IOWA DEPARTMENT OF
NATURAL RESOURCES

2010 Iowa Greenhouse Gas Inventory Report

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Iowa Department of Natural Resources
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Acronyms and Key Terms

AEO	Annual Energy Outlook
AFOLU	agriculture, forestry, and land use
BOD	biochemical oxygen demand
BOF	blast oven furnace
CH_4	methane
CCS	Center for Climate Strategies
CCT	Carbon Control Tool
CEEE	Center for Energy & Environmental Education
CGRER	Center for Global and Regional Environmental Research
CO_2	carbon dioxide
CRP	Conservation Reserve Program
DNR	Iowa Department of Natural Resources
DOE	United States Department of Energy
DOT	United States Department of Transportation
EAF	electric arc furnace
EIA	United States Energy Information Administration
EIIP	Emission Inventory Improvement Program
EPA	United States Environmental Protection Agency
FERC	Federal Energy Regulatory Agency
FHWA	Federal Highway Administration
GHG	greenhouse gas
HDGV	heavy duty gas vehicle
HDDV	heavy duty diesel vehicle
IDALS	Iowa Department of Agriculture and Land Stewardship
IDOT	Iowa Department of Transportation
IEA	International Energy Agency
ILPA	Iowa Limestone Producers Association
IPCC	Intergovernmental Panel on Climate Change
LDC	local distribution company
LDDT	light duty diesel truck
LDDV	light duty diesel vehicle
LDGT	light duty gasoline truck
LDGV	light duty gasoline vehicle
LFGTE	landfill gas to energy
LMOP	Landfill Methane Outreach Program
LULUCF	land use, land use change, and forestry
MC	motorcycle
MMtC	million metric tons carbon

Acronyms and Key Terms (Continued)

MtCE	metric tons carbon equivalent
$MtCO_2e$	metric tons carbon dioxide equivalent
$MMtCO_2e$	million metric tons carbon dioxide equivalent
MRO	Midwest Reliability Organization
MROW	Midwest Reliability Organization West
MSW	municipal solid waste
N	nitrogen
NERC	North America Electric Reliability Corporation
NIFC	National Interagency Fire Center
NRCS	Natural Resources and Conservation Service
N_2O	nitrous oxide
OECD	Organization for Economic Co-operation and Development
PET	polyethylene terephthalate
PHMSA	Pipeline and Hazardous Materials Safety Administration
PS	polystyrene
PVC	polyvinyl chloride
SERC	SERC Reliability Corporation
SMRW	SERC Midwest
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VMT	vehicle miles traveled

Executive Summary

Background

This report is required by Iowa Code 455B.104 which states that "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…." This report updates Iowa's 2005 Statewide Greenhouse Gas (GHG) Emission Inventory that was developed by the Center for Climate Strategies (Strait et al. 2008) for the Iowa Climate Change Advisory Council (ICCAC).

This is a "top-down" inventory based on statewide activity data from agriculture, fossil fuel combustion, industrial processes, natural gas transmission and distribution, transportation, solid waste, and wastewater treatment. It also includes carbon sequestered from land use, land use change, and forestry (LULUCF). GHG emissions were calculated using the State Inventory Tool (SIT), the standard GHG inventory method developed for states by the United States Environmental Protection Agency (EPA). The calculation method, results, and uncertainty for each sector are discussed in detail in their associated chapter. A majority of states have recently completed GHG inventories utilizing the same methodologies. Benefits of reports like this include the evaluation of emissions trends, development of a baseline to track progress in reducing emissions, and comparison with national trends (EPA 2011c). EPA also annually conducts a nationwide GHG inventory. The most recent was conducted for years 1990 – 2009 (EPA 2011b).

2010 Statewide GHG Emissions

In 2010, total Iowa *gross* greenhouse gas emissions (i.e. excluding carbon sinks) were 136.52 million metric tons carbon dioxide equivalents ($MMtCO_2e$). Table 1 and Figure 1 on the next page present the GHG emissions from each sector.

