45	10.59	1.00	0.08
56-01-013	Morse Rubber, LLC	3069	824.81	0.09	0.00	0.00
70-01-011	Muscatine Power & Water	4911	**1,768,910.37**	206.30	29.44	1.62
78-01-092	National Cooperative Refinery Association	5171	0.00	0.00	0.00	0.00
65-04-001	Natural Gas Pipeline Co. of America/Station 107	4922	86,761.07	9.69	0.16	0.08
91-06-001	Natural Gas Pipeline Co. of America/Station 108	4922	85,592.03	9.56	0.16	0.08
54-10-001	Natural Gas Pipeline Co. of America/Station 109	4922	84,154.67	9.40	0.16	0.08
63-01-013	Natural Gas Pipeline Co. of America/Station 198	4922	66,694.09	7.45	0.13	0.06
58-04-002	Natural Gas Pipeline Co. of America/Station 199	4922	3,402.73	0.38	0.01	0.00
58-02-007	Natural Gas Pipeline Co. of America/Station 204	4922	19,275.17	2.15	0.04	0.02
92-10-001	Natural Gas Pipeline Co. of America/Station 205	4922	3,410.45	0.38	0.01	0.00
82-01-089	Nichols Aluminum - Casting	3353	54,328.90	5.65	0.14	0.05
82-01-017	Nichols Aluminum - Davenport	3353	6,408.37	0.72	0.01	0.01
41-02-005	Northern Natural Gas Company - Garner LNG Plant	4922	2,417.32	0.27	0.00	0.00
78-04-006	Northern Natural Gas Company - Oakland	4922	53,875.76	6.02	0.10	0.05
08-03-004	Northern Natural Gas Company - Ogden	4922	72,856.41	8.14	0.14	0.07
18-06-002	Northern Natural Gas Company - Paullina	4922	4,752.58	0.53	0.01	0.00
25-05-002	Northern Natural Gas Company - Redfield	4922	33,713.77	3.76	0.06	0.03
41-02-005	Northern Natural Gas Company - Ventura	4922	20,928.51	2.34	0.04	0.02

Facility #	Facility Name	SIC	CO_2 (tons)	CH_4 (tons)	N_2O (tons)	$MMtCO_2e$
07-01-057	Northern Natural Gas Company - Waterloo	4922	20,658.81	2.31	0.04	0.02
75-01-018	NuStar Pipe Line Operating Partnership, LP - Lemars	4613	0.00	0.00	0.00	0.00
30-02-010	NuStar Pipe Line Operating Partnership, LP - Milford	4613	0.00	0.00	0.00	0.00
60-01-012	NuStar Pipe Line Operating Partnership, LP - Rock Rapids	4613	0.00	0.00	0.00	0.00
07-01-061	Omega Cabinets Ltd.	2434	3,525.41	0.39	0.01	0.00
14-01-010	Pella Corporation - Carroll Division	2431	1,491.12	0.17	0.00	0.00
63-02-003	Pella Corporation - Pella Division	2431	11,207.74	1.25	0.02	0.01
73-01-012	Pella Corporation - Shenandoah Operations	2431	396.39	0.04	0.00	0.00
84-03-018	Pella Corporation - Sioux Center Operations	2431	755.60	0.08	0.00	0.00
63-02-005	Pella Municipal Power Plant	4911	**109,123.01**	12.47	1.73	0.10
57-01-025	Penford Products Co.	2046	132,226.88	14.76	0.25	0.12
47-04-001	Platinum Ethanol	2869	186,988.60	20.89	0.35	0.17
57-01-095	PMX Industries Inc.	3351	18,895.51	2.11	0.04	0.02
39-11-001	POET Biorefining - Coon Rapids	2869	76,289.09	8.52	0.14	0.07
30-01-012	Polaris Industries, Inc.	3799	5,586.83	0.62	0.01	0.01
94-07-004	Praxair, Inc. - Fort Dodge, IA Carbon Dioxide Plant	2813	0.00	0.00	0.00	0.00
90-01-023	Praxis Companies, LLC	3088	0.83	0.00	0.00	0.00
77-01-174	Principal Life Insurance Company	6311	857.36	0.10	0.00	0.00
57-01-027	Quaker Manufacturing LLC	2043	10,082.09	1.13	0.02	0.01
57-01-226	Red Star Yeast Company, LLC	2099	0.00	0.00	0.00	0.00
29-01-079	Riley Industrial Painting	3479	368.52	0.04	0.00	0.00
56-01-009	Roquette America, Inc.	2046	**525,245.18**	61.17	7.16	0.48
82-01-121	Scott County Landfill	4953	20.38	0.00	0.00	0.00
35-01-008	Seabee	3593	1,479.19	0.17	0.00	0.00
77-01-169	Siegwerk USA Inc.	2893	180.68	0.02	0.00	0.00
56-02-053	Siemens Energy Inc. - Fort Madison	2893	1,879.99	0.19	0.01	0.00
94-01-040	Silgan Containers Mfg. Corp. - Fort Dodge	3411	1,049.31	0.12	0.00	0.00
56-02-030	Silgan Containers Mfg. Corp. - Fort Madison	3411	645.31	0.07	0.00	0.00
97-04-001	Sioux City Brick & Tile Company	3251	7,526.64	0.84	0.01	0.01
82-02-004	Sivyer Steel	3325	13,991.79	1.56	0.03	0.01
55-01-002	Snap-On Tools Manufacturing Company	3499	4,983.84	0.55	0.01	0.00
63-08-001	South Central Iowa Solid Waste Agency (SCISWA)	4953	12.57	0.00	0.00	0.00
78-01-110	Southwest Iowa Renewable Energy, LLC	2869	75,228.17	8.40	0.14	0.07
70-08-002	SSAB Iowa Inc	3312	204,999.21	23.31	1.12	0.19
53-02-008	Star Building Systems	3448	921.74	0.10	0.00	0.00
41-02-011	Stellar Industries, Inc.	3713	560.03	0.06	0.00	0.00
86-01-001	Tama Paperboard	2631	26,348.30	2.94	0.05	0.02

