Chatham County
North Carolina

Baseline Greenhouse Gas Inventory

April 2010

Completed with assistance and funding from Duke University's Nicholas School of the Environment

Background and Context

- A baseline inventory is necessary for creating greenhouse gas reduction goals because it provides a starting point for measurement.

- Greenhouse gases are naturally occurring gases in Earth's atmosphere that absorb and emit radiation.

- Greenhouse gases greatly affect the temperature of the Earth; without them, Earth's surface would be on average about 59 degrees F colder than at present.

- Human activities since the start of the Industrial Revolution have increased concentrations of greenhouse gases in the atmosphere roughly 35% (from 280 ppm in 1850 to 380 ppm today).[1]

- Some greenhouse gases such as carbon dioxide occur naturally and are emitted to the atmosphere through natural processes and human activities. Other greenhouse gases such as fluorinated gases are created and emitted solely through human activities. The principal greenhouse gases that enter the atmosphere because of human activities are:

    - **Carbon Dioxide (CO_2)**: CO_2 enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacturing of cement). Carbon dioxide is also removed from the atmosphere or "sequestered" when it is absorbed by plants as part of the biological carbon cycle.
    - **Methane (CH_4)**: CH_4 is emitted during the production and transportation of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills.
    - **Nitrous Oxide (N_2O)**: N_2O is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.

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[1] Neftel, A., H. Friedli, E. Moor, H. Lötscher, H. Oeschger, U. Siegenthaler, and B. Stauffer, 1994, *Historical CO_2 record from the Siple Station ice core*, in *Trends: A Compendium of Data on Global Change*, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy (Oak Ridge, TN). Also, World Data Centre for Greenhouse Gases (WDCGG), *WMO Greenhouse Gas Bulletin: The State of Greenhouse Gases in the Atmosphere Using Global Observations through 2005* (Geneva, 2006), at [http://gaw.kishou.go.jp/wdcgg.html].

- **Fluorinated Gases**: Hydrofluorocarbons, perfluorcarbons, and sulfur hexafluoride are synthetic, powerful greenhouse gases emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for ozone-depleting substances. [2]

- Because all greenhouse gases do not have the same atmosphere warming potential, **carbon dioxide equivalents (CO_2 eq.)** provide a universal standard of measurement against which impacts of releasing (or avoiding the release of) different greenhouse gases can be evaluated.

  For example: One molecule of methane (CH_4) is 21 times more powerful at warming the atmosphere than one molecule of CO_2.

  CO_2 = 1 CO_2 eq.
  CH_4 = 21 CO_2 eq.
  N_2O = 310 CO_2 eq.
  Fluorinated Gases = 650-23,900 CO_2 eq.

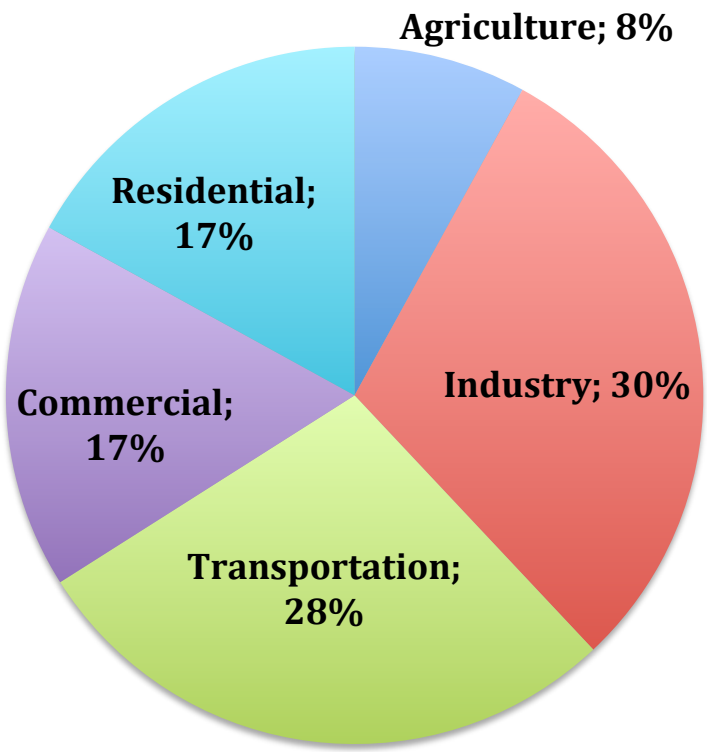
NOTE: All measurement of greenhouse gases in this inventory will be reported in U.S. tons (2,000 lbs) of carbon dioxide equivalents (CO_2 eq.).

