

## Connecticut Greenhouse Gas Inventory: 1990-2001

### Background

In 2001, the Conference of New England Governors and Eastern Canadian Premiers (NEG/ECP) adopted a regional climate action plan covering all six New England states, including Connecticut, and the five eastern Canadian provinces of Quebec, New Brunswick, Nova Scotia, Newfoundland, and Prince Edward Island. The NEG/ECP climate plan established the primary goal of stabilizing aggregate greenhouse gas (GHG) emissions at 1990 levels by 2010, and then reducing emissions ten percent below 1990 levels by 2020 and substantially further in subsequent years. As a party to the action plan, Connecticut made a commitment to pursue significant reductions of GHG emissions in the state.

With the adoption of Public Act 04-252, An Act Concerning Climate Change, the Connecticut General Assembly strengthened Connecticut's commitment to better understand GHG emissions on a state level. This act, codified in section 22a-200a of the Connecticut General Statutes, also established GHG emission reduction goals for 2010, 2020, established GHG reporting requirements, and required the Department of Environmental Protection (DEP) create and periodically update a GHG emissions inventory for Connecticut. A GHG emissions inventory is necessary for DEP to identify emission reduction targets that represent Connecticut's appropriate contribution towards meeting the regional goals identified in the NEG/ECP regional climate action plan.

DEP compiled this comprehensive inventory of GHGs in Connecticut using a "top down" methodology. The data is based on the output from the May 2006 version of the United States Environmental Protection Agency's (EPA) GHG Inventory Tool. Additional data is included based on adjustments performed by the Northeast States for Coordinated Air Use Management (NESCAUM). Aggregate data from the transportation, energy, agriculture, waste storage and treatment, and industrial sectors is compiled from sources such as the United States Department of Energy (DOE), United States Department of Agriculture (USDA), and the United States Environmental Protection Agency (USEPA). Estimated GHG emissions are calculated based on summary data for GHG sources including, but not limited to, fossil fuel consumption, waste storage, and livestock population.