Facility #	Facility Name	SIC	CO_2 (tons)	CH_4 (tons)	N_2O (tons)	$MMtCO_2e$
40-01-014	Tasler, Inc. - EPS	3086	2,981.66	0.33	0.01	0.00
97-01-030	Terra Nitrogen - Port Neal Complex	2873	778,720.17	86.99	1.47	0.71
77-01-003	Titan Tire Corporation	3011	36,047.76	3.79	0.09	0.03
65-01-005	Trajet Products, Inc.	3087	0.00	0.00	0.00	0.00
18-01-002	Tyson Deli, Inc.	2013	8,267.64	0.92	0.02	0.01
07-01-071	Tyson Fresh Meats, Inc.	2011	39,683.29	4.43	0.08	0.04
70-01-048	Union Tank Car Co.-Muscatine	4741	2,979.88	0.33	0.01	0.00
25-02-001	United Brick & Tile - Adel Plant	3251	9,457.33	1.06	0.02	0.01
29-06-001	United States Gypsum Company	3275	61,155.25	6.83	0.12	0.06
94-01-017	United States Gypsum Company	3275	14,240.89	1.59	0.03	0.01
52-01-005	University of Iowa Main Campus, Hospitals, and Oakdale Campus	8221	10,299.09	1.00	0.02	0.01
52-01-005	University of Iowa Main Power Plant	8221	**303,349.91**	29.48	3.71	0.28
07-02-006	University of Northern Iowa - Main Campus	8221	688.16	0.08	0.00	0.00
07-02-006	University of Northern Iowa - Power Plant	8221	97,302.81	11.24	1.48	0.09
12-04-005	Unverferth Manufacturing Co. Inc.	3523	2,134.49	0.00	0.00	0.00
85-01-017	USDA - NADC	8733	43,633.66	4.83	0.09	0.04
85-01-056	USDA - National Veterinary Services Laboratories	8734	16.90	0.00	0.00	0.00
82-02-002	Veolia Water NA - Davenport	5093	83.82	0.01	0.00	0.00
63-02-004	Vermeer Manufacturing Company	3531	1,132.52	0.10	0.00	0.00
84-01-002	Vogel Paint & Wax Co., Inc.	2851	1,007.62	0.11	0.00	0.00
68-09-006	Wacker Chemical Corporation	2046	8,477.94	0.94	0.02	0.01
09-01-013	Waverly Light & Power - North & South Plants	4911	286.22	0.02	0.00	0.00
40-01-003	Webster City Diesel Turbine	4911	38.78	0.00	0.00	0.00
05-04-002	Western Minnesota Municipal Power Agency - Exira Station	4911	**2,399.50**	0.26	0.00	0.00
48-05-001	Whirpool Corporation - Amana Division	3632	12,801.45	1.37	0.03	0.01
29-01-012	Winegard Company	3663	1,189.00	0.13	0.00	0.00
34-01-027	Winnebago Industries, Inc. - Charles City	3716	565.23	0.06	0.00	0.00
95-01-001	Winnebago Industries, Inc. - Forest City	3716	8,377.47	0.94	0.02	0.01
35-01-010	Winnebago Industries, Inc. - Hampton	3716	652.05	0.07	0.00	0.00
17-01-068	Woodharbor Doors and Cabinetry	2434	960.19	0.11	0.00	0.00
98-01-006	Woodharbor Doors and Cabinetry - Northwood Facility	2431	638.46	0.07	0.00	0.00
16-01-004	Xerxes Corporation	3089	49.12	0.00	0.00	0.00
	Total		**56,314,583.88**	**6,407.75**	**815.28**	**51.44**