Table 1: Iowa GHG Emissions 2005 – 2010, by Sector[1,2]

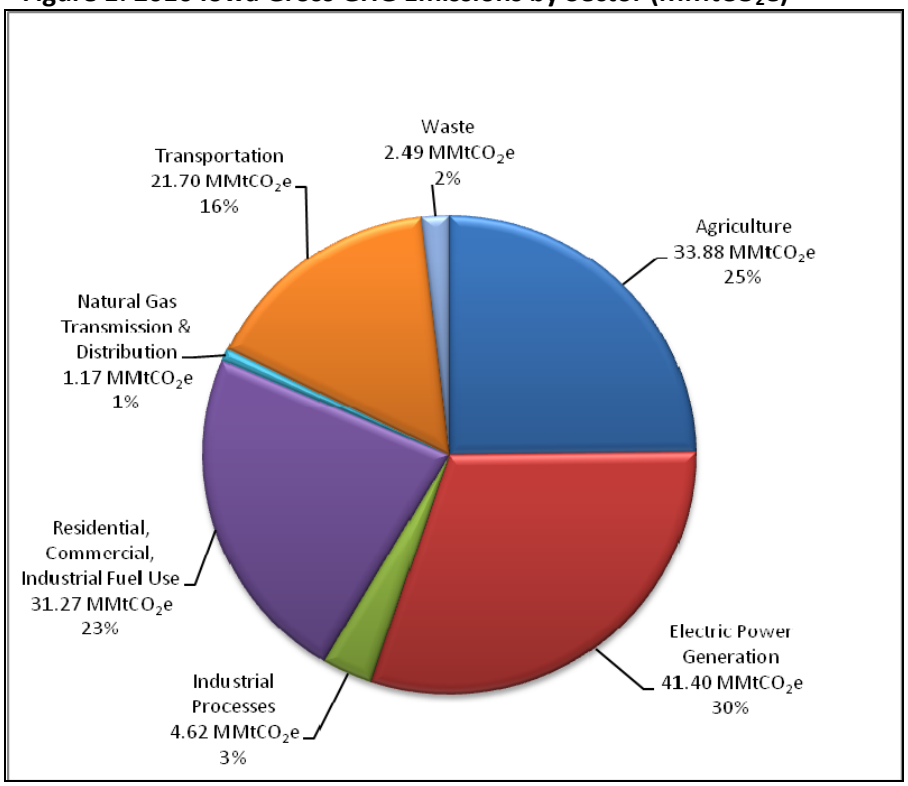
Emissions ($MMtCO_2e$)	2005	2006	2007	2008	2009	2010
Agriculture	32.14	34.25	38.73	34.81	34.63	33.88
Enteric Fermentation	5.95	6.35	6.62	6.77	6.74	6.50
Manure Management	6.77	6.80	7.48	8.19	8.25	7.93
Agricultural Soil Management	19.42	21.10	24.63	19.85	19.63	19.45
Burning of Agricultural Crop Waste	0.01	0.01	0.01	0.01	0.01	0.01
Fossil Fuel Combustion	60.90	60.68	66.26	69.53	65.38	72.67
Electric Power Fuel Use	36.84	36.35	40.04	41.78	37.71	41.40
Residential, Commercial, and Industrial (RCI) Fuel Use	24.07	24.32	26.21	27.75	27.66	31.27

[1] Totals may not equal the exact sum of subtotals in this table due to independent rounding.
[2] Numbers in parentheses are negative numbers.

Table 1 (continued)

Emissions ($MMtCO_2e$)	2005	2006	2007	2008	2009	2010
Industrial Processes	4.67	4.81	4.83	4.93	4.22	4.62
Land Use, Land Use Change, and Forestry (LULUCF)	(16.97)	(16.93)	(16.96)	(17.09)	(17.15)	(16.96)
Natural Gas and Oil Transmission and Distribution	1.15	1.15	1.16	1.07	1.17	1.17
Transportation	21.88	22.38	22.81	21.97	21.42	21.70
Waste	2.62	2.56	2.60	2.62	2.59	2.49
Municipal Solid Waste (MSW)	2.17	2.11	2.14	2.15	2.12	2.03
Wastewater	0.45	0.45	0.46	0.47	0.47	0.46
Gross Emissions	**123.37**[3]	**125.83**	**136.39**	**134.94**	**129.41**	**136.52**
Sinks	**(16.97)**	**(16.93)**	**(16.96)**	**(17.09)**	**(17.15)**	**(16.96)**
Net Emissions	**106.40**	**108.90**	**119.43**	**117.84**	**112.26**	**119.56**
% change in Gross from Previous Year		2.00%	8.40%	(1.07)%	(4.10)%	5.50%
% change in Gross from 2005		2.00%	10.56%	9.38%	4.90%	10.67%

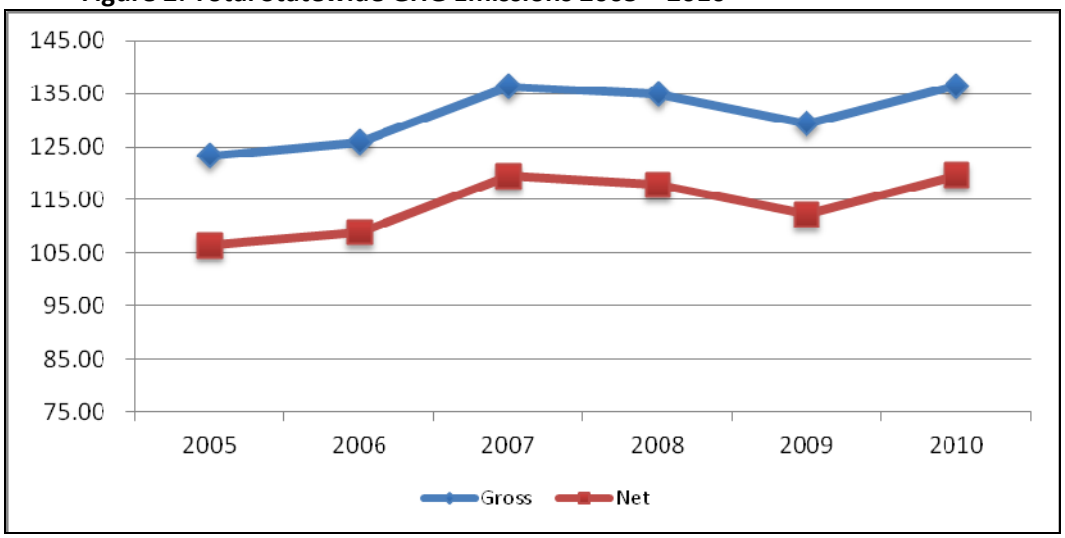
Figure 1: 2010 Iowa Gross GHG Emissions by Sector ($MMtCO_2e$)



[3] The 2005 value is as revised by the Department. The 2005 GHG emissions presented in this inventory are slightly higher (3.87 $MMtCO_2e$) than the emissions in the previous 2005 inventory conducted by Strait et al. The difference can be attributed to improved activity data and emissions factors since the inventory was conducted. The Department also determined that the SIT had been over-estimating emissions from both agricultural soils and agricultural burning. This is further discussed in *Chapter 2–Agriculture.*

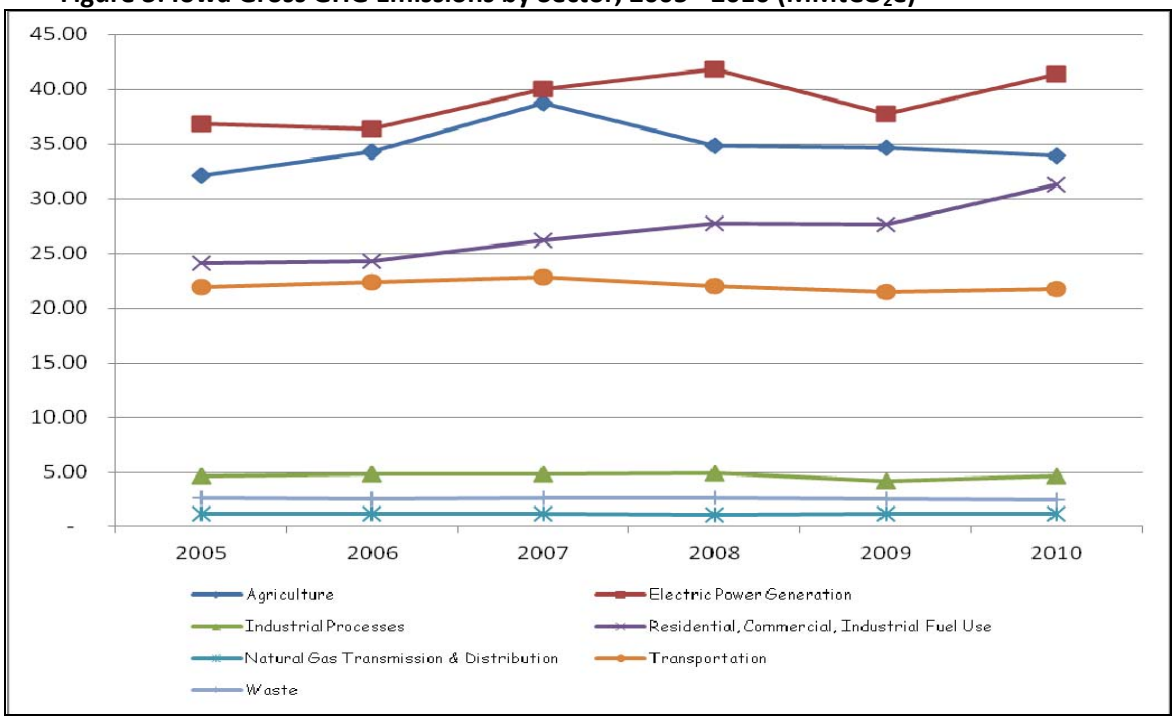
Total 2010 statewide gross GHG emissions increased 5.5% from 2009 and 10.7% from 2005 as shown in Figure 2 partially due to increases in the amount of fossil fuel combusted in the electric power and residential, commercial, industrial (RCI) sectors. Gross GHG emissions decreased 5.1% from 2007 – 2009, mostly due to the economic downturn. Net GHG emissions followed the same trend, as the amount of carbon sequestered remained stable.

Figure 2: Total Statewide GHG Emissions 2005 – 2010



The total gross GHG emissions increased from 2005 – 2010 in each sector except in the industrial processes, transportation, and waste sectors as shown in Figure 3.

Figure 3: Iowa Gross GHG Emissions by Sector, 2005 - 2010 (MMtCO$_2$e)



While the emissions from each sector are discussed in more detail in the chapter for each category, they can be summarized as follows:

- ***Agriculture*** – Includes GHG emissions from livestock and crop production such as enteric fermentation, manure management, agricultural soils, and agricultural burning. GHG emissions from fossil-fuel fired agricultural equipment are included in the transportation sector. Agricultural emissions increased 5.4% from 2005 – 2010, due to increases in both animal and crop production. This is further discussed in *Chapter 2 – Agriculture.*

- ***Fossil Fuel Combustion*** – Includes GHG emissions from fossil fuel consumption in two categories – electric power and residential, commercial, industrial (RCI). A 12.4% increase in electric power GHG emissions and a 30.0% increase RCI GHG emissions can be directly attributed to increases in the amount of fossil fuel consumed in each sector. This is further discussed in *Chapter 3 – Fossil Fuel Consumption*. GHG emissions from fossil fuels consumed by mobile sources are discussed in *Chapter 6 – Transportation.*

- ***Industrial Processes*** – Includes non-combustion GHG emissions from a variety of processes including cement production, lime manufacture, limestone and dolomite use, soda ash use, iron and steel production, ammonia production, nitric acid production, substitutes for ozone depleting substances (ODS), and electric power and distribution. GHG emissions trends in each sector vary, but overall GHG emissions from this sector decreased 1.1% from 2005 – 2010. This is further discussed in *Chapter 4 – Industrial Processes.*

- ***Natural Gas Transmission and Distribution*** – includes GHG emissions from natural gas transmission and distribution networks.GHG emissions increased 1.6% from 2005 – 2010 partly due to an increase in the miles of transmission lines in the state. This is further discussed in *Chapter 5 – Natural Gas Transmission & Distribution.*

- ***Transportation*** – includes GHG emissions from both highway and non-highway vehicles such as aviation, boats, locomotives, tractors, other utility vehicles, and alternative fuel vehicles. Transportation GHG emissions decreased 0.8% from 2005 – 2010, partly due to a decrease in the amount of gasoline combusted by motor vehicles. This is further discussed in *Chapter 6 – Transportation.*

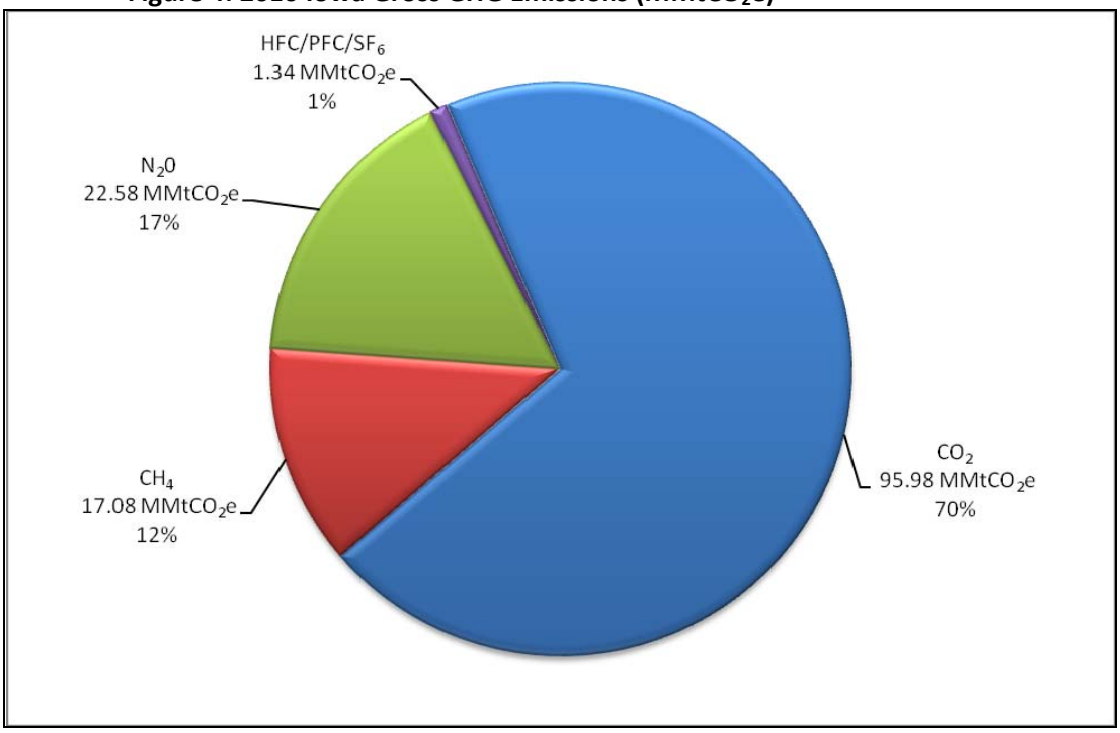
- ***Waste*** – includes GHG emissions from municipal solid waste (MSW) landfills and the treatment of municipal and industrial wastewater. GHG emissions from waste decreased 5.0% from 2005 – 2010, largely due to decreases in the amount of MSW both landfilled and combusted, as well as increases in the amount of methane emissions avoided by flaring and landfill gas to energy (LFGTE) projects. This is further discussed in *Chapter 7 – Waste: Solid Waste and Chapter 8 – Waste: Wastewater Treatment.*

- ***Land Use, Land Use Change, and Forestry (LULUCF)*** – includes emissions from liming of agricultural soils and fertilization of settlement soils, as well as carbon sequestered by forests, urban trees, and yard waste and food scraps that are sent to the landfill. The amount of CO_2 sequestered remained stable from 2005 – 2010, decreasing 0.02%. This is mostly due to a lack of more current forest carbon flux data. This is further discussed in *Chapter 9 – Land Use, Land Use Change, and Forestry (LULUCF).*

<u>Greenhouse Gases Emitted</u>

Greenhouse gases (GHG) included in the inventory are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFC), hydrofluorocarbons (HFC), and sulfur hexafluoride (SF_6). Figure 4 shows the distribution of GHG emissions in 2010. The high percentage of CO_2 emissions is due to the high amount of CO_2 emissions (72.32 $MMtCO_2e$) from fossil fuel combustion. The majority of N_2O emissions (19.45 $MMtCO_2e$) are from agricultural soils, and the majority of CH_4 emissions (13.74 $MMtCO_2e$) are from enteric fermentation and manure management in the agricultural sector. More detail on the individual GHGs emitted from each sector is available in *Appendix A – Iowa GHG Emissions 2005 – 2010, by Pollutant.*

Figure 4: 2010 Iowa Gross GHG Emissions ($MMtCO_2e$)



EPA's Greenhouse Gas Equivalencies Calculator (2011a) estimates that the quantity of gross GHG emissions (i.e. excluding carbon sinks) emitted in Iowa in 2010 is equivalent to:

- Annual GHG emissions from 26.8 million passenger vehicles
- CO_2 emissions from the electricity use of 17.0 million homes for one year
- CO_2 emissions from the energy use of 11.8 million homes for one year
- The carbon sequestered by 3.5 billion tree seedlings grown for ten years
- GHG emissions avoided by recycling 47.6 million tons of waste instead of sending it to the landfill

Comparison with National Emissions

Figure 5 and Figure 6 compare Iowa and national GHG emissions by sector. For comparison purposes and to be consistent with the sectors in the national GHG inventory, the fossil fuel combustion, natural gas distribution and transmission, and transportation sectors have been combined into one sector called "Energy". Emissions from 2009 are used for this comparison as the 2010 national GHG inventory has not yet been published. Overall, Iowa emits 2.0% of U.S. GHG emissions. (EPA 2011b).

Figure 5: 2009 Iowa GHG Emissions by Sector

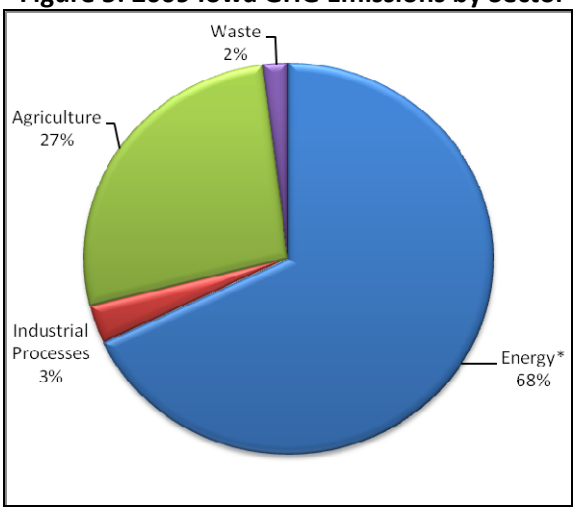
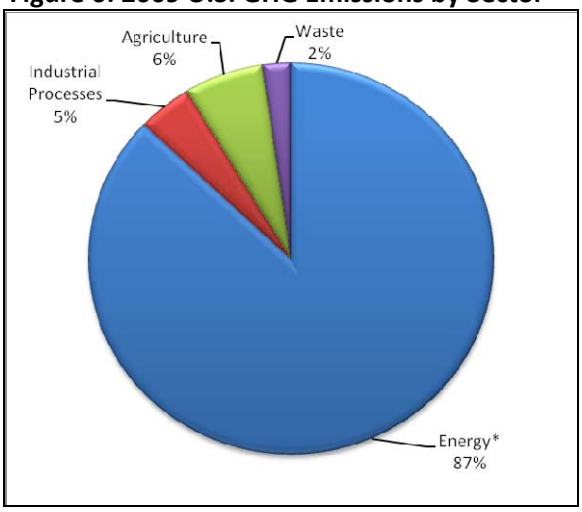


Figure 6: 2009 U.S. GHG Emissions by Sector



** The energy sector includes fossil fuel combustion, natural gas transmission and distribution, and transportation emissions.*

Iowa's population increased by 3.1% from 2005 – 2010. Per capita gross GHG emissions increased 6.7% during the same time period to 44.82 metric tons CO_2e per person in 2010 (43.02 metric tons in 2009) as shown in Figure 7. 2009 U.S. per capita emissions were 21.71 metric tons CO_2e per person.

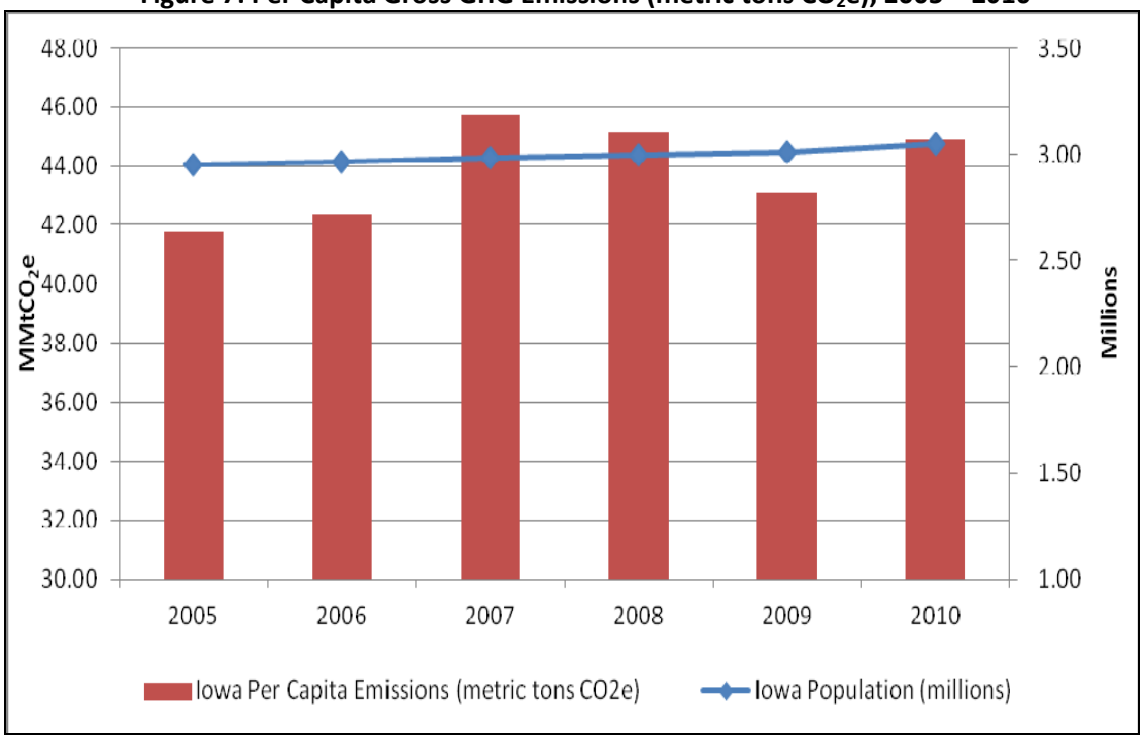



Figure 7: Per Capita Gross GHG Emissions (metric tons CO_2e), 2005 – 2010