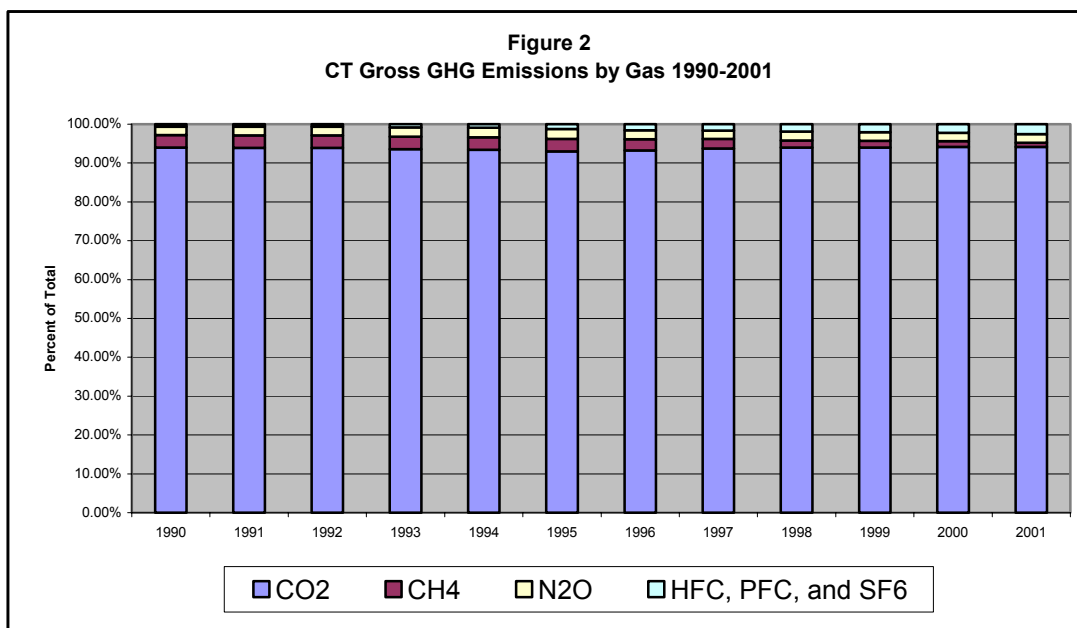
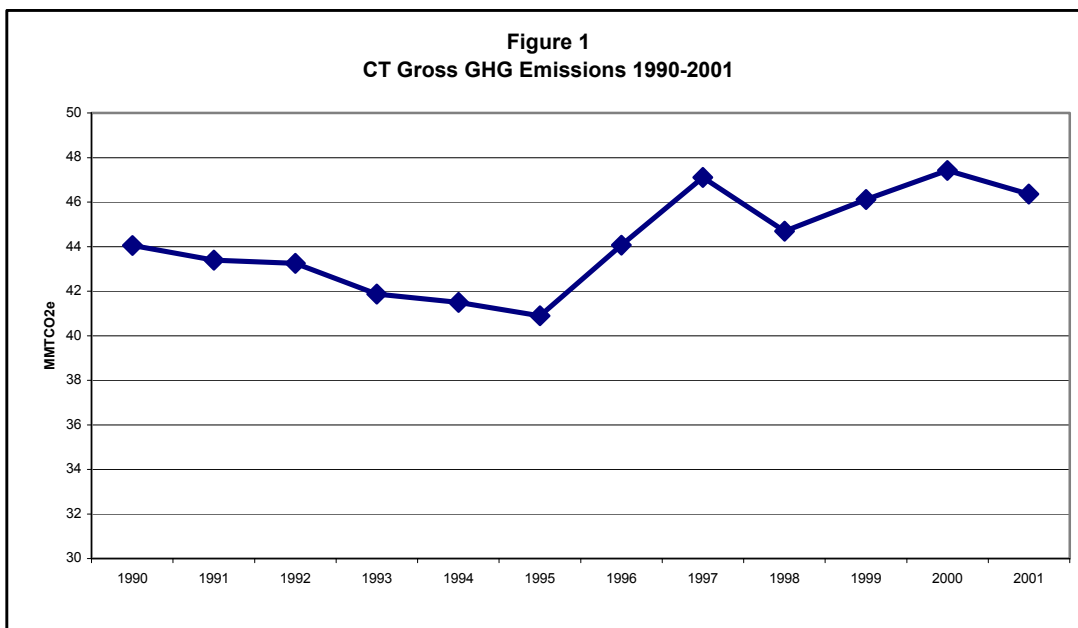
### GHG Emissions

The greenhouse gases included in this inventory are carbon dioxide (CO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), methane (CH<sub>4</sub>), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF<sub>6</sub>). These gases trap radiant heat and contribute to the planet's "greenhouse effect." CO<sub>2</sub> is the GHG gas emitted in greatest amounts, but the other gases have a greater impact on a volume basis. Carbon dioxide is the standard for GHG emissions, and other GHGs are assigned Global Warming Potential (GWP) values, or the amount of CO<sub>2</sub> that would have an equivalent greenhouse effect over a 100-year period (Table 1). GHG quantities in this report are given as million metric tons of CO<sub>2</sub> equivalent (MMT CO<sub>2</sub>e). The use of this metric allows for a normalization of emissions from each GHG with regard to their estimated impact on global warming.

Table 1: GWPs

Greenhouse Gas (GHG)	Global Warming Potential (GWP)
carbon dioxide	1
methane	21
nitrous oxide	310
hydrofluorocarbons	140 – 11,700
perfluorocarbons	6,500 - 9,200
sulfurhexafluoride	23,900

Gross GHG emissions in Connecticut have shown an overall increase from 1990 through 2001 (Figure 1). As expected, CO<sub>2</sub> emissions constitute the majority of CT's total gross GHG emissions (Figure 2). Table 2 provides a detailed breakdown of the CT GHG inventory for the years 1990-2001. Overall GHG emissions trends are very highly dependent on energy-related emissions trends. Nearly 90 percent of total state GHG emissions per year are the result of fossil fuel combustion (Figure 3). Other energy-related emissions contributed two to three percent per year, including methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) from fossil fuel combustion, and methane from natural gas transmission and distribution. Waste management accounted for nearly all of the balance of total statewide GHG emissions per year. Industrial production processes produced approximately one to two percent of annual emissions, and agriculture contributed less than one percent. In addition to sources of GHG emissions, various activities can act as a net "sink" or repository for GHGs. Land Use Change and Forestry (LUCF) is one such category and is based on the ability of plants to absorb or "sequester" Carbon Dioxide, removing it from the global warming process.