Appendix E: 2009 GHG Emissions Per Dry Mill Ethanol Plant

			2009			
Facility ID	**Facility Name**	**City**	**Million Gallons Denatured Ethanol Produced**[61]	**% of Operating Capacity**[62]	**$MMtCO_2e$ from Fermentation**	**$MMtCO_2e$ from Fuel Combustion**
66-10-001	Absolute Energy, LLC	St. Ansgar	105	96%	0.29	0.16
24-01-007	Amaizing Energy, LLC	Denison	51	78%	0.14	0.07
29-02-012	Big River Resources, LLC*	W. Burlington	102	78%	0.28	0.18
31-02-019	Big River United Energy, LLC	Dyersville	28	23%	0.08	0.13
99-05-003	CORN LP*	Goldfield	59	96%	0.16	0.17
55-09-003	Global Ethanol, LLC*	Lakota	100	79%	0.28	0.16
17-01-100	Golden Grain Energy*	Mason City	108	72%	0.30	0.16
73-01-025	Green Plains Shenandoah LLC	Shenandoah	58	92%	0.16	0.08
30-01-022	Green Plains Superior LLC	Superior	50	83%	0.14	0.08
39-06-002	Hawkeye Menlo	Menlo	110	83%	0.31	0.16
10-04-007	Hawkeye Renewables, LLC	Fairbank	109	83%	0.30	0.16
42-01-019	Hawkeye Renewables, LLC	Iowa Falls	106	92%	0.29	0.17
12-04-007	Hawkeye Shell Rock LLC	Shell Rock	110	84%	0.31	0.17
19-04-002	Homeland Energy Solutions, LCC*	Lawler	83	49%	0.23	0.12
85-02-017	Lincolnway Energy, LLC*	Nevada	53	97%	0.15	0.17
18-02-006	Little Sioux Corn Processors, LP*	Marcus	109	91%	0.30	0.15

[61] As reported by each facility on their 2009 inventory.
[62] Percent operating capacity = permitted capacity (gallons) / gallons produced

			2009			
Facility ID	**Facility Name**	**City**	**Million Gallons Denatured[41] Ethanol Produced[63]**	**% of Operating Capacity[64]**	**$MMtCO_2e$ from Fermentation**	**$MMtCO_2e$ from Fuel Combustion**
37-02-004	Louis Dreyfus Commodities Grand Junction LLC	Grand Junction	72	65%	0.20	0.10
42-08-001	Pine Lake Corn Processors LLC	Steamboat	27	40%	0.08	0.05
47-04-001	Platinum Ethanol*	Arthur	117	87%	0.33	0.17
75-05-005	Plymouth Energy LLC	Merrill	40	63%	0.11	0.06
72-03-002	Poet Biorefining	Ashton	52	80%	0.14	0.09
39-11-001	Poet Biorefining*	Coon Rapids	50	77%	0.14	0.07
02-05-001	Poet Biorefining	Corning	63	96%	0.18	0.10
74-01-022	Poet Biorefining	Emmetsburg	54	49%	0.15	0.08
94-02-004	Poet Biorefining	Gowrie	64	92%	0.18	0.09
98-07-004	Poet Biorefining	Hanlontown	54	85%	0.15	0.08
40-02-002	Poet Biorefining	Jewell	63	91%	0.18	0.08
47-05-002	Quad County Corn Processors Cooperative	Galva	26	82%	0.07	0.04
84-03-020	Siouxland Energy & Livestock Coop	Sioux Center	53	82%	0.15	0.05
78-01-110	Southwest Iowa Renewable Energy, LLC*	Council Bluffs	84	67%	0.23	0.07
11-05-004	Valero Renewable Fuels Company, LLC	Albert City	68	61%	0.19	0.10
94-01-073	Valero Renewable Fuels Company, LLC	Fort Dodge	112	94%	0.31	0.18
34-01-040	Valero Renewable Fuels Company, LLC	Charles City	127	93%	0.35	0.19
71-02-010	Valero Renewable Fuels Company, LLC	Hartley	112	95%	0.31	0.18
	Total		**2,581**		**7.19**	**4.06**

* Facility is subject to the federally enforceable major source operating permit program (Title V).

[63] As reported by each facility on their 2009 inventory.