Methodology

This inventory utilizes formulae provided by ICLEI (Local Governments for Sustainability) software to calculate estimated emissions of greenhouse gases associated with energy use in Chatham County. Chatham County joined ICLEI in 2009. More about Chatham County's Sustainable Communities Development Department can be found at: http://www.chathamnc.org/Index.aspx?page=1193

[2] All information for greenhouse gases taken from the EPA's Climate Change Website: http://www.epa.gov/climatechange/emissions/

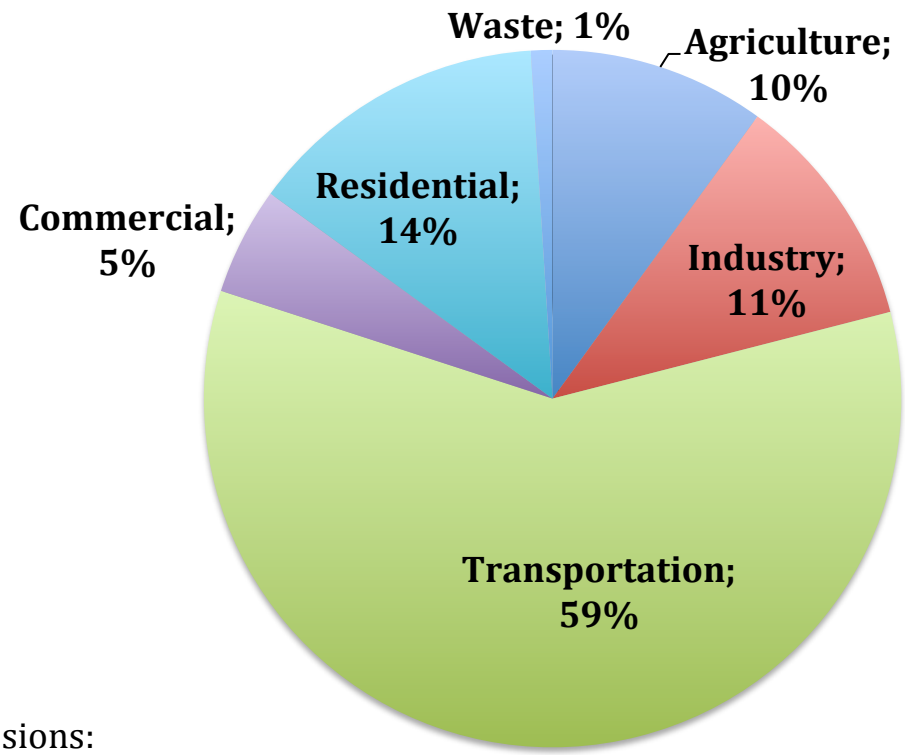
United States GHG Emissions by Sector



Total Emissions:
7,922,880,000 US tons CO_2 eq.

Source: U.S. EPA

Chatham County GHG Emissions by Sector



Total Emissions:
2,087,803 US tons CO_2 eq.

Chatham County Transportation Emissions

Transportation is Chatham County is predominately characterized by commuters leaving the county on a daily basis to work in surrounding counties and returning home in the evening. A major interstate does not run though Chatham County, but two major state highways (Hwy 64 and Hwy 15-501) bring drivers through the county.

According to data collected from the NCDOT[3], there were 1.892 billion vehicle miles traveled (VMT) in Chatham County in 2007. The associated energy consumption was 15,383,795 MMBtu.[4] Using ICLEI's formula, the associated greenhouse gas emissions is 1,230,115 U.S. tons of CO_2 eq., constituting 59% of Chatham County's GHG emissions.

With a population of 63,082, Chatham County's per capita transportation emissions are 19.5. In comparison, Durham County and Orange County have per capita transportation emissions of 19.2 and 16.1, respectively.

[3] Data received from Ellen Beckman, Transportation Planner for the City of Durham/DCHC MPO. Phone: 919-560-4366

[4] MMBtu = 1,000,000 Btu

Chatham County Residential Emissions

Greenhouse gas emissions in the residential sector are a predominately a result of the combustion of fossil fuels to heat, cool, and light homes. **The resiential sector constitutes 287,107 U.S. tons of CO_2 eq., contributing 14% of Chatham County's greenhouse gas emissions.**

The vast majority (91.7%) of residential GHG emissions are a result of the production of electricity. Progress Energy reported that in February of 2010, they provided 29,937,729 kWh of electricity to Chatham County residential customers.

NOTE: The source for data at Progress Energy[5] was only willing to provide data for one month (Feb. 2010) for the residential, industrial, and commercial sectors. February is usually one of the coldest and darkest months of the year, thus requiring more electricity to heat and light the home. It is also the shortest month of the year, so the practitioner of this evaluation deemed it appropriate to use the value associated with February of 2010 as an average for monthly electricity consumption in Chatham County.

Volumes of natural gas and kerosene usage were not available from Chatham County's providers. Therefore, a metric was developed to determine how much of the state's natural gas and kerosene consumption was consumed in Chatham County.

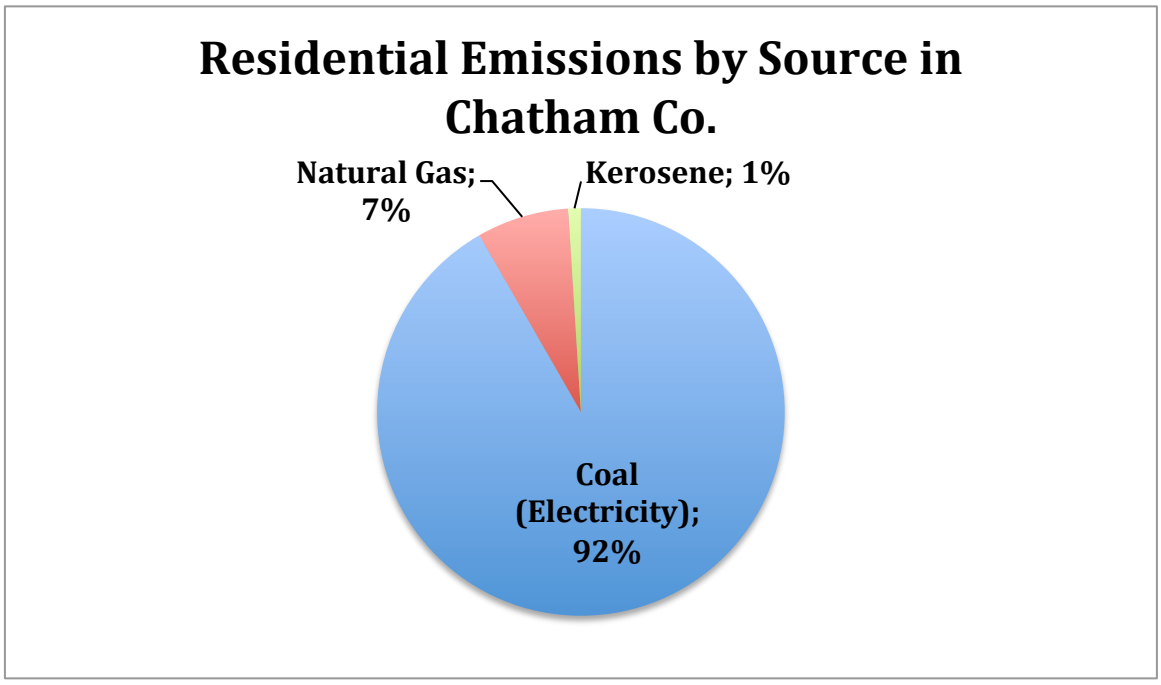
According to the U.S. Energy Information Administration (EIA), North Carolina consumes 52,525,921,853 cubic feet of natural gas annually for residential purposes. Chatham County's population is roughly .68% of the state's population, .68% of the state's residential natural gas consumption is credited to Chatham County.

The EIA also reports that the state consumes roughly 35,666,034 gallons of kerosene annually for residential purposes. Using the same rational as above, .68% of the state's residential kerosene consumption is credited to Chatham County.

ICLEI's software provides conversion factors for all three sources of greenhouse gases in the residential sector and resulted in the following:

Electricity (Coal) – 263,373 tons CO_2 eq.
Natural Gas – 20,955 tons CO_2 eq.
Kerosene – 2,779 tons CO_2 eq.

[5] Gary Andrews, Sr. Program Specialist, 919-546-2090, gary.andrews@pgnmail.com


Residential Emissions by Source in Chatham Co.
Natural Gas; 7%
Kerosene; 1%
Coal (Electricity); 92%

Chatham County Industrial Emissions

Greenhouse gas emissions in the industrial sector are a predominately a result of the combustion of fossil fuels to heat, cool, and light industrial facilities, as well as power the equipment associated with the manufacturing of goods. **The industrial sector constitutes 222,784 U.S. tons of CO_2 eq., contributing 11% of Chatham County's greenhouse gas emissions.**

The majority (76.5%) of industrial GHG emissions are a result of the production of electricity. Progress Energy reported that in February of 2010, they provided 19,382,822 kWh of electricity to Chatham County industrial customers.

NOTE: The source for data at Progress Energy[6] was only willing to provide data for one month (Feb. 2010) for the residential, industrial, and commercial sectors. February is usually one of the coldest and darkest months of the year, thus requiring more electricity to heat and light the home. It is also the shortest month of the year, so the practitioner of this evaluation deemed it appropriate to use the value associated with February of 2010 as an average for monthly electricity consumption in Chatham County.

Volumes of natural gas and kerosene usage were not available from Chatham County's providers. Therefore, a metric was developed to determine how much of the state's natural gas and kerosene consumption was consumed in Chatham County.

According to the U.S. Energy Information Administration (EIA), North Carolina consumes 88,400,999,961 cubic feet of natural gas annually for industrial purposes. Chatham County's manufacturers shipments are roughly .65% of the state's manufacturers shipments, .65% of the state's industrial natural gas consumption is credited to Chatham County.

The EIA also reports that the state consumes roughly 359,049 gallons of kerosene annually for industrial purposes. Using the same rational as above, .65% of the state's industrial kerosene consumption is credited to Chatham County.

In addition to coal for generating electricity, the EIA reports coal is consumed for other industrial processes. Using the .65% rationale, Chatham County is credited with the consumption of 7,424 tons of coal for industrial purposes.

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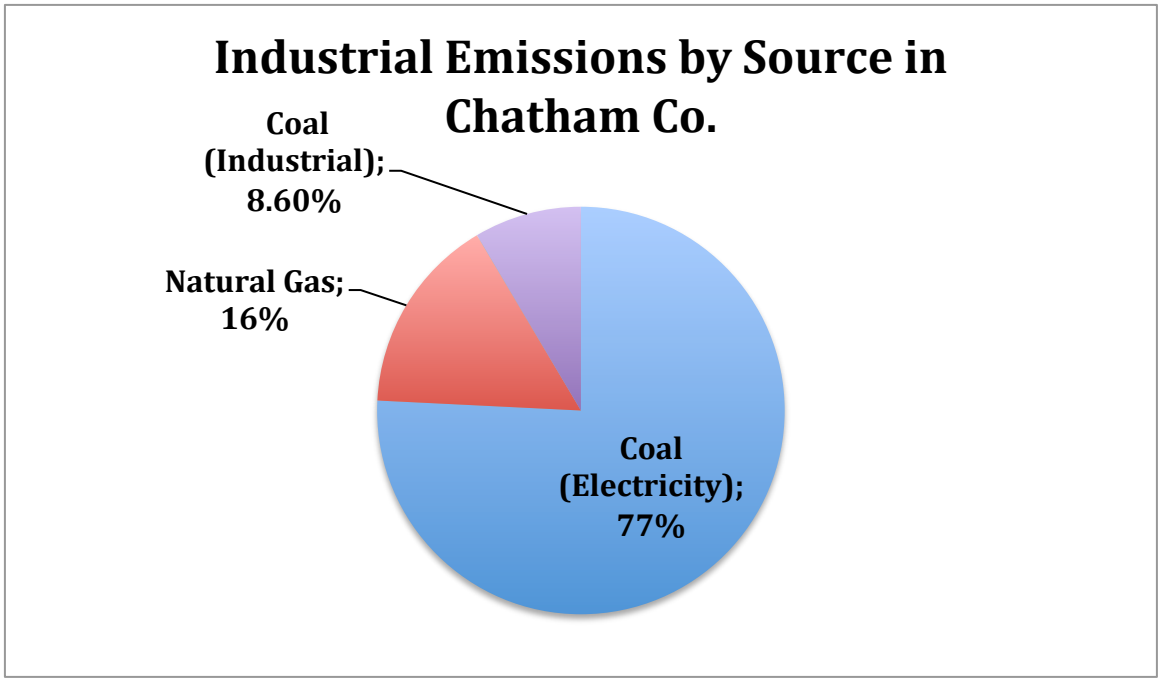
[6] Gary Andrews, Sr. Program Specialist, 919-546-2090, gary.andrews@pgnmail.com

ICLEI's software provides conversion factors for all four sources of greenhouse gases in the industrial sector and resulted in the following:

Coal (Electricity) – 170,517 tons CO_2 eq.
Natural Gas – 35,319 tons CO_2 eq.
Coal (Industrial) – 16,920 tons CO_2 eq.
Kerosene – 26 tons CO_2 eq.



Chatham County Commercial Emissions

Greenhouse gas emissions in the commercial sector are a predominately a result of the combustion of fossil fuels to heat, cool, and light commercial facilities. **The industrial sector constitutes 112,721 U.S. tons of CO_2 eq., contributing 5% of Chatham County's greenhouse gas emissions.**

The vast majority (92.7%) of commercial GHG emissions are a result of the production of electricity. Progress Energy reported that in February of 2010, they provided 11,873,109 kWh of electricity to Chatham County commercial customers.

NOTE: The source for data at Progress Energy[7] was only willing to provide data for one month (Feb. 2010) for the residential, industrial, and commercial sectors. February is usually one of the coldest and darkest months of the year, thus requiring more electricity to heat and light the home. It is also the shortest month of the year, so the practitioner of this evaluation deemed it appropriate to use the value associated with February of 2010 as an average for monthly electricity consumption in Chatham County.

Volumes of natural gas and kerosene usage were not available from Chatham County's providers. Therefore, a metric was developed to determine how much of the state's natural gas and kerosene consumption was consumed in Chatham County.

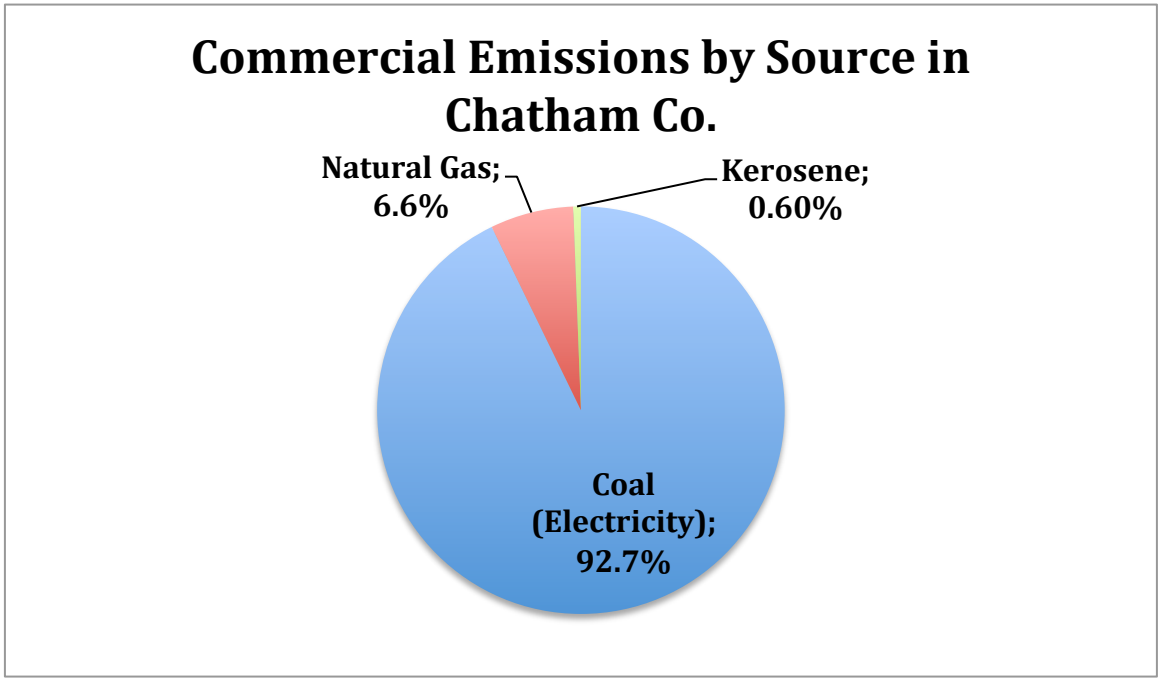
According to the U.S. Energy Information Administration (EIA), North Carolina consumes 45,433,999,949 cubic feet of natural gas annually for commercial purposes. Chatham County's retail sales are is roughly .27% of the state's retail sales; therefore .27% of the state's industrial natural gas consumption is credited to Chatham County.

The EIA also reports that the state consumes roughly 47,626 gallons of kerosene annually for commercial purposes. Using the same rational as above, .27% of the state's commercial kerosene consumption is credited to Chatham County.

ICLEI's software provides conversion factors for all four sources of greenhouse gases in the industrial sector and resulted in the following:

Coal (Electricity) – 104,452 tons CO_2 eq.
Natural Gas – 7,476 tons CO_2 eq.
Kerosene – 91 tons CO_2 eq.

[7] Gary Andrews, Sr. Program Specialist, 919-546-2090, gary.andrews@pgnmail.com


Commercial Emissions by Source in Chatham Co.
Natural Gas; 6.6%
Kerosene; 0.60%
Coal (Electricity); 92.7%

Chatham County Agricultural (Livestock) Emissions

Since the software provided by ICLEI is designed for use in municipalities, they have not created a protocol for accounting greenhouse gas emissions associated with livestock agriculture. Therefore, two separate peer review papers were used as the protocol for calculating the greenhouse gas emissions associated with livestock agriculture in Chatham County.

The majority of livestock-related greenhouse gas emissions are from the methane produced from the animals as they digest their food and from the concentrated carbon dioxide produced in broiler houses. **The agricultural (livestock) sector constitutes 211,048 U.S. tons of CO_2 eq., contributing 10% of Chatham County's greenhouse gas emissions.**

In order to calculate the emissions associated with broiler production in Chatham County, a study titled *Greenhouse Gas Emissions from Broiler House in the Southeastern United States* and published by the American Society of Agricultural and Biological Engineers,[8] provided a protocol for accounting.

According to this study, total CO_2 equivalent GHG emissions for broiler operations is 5.238Mg/1,000 birds, with 88.6% contributed by CO_2.

CH_4 emissions averaged 3.41 kg /1,000 birds

N_2O emissions averaged 1.72 kg/1,000 birds

The CO_2 equivalents for the CH_4 and N_2O emissions were, 188 lbs and 1128 lbs per 1,000 birds.

The USDA estimates there were approximately 25,000,000 birds in Chatham County in 2008, which results in the following emissions in CO_2 equivalents.

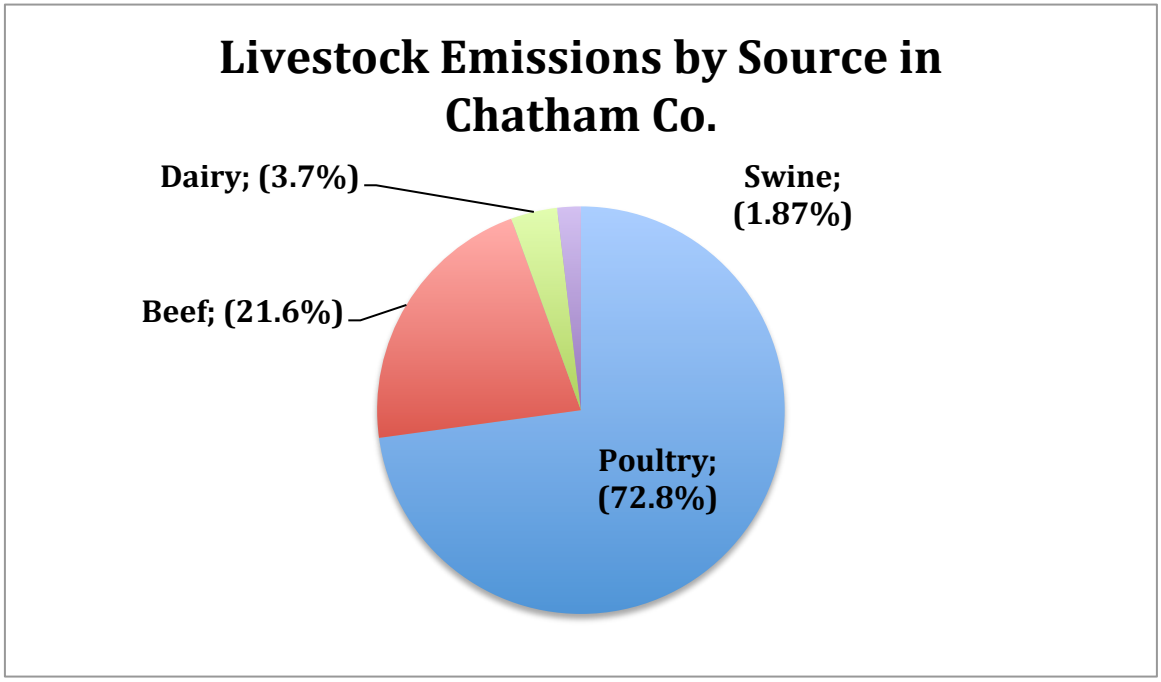
Poultry	
CH4 eq.	2,350 tons
N2O eq.	14,100 tons
CO2	137,250 tons
Total	153,700 tons

[8] http://asae.frymulti.com/abstract.asp?aid=25013&t=2

In order to calculate the emissions associated with beef, dairy, and swine production in Chatham County, the EPA's 2009 Agriculture Greenhouse Gas Emissions Inventory[9] provided a protocol for accounting.

The following were the results:

	Beef	Dairy	Swine
CH4 eq.	42,837	7,214	3,663
NO2 eq.	2,797	563	274
CO2			
Total	45,635	7,777	3,937



[9] http://www.epa.gov/climatechange/emissions/downloads09/Agriculture.pdf

Chatham County Internal Government Emissions

Two inputs were provided for the internal inventory; electricity consumed in county buildings (excluding schools) and the gasoline consumption of the county's vehicles.

With these two inputs, the internal inventory accounts for 1,182 tons of CO_2 equivalents, .06% of the greenhouse gas inventory for all of Chatham County.