**Table 2 – Connecticut GHG Inventory Summary 1990 - 2001**

<b>Emissions (MMTCO2E)</b>	<b>1990</b>	<b>1991</b>	<b>1992</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>
<b>Energy</b>	<b>41.80</b>	<b>40.99</b>	<b>41.10</b>	<b>39.43</b>	<b>38.76</b>	<b>38.01</b>	<b>41.06</b>	<b>44.09</b>	<b>41.69</b>	<b>42.88</b>	<b>44.11</b>	<b>42.77</b>
• CO2 from Fossil Fuel Combustion	40.53	39.70	39.99	38.11	37.43	36.66	39.71	42.78	40.40	41.61	42.83	41.55
• Stationary Combustion (non-CO2)	0.20	0.20	0.21	0.21	0.20	0.22	0.22	0.20	0.18	0.18	0.21	0.19
• Mobile Combustion (non-CO2)	0.57	0.60	0.61	0.63	0.63	0.65	0.64	0.64	0.64	0.62	0.62	0.57
• Natural Gas and Oil Systems (non-CO2)	0.50	0.50	0.28	0.49	0.48	0.48	0.48	0.47	0.48	0.47	0.46	0.45
<b>Industrial Processes</b>	<b>0.32</b>	<b>0.31</b>	<b>0.30</b>	<b>0.38</b>	<b>0.43</b>	<b>0.57</b>	<b>0.72</b>	<b>0.84</b>	<b>0.91</b>	<b>1.01</b>	<b>1.11</b>	<b>1.20</b>
<b>Waste</b>	<b>1.65</b>	<b>1.81</b>	<b>1.57</b>	<b>1.77</b>	<b>2.03</b>	<b>2.04</b>	<b>2.03</b>	<b>1.93</b>	<b>1.84</b>	<b>1.98</b>	<b>1.95</b>	<b>2.15</b>
• Municipal Solid Waste	1.31	1.47	1.23	1.43	1.68	1.70	1.68	1.58	1.49	1.63	1.58	1.79
• Wastewater	0.34	0.34	0.34	0.34	0.35	0.34	0.34	0.34	0.35	0.35	0.36	0.37
<b>Agriculture</b>	<b>0.28</b>	<b>0.28</b>	<b>0.28</b>	<b>0.28</b>	<b>0.28</b>	<b>0.27</b>	<b>0.26</b>	<b>0.25</b>	<b>0.25</b>	<b>0.25</b>	<b>0.25</b>	<b>0.24</b>
• Enteric Fermentation	0.12	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.10
• Manure Management	0.05	0.04	0.04	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04
• Agricultural Soil Management	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.09
<b>Landuse Change and Forestry (LUCF)</b>	<b>-3.27</b>	<b>-3.27</b>	<b>-3.27</b>	<b>-2.71</b>	<b>-2.69</b>	<b>-2.71</b>	<b>-2.71</b>	<b>-2.68</b>	<b>-2.68</b>	<b>-2.71</b>	<b>-2.71</b>	<b>-2.71</b>
<b>Gross Emissions</b>	<b>44.05</b>	<b>43.39</b>	<b>43.25</b>	<b>41.86</b>	<b>41.49</b>	<b>40.90</b>	<b>44.06</b>	<b>47.11</b>	<b>44.69</b>	<b>46.12</b>	<b>47.42</b>	<b>46.36</b>
<b>Sinks</b>	<b>-3.27</b>	<b>-3.27</b>	<b>-3.27</b>	<b>-2.71</b>	<b>-2.69</b>	<b>-2.71</b>	<b>-2.71</b>	<b>-2.68</b>	<b>-2.68</b>	<b>-2.71</b>	<b>-2.71</b>	<b>-2.71</b>
<b>Net Emissions</b>	<b>40.78</b>	<b>40.12</b>	<b>39.98</b>	<b>39.16</b>	<b>38.80</b>	<b>38.19</b>	<b>41.35</b>	<b>44.43</b>	<b>42.01</b>	<b>43.41</b>	<b>44.71</b>	<b>43.65</b>

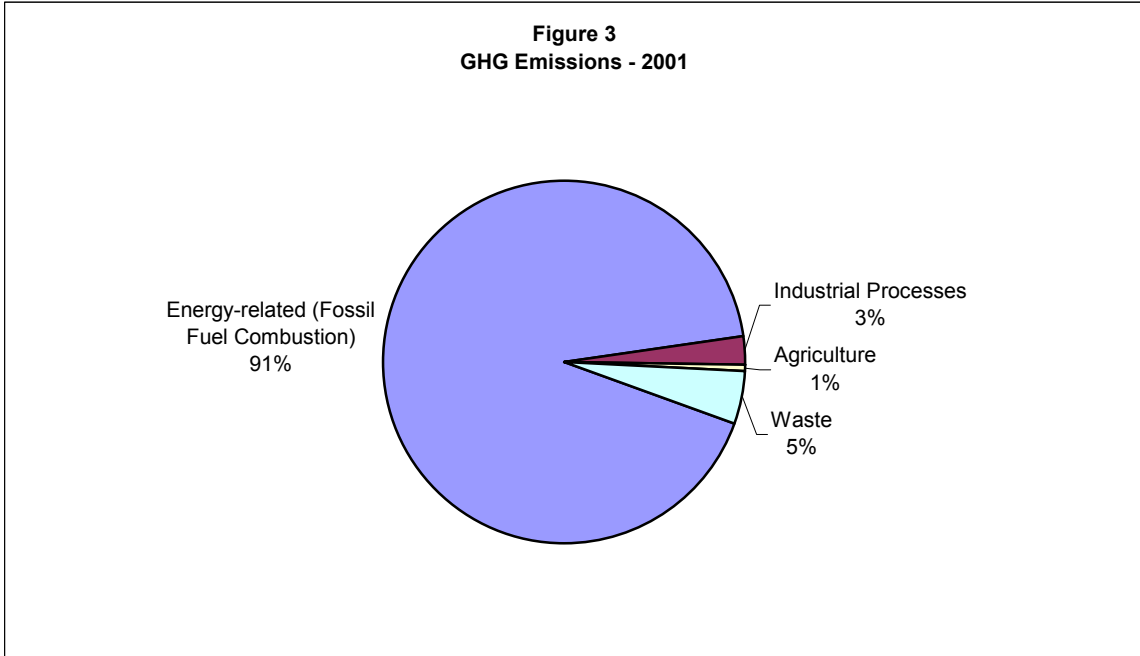
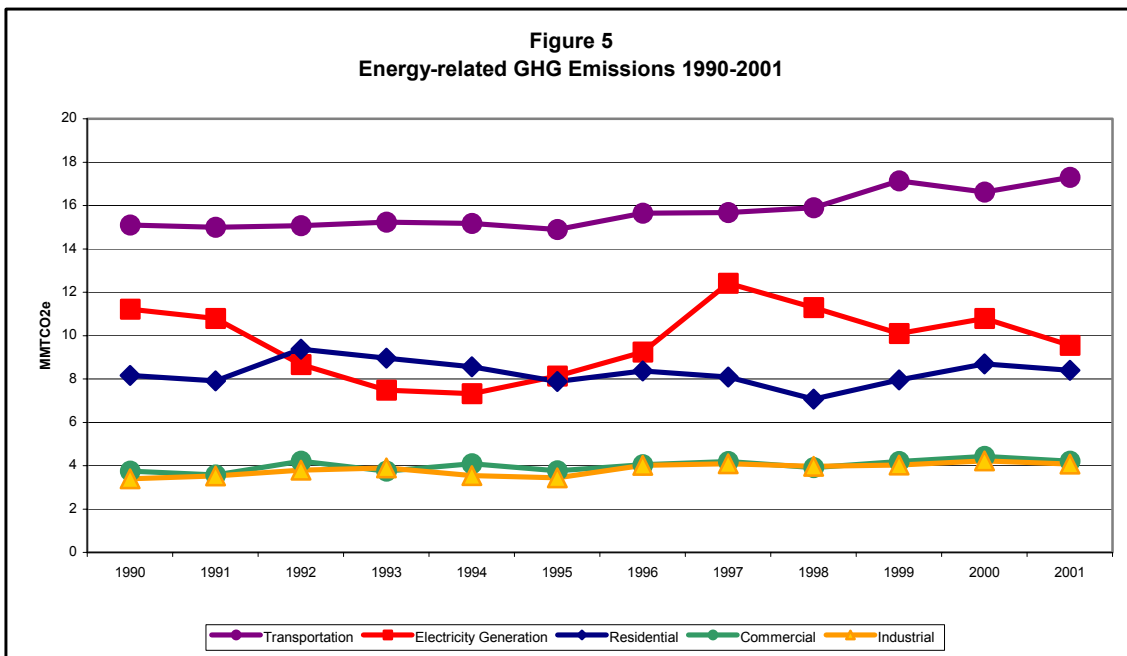
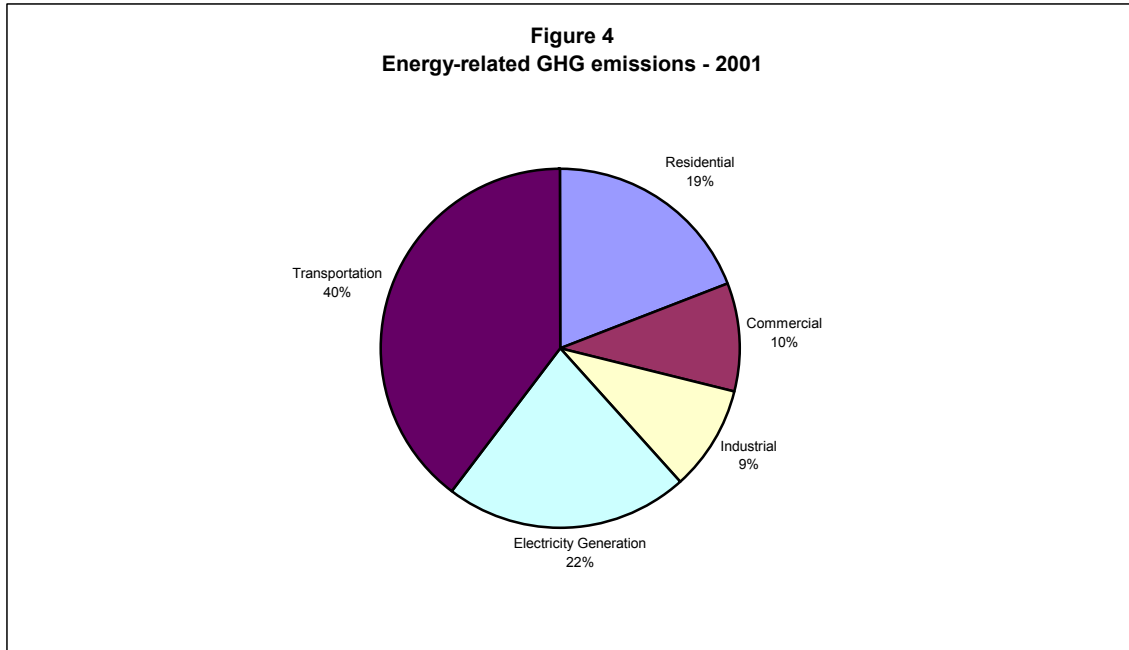


Figure 4 illustrates the breakdown of energy-related GHG emissions<sup>1</sup> in Connecticut, with the division of fossil fuel combustion-related emissions by usage category (Transportation, Electricity Generation, Residential, Commercial, Industrial). Transportation is shown to be the leading source of GHG, followed by Electric Utilities and Residential combustion. Trends in these energy-related categories over the 1990-2001 period are shown in Figure 5.



<sup>1</sup> For energy-related GHG emissions, Transportation includes on-road and non-road sources, Residential includes home heating, Commercial includes commercial heating, Industrial includes industrial heating and Electricity Generation includes direct generation-related emissions.

On average in the 1990-2001 timeframe, transportation accounted for 38% of fossil fuel combustion-related CO<sub>2</sub> emissions annually. Energy consumption in the residential sector accounted for an average 20% annually, while energy consumption in the industrial and commercial sectors each contributed 9%-10%. Year to year fluctuations occurred in the electricity generation sector. Its contribution to fossil fuel combustion-related CO<sub>2</sub> emissions varied from about 18% to 30%, with an average of 23%. Peak emissions occurred from 1997-1998 during a period when several nuclear power plants in Connecticut were taken out of service for extended periods and the state was proportionally more reliant on fossil-fired power plants.

## **GHG Reduction Plans**

An inventory of GHG sources and their associated emissions is invaluable when developing strategies for the reduction of GHG emissions. Key sectors can be identified and evaluated for potential GHG reductions.

Connecticut adopted a Climate Change Action Plan in 2005, making it one of the first states to address climate change in such a significant and comprehensive manner. The plan contains 55 recommended actions, grouped into five main sectors, which addressed goals for reduction of GHG emissions from all significant sources in the state. Examples of recommended actions in each of the five main sectors include:

- **Transportation & Land Use:** Raising emission standards for new cars; reducing black carbon from diesel engines through the use of low sulfur diesel, engine improvements and tailpipe controls; investing in a hydrogen infrastructure and R&D program.
- **Residential, Commercial, Industrial:** Upgrading building codes and using energy efficient materials and design concepts in the construction of new state buildings and schools (LEED standard); promoting the purchase of environmentally preferable products and services by state agencies; testing biodiesel for heating.
- **Agriculture, Forestry, Waste:** Adopting actions to increase recycling and source reductions to 40%; encouraging consumers to buy local produce; supporting landfill gas-to-energy projects.
- **Electricity Generation:** Increasing the amount of renewable energy supplied to the electricity grid; implementing a program for Connecticut ratepayers to choose to purchase electricity derived from clean energy; state government purchase of clean energy; developing a regional program to cap CO<sub>2</sub> emissions from large power plants.
- **Education:** Increasing awareness among the general public, policymakers, community leaders, and others of climate change issues and solutions; integrating into curricula and outreach programming.

Of the 55 recommended actions, 38 were designated for immediate implementation by the Governor's Steering Committee on Climate Change. Further research was requested for the remaining 17 measures. It is estimated that reductions of 5.74 MMTCO<sub>2</sub>e in 2010 and 17.99 MMTCO<sub>2</sub>e in 2020 are needed to meet the statutory goals. The initial 38 actions are projected to result in projected reductions of 3.64 MMTCO<sub>2</sub>e in 2010 and 6.88 MMTCO<sub>2</sub>e in 2020. Thus, only 63.4 percent of the 2010 statutory goal and 38.2 percent of the 2020 statutory goal are achieved in 2020 by just these measures. Given these results, it is clear that reductions from the remaining 17 measures are crucial for Connecticut to meet its reductions targets. The additional measures result in additional projected reductions of 5.02 MMTCO<sub>2</sub>e in 2010 and 12.44 MMTCO<sub>2</sub>e in 2020. Working committees at both the agency head and staff level are continuing to develop, implement and track progress on each recommended action.

## **Further Information**

For additional detailed background information related to GHG emissions in Connecticut, please refer to the "Connecticut Greenhouse Gas Inventory 1990-2000", which is available online at [www.ctclimatechange.com/pdf/CC\\_Inventory\\_Report.pdf](http://www.ctclimatechange.com/pdf/CC_Inventory_Report.pdf).