[64] Percent operating capacity = permitted capacity (gallons) / gallons produced

Appendix F: 2009 Fluorinated Gas (F-gas) Emissions per Major Source Facility (sorted by F-gas)

Facility ID	Facility Name	Common Name	Name	Emissions (lbs)	GWP	$MtCO_2e$	$MMtCO_2e$
82-01-002	Alcoa	HFC-125	pentafluoroethane	627.00	2,800	796.34	0.00
62-01-001	Clow Valve Company	HFC-125	pentafluoroethane	3.52	2,800	4.47	0.00
85-01-056	USDA - National Veterinary Services Laboratories	HFC-125	pentafluoroethane	8.32	2,800	10.57	0.00
23-01-006	ADM Clinton Corn Processing	HFC-134a	1,1,1,2-tetrafluoroethane	2,783.00	1,300	1,641.08	0.00
57-01-080	ADM Corn Processing	HFC-134a	1,1,1,2-tetrafluoroethane	3,016.00	1,300	1,778.47	0.00
23-01-006	ADM Polymer	HFC-134a	1,1,1,2-tetrafluoroethane	11,480.00	1,300	6,769.53	0.01
82-01-002	Alcoa	HFC-134a	1,1,1,2-tetrafluoroethane	542.00	1,300	319.61	0.00
62-01-001	Clow Valve Company	HFC-134a	1,1,1,2-tetrafluoroethane	0.32	1,300	0.19	0.00
85-01-007	Iowa State University Central Campus	HFC-134a	1,1,1,2-tetrafluoroethane	643.00	1,300	379.16	0.00
85-01-007	Iowa State University Heating Plant	HFC-134a	1,1,1,2-tetrafluoroethane	500.00	1,300	294.84	0.00
77-01-035	John Deere Des Moines Works	HFC-134a	1,1,1,2-tetrafluoroethane	0.00	1,300	0.00	0.00
07-10-010	John Deere Foundry	HFC-134a	1,1,1,2-tetrafluoroethane	43.00	1,300	25.36	0.00
07-01-085	John Deere Waterloo Works - Donald Street Site	HFC-134a	1,1,1,2-tetrafluoroethane	2,220.00	1,300	1,309.09	0.00
77-14-003	Metro Park East Sanitary Landfill	HFC-134a	1,1,1,2-tetrafluoroethane	45.00	1,300	26.54	0.00
70-01-008	Monsanto Company – Muscatine	HFC-134a	1,1,1,2-tetrafluoroethane	1,025.00	1,300	604.42	0.00
51-01-095	PMX Industries Inc	HFC-134a	1,1,1,2-tetrafluoroethane	65.60	1,300	38.68	0.00
53-02-008	Robertson Ceco II dba Star Building Systems	HFC-134a	1,1,1,2-tetrafluoroethane	189.00	1,300	111.45	0.00
52-01-008	University of Iowa Campus, Hospitals, and Oakdale Campus	HFC-134a	1,1,1,2-tetrafluoroethane	74.00	1,300	43.64	0.00
85-01-017	USDA - National Animal Disease Center	HFC-134a	1,1,1,2-tetrafluoroethane	2.00	1,300	1.18	0.00

Facility ID	Facility Name	Common Name	Name	Emissions (lbs)	GWP	$MtCO_2e$	$MMtCO_2e$
85-01-056	USDA - National Veterinary Services Laboratories	HFC-134a	1,1,1,2-tetrafluoroethane	2.79	1,300	1.64	0.00
48-05-001	Whirlpool Corporation - Amana Division	HFC-134a	1,1,1,2-tetrafluoroethane	0.00	1,300	0.00	0.00
62-01-001	Clow Valve Company	HFC-143a	1,1,1-trifluoroethane	4.16	3,800	7.17	0.00
85-01-056	USDA - National Veterinary Services Laboratories	HFC-143a	1,1,1-trifluoroethane	9.84	3,800	16.96	0.00
31-01-009	John Deere Dubuque Works	HFC-152a	1,1-difluoroethane	0.91	140	0.06	0.00
95-01-001	Winnebago Industries - Forest City Operations	HFC-152a	1,1-difluoroethane	0.13	140	0.01	0.00
85-01-056	USDA - National Veterinary Services Laboratories	HFC-23	trifluoromethane	0.30	11,700	1.58	0.00
48-05-001	Whirlpool Corporation - Amana Division	HFC-245fa	1,1,1,3,3-pentafluoropropane	0.00	950*	0.00	0.00
95-01-001	Winnebago Industries - Forest City Operations	HFC-245fa	1,1,1,3,3-pentafluoropropane	100.00	950*	43.09	0.00
35-01-010	Winnebago Industries - Hampton Operations	HFC-245fa	1,1,1,3,3-pentafluoropropane	100.00	950*	43.09	0.00
04-01-002	Curwood, Inc	SF_6	Sulfur Hexafluoride	30.00	23,900	325.23	0.00
77-01-022	Bridgestone Americas Tire Operations LLC	SF_6	Sulfur Hexafluoride	2,967.00	23,900	32,165.37	0.03
	TOTAL					**46,758.81**	**0.05